

**U.S. Chemical Safety and  
Hazard Investigation Board**

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Rafael Moure-Eraso, Ph.D.  
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OSWER Docket  
EPA Docket Center, Mail Code 2822-1T  
Environmental Protection Agency  
1200 Pennsylvania Avenue NW  
Washington, DC 20460

Attention: Docket No. EPA-HQ-OEM-2014-0328

Dear Sir or Madam:

**OCT 29 2014**

Please find attached the U.S. Chemical Safety and Hazard Investigation Board's (CSB's) response to the Environmental Protection Agency's (EPA's) July 31, 2014 Request for Information (at 79 FR 44604) on potential revisions to its Risk Management Program regulations and related programs.

As you know, the CSB has a unique role in providing suggestions to the EPA. In fact, our governing statute (at 42 USC §7412) specifically tasked the CSB with "recommending the adoption of regulations for the preparation of risk management plans and general requirements for the prevention of accidental releases" and "for the mitigation of the potential adverse effect on human health or the environment as a result of accidental releases which should be applicable to any stationary source handling any regulated substance in more than threshold amounts." Though the CSB was not yet operational at the time EPA was developing its RMP regulations, we believe our experience over the last 16 years – including our conduct of more than 140 investigations and issuance of more than 700 safety recommendations – uniquely positions us to contribute to EPA's historic efforts to revise these provisions.

The CSB appreciates EPA's consideration of the enclosed information and thanks the agency for the opportunity to contribute to this important initiative. If you have any questions about our comments, or if we may be of further assistance, please do not hesitate to contact us.

Sincerely,

A handwritten signature in cursive script that reads "Rafael Moure-Eraso".

Rafael Moure-Eraso, PhD, CIH  
Chairperson

**Section C: Items in OSHA's Request for Information Relevant to EPA's Risk Management Plan Regulation**

**1. Updating the List of Regulated Substances**

**1b. Adding High and/or Low Explosives**

The CSB responded to a similar question posed in the Occupational Safety and Health Administration's (OSHA's) Request for Information (RFI)<sup>1,2</sup> regarding expanding the requirements of 29 CFR §1910.109<sup>3</sup> to cover dismantling and disposal of explosives, blasting agents, and pyrotechnics.

In its investigation of the April 8, 2011, fireworks explosion and fire in Hawaii that resulted in five worker fatalities,<sup>4</sup> the CSB found that the OSHA Process Safety Management (PSM) standard<sup>5</sup> could have prevented the incident if applied. Donaldson Enterprises, Inc. (DEI) would have been required to conduct a formal Process Hazard Analysis (PHA) on its disassembly procedure that explicitly identified a) the hazards of the disassembly process; b) any previous incidents that had a likely potential for a catastrophic consequence in the workplace; c) engineering and administrative controls applicable to the hazards; d) consequences of the failure of those controls; e) justification and risk assessment associated with facility siting; and f) a human factors analysis of the proposed process. Instead, DEI conducted a superficial "Activity Hazard Analysis" which focused primarily on personal safety and did not adequately identify the major accident hazards associated with the disassembly process and implement sufficient safeguards to control hazards.

However, the CSB did not make a recommendation to OSHA to revise its PSM regulations in part because Section 4(b)(1) of the Occupational and Safety and Health Act of 1970 precludes OSHA from any enforcement activity over a working condition if another federal agency exercises its statutory authority over the same activity. OSHA's authority to regulate the manufacturing, distribution, handling, and storage of fireworks in Hawaii would be preempted by the Bureau of Alcohol, Tobacco and Firearms (ATF), 27 CFR Part 555, *Commerce in Explosives*, which regulates the importation, manufacturing, distribution, and storage of explosive materials, including fireworks. ATF storage regulations include requirements for storage within types 1, 2, 3, and 4 magazines but do not cover disposal activities.

The CSB also found that the disposal of fireworks falls under the jurisdiction of EPA's Resource Conservation and Recovery Act (RCRA)<sup>6</sup> because this activity constitutes the disposal of a hazardous waste and requires a RCRA hazardous waste permit. The CSB concluded that the RCRA permitting system did not adequately cover the safe disposal of hazardous waste, especially for fireworks. As a result, the CSB recommended that EPA revise RCRA regulations

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<sup>1</sup> 78 FR 73756, December 9, 2013.

<sup>2</sup> See the CSB's response to OSHA's December 9, 2013 Request for Information (78 FR 73756), dated March 31, 2014. This document is available in OSHA Docket No. 2013-0020 or from the CSB's website at: [http://www.csb.gov/assets/1/16/CSB\\_RFIcomments.pdf](http://www.csb.gov/assets/1/16/CSB_RFIcomments.pdf).

<sup>3</sup> 29 CFR §1910.109 is OSHA's *Explosives and blasting agents* standard.

<sup>4</sup> See CSB Investigation Report, "Donaldson Enterprises, Inc. Fireworks Disposal Explosion and Fire." Report No. 2011-06-I-HI. January 17, 2013. Available at: [http://www.csb.gov/assets/1/19/DEI\\_Final\\_01172013.pdf](http://www.csb.gov/assets/1/19/DEI_Final_01172013.pdf).

<sup>5</sup> 29 CFR §1910.119.

<sup>6</sup> 40 CFR §270.

to require a permitting process with rigorous safety reviews that ensure the use of best available technology, safe disposal methodologies, and safety management practices, such as those required by OSHA's PSM standard.<sup>7</sup>

The CSB concluded its response to the OSHA RFI concerning the regulation of explosives and pyrotechnics by welcoming changes to OSHA's §1910.109 standard to incorporate requirements for the safe disposal of fireworks, as the standard already regulates the manufacturing and storage of fireworks. The CSB DEI investigation report concluded that the need to dispose contraband fireworks is a growing problem in the US. The CSB urged OSHA to consider expanding its definition of "manufacture" to require that fireworks disposal activities also be covered by the PSM standard, as another option. Finally, the CSB suggested that OSHA collaborate with EPA on this rulemaking so that environmental, health, and safety issues are addressed, and to avoid any redundancy when developing regulations for the safe disposal of fireworks.

The EPA may consider relisting explosives on the RMP list. Similarly to OSHA, RMP regulations should cover the "manufacture" of fireworks, including disposal activities. The CSB also urges the EPA to again consider the CSB's recommendation to expand RCRA regulations to more robustly cover safety and health in the disposal of hazardous waste such as fireworks. Finally, the EPA should work in conjunction with OSHA as it works to develop and strengthen environmental, health, and safety regulations to help avoid any redundancy and so that the disposal of fireworks is more effectively regulated and incidents similar to the DEI fireworks explosion and fire are prevented in the future.

### **1c. Adding Ammonium Nitrate**

The CSB urges EPA to update the List of Regulated Substances under the Risk Management Program to include pure ammonium nitrate, such as fertilizer and technical grade ammonium nitrate. The CSB is currently investigating the fire and explosion at the West Fertilizer Company (WFC) that occurred on April 17, 2013.<sup>8</sup> The explosion resulted in 15 fatalities, including members of the public and emergency responders, and caused widespread community damage. The CSB believes that if fertilizer grade ammonium nitrate were covered under RMP, WFC would have been required to implement safety measures that might have prevented or mitigated the consequences of this incident.

Preliminary findings indicate that WFC developed a safety management program for its RMP covered chemical: anhydrous ammonia.<sup>9</sup> Following EPA's last inspection in 2006, WFC hired an insurance company to develop its RMP for anhydrous ammonia. This program included

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<sup>7</sup> CSB Recommendation No. 2011-6-I-HI-R9 to EPA reads as follows:

*Revise the Resource Conservation and Recovery Act (RCRA) Subtitle C regulations to require a permitting process with rigorous safety reviews to replace the use of emergency permits under 40 CFR §270.61 for the disposal of explosive hazardous materials, including fireworks. At a minimum, the new process should require the use of best available technology, safe disposal methodologies, as well as safety management practices, such as those required by OSHA's Process Safety Management Standard (PSM), 29 CFR §1910.119 (e.g., hazard analysis and control, management of change).*

<sup>8</sup> Additional information is available at: <http://www.csb.gov/west-fertilizer-explosion-and-fire/>.

<sup>9</sup> WFC was covered under RMP Program 2 for its storage of anhydrous ammonia, which exceeded the threshold limit of 10,000lbs. WFC fell under Program 2 requirements for its storage of anhydrous ammonia because it did not meet the requirements for Program 3 and was not eligible for Program 1.

important safety elements to prevent, control and respond to an anhydrous ammonia release. For example, a hazard review was conducted to identify release scenarios and address actions that would prevent or mitigate a release. Another important feature of the RMP was the development of an emergency response plan that listed step-by-step procedures for employees to respond to an anhydrous ammonia release. Other program elements included: operating procedures, maintenance and inspection programs, training programs, incident investigations, off-site consequence analysis and compliance audits.

EPA's RMP program also required WFC to comply with recognized and generally accepted good engineering practices with anhydrous ammonia, such as the ANSI K61.1, "Safety Requirements for the Storage and Handling of Anhydrous Ammonia", and the Occupational Safety and Health Administration (OSHA) regulation, *Storage and Handling of Anhydrous Ammonia*, 29 CFR §1910.111.<sup>10</sup>

Had ammonium nitrate been listed under EPA's RMP list of chemicals, WFC would likely have been more aware of the explosion hazards of AN, which may have led to better management of the chemical through compliance with industry practices and federal safety regulations. The company would have been required to perform a hazard analysis, identify the hazards, and take steps to prevent or mitigate the risk of a catastrophic accident such as that which occurred on April 17, 2013.

WFC would also have had to comply with federal standards and industry best practices under RMP. WFC was covered under OSHA's *Explosives and Blasting Agents* standard, 29 CFR §1910.109, which regulates bulk storage of fertilizer grade ammonium nitrate.<sup>11</sup> However, the company was not in compliance with the standard, which OSHA cited them for after the April 2013 explosion.<sup>12</sup> WFC would also have been required to refer to consensus standards such as the National Fire Protection Association's NFPA 400, *Hazardous Materials Code*, which is currently being revised to address safe handling and storage requirements for bulk loads of ammonium nitrate. EPA should consider the upcoming revision of NFPA 400 in its modification of the RMP regulation.

To address EPA's question regarding the effectiveness of RMP, the CSB believes that EPA's regulation includes the necessary safety measures to prevent another incident such as the one that occurred in April 2013. The addition of a separate prescriptive regulation for ammonium nitrate may be equally effective in preventing future ammonium nitrate fires and explosions. However, the RMP is an existing standard that already requires a safety management system that would address construction requirements, maintenance, training and emergency response planning, in addition to others. All of these elements, which are also included in the equivalent worker-safety standard, OSHA's *Process Safety Management (PSM)* standard, constitute a comprehensive approach to safe handling of hazardous materials. While both RMP and PSM primarily target manufacturing processes, these standards also cover other sectors whose processes are less complex but still pose a risk of a catastrophic accident if not properly controlled.<sup>13</sup>

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<sup>10</sup> 40 CFR 68.65(d)(1)(vi)

<sup>11</sup> See CSB's response to OSHA's December 9, 2013 Request for Information (78 FR 73756), *Ibid*.

<sup>12</sup> See OSHA Inspection No. 901718.015

<sup>13</sup> OSHA 3132, *Process Safety Management* (1994), p.4.

Evidence from the West Fertilizer incident shows that employees were aware of the hazards and safe storage practices associated with the anhydrous ammonia stored onsite. Therefore, companies like WFC that already store RMP listed chemicals are familiar with the program requirements and could be expected to easily apply them to their storage of ammonium nitrate. Also, adding ammonium nitrate to the RMP list would subject Program 2 and 3 sources to additional requirements under the recognized and generally accepted good engineering practices (RAGAGEP) provisions, which would include relevant NFPA standards. Consensus standards such as those produced by NFPA are generally revised more frequently than federal regulations and therefore may be able to address changing conditions and new and emerging hazards within the industry before rulemaking can be completed<sup>14</sup>

*Considerations for TNT Equivalence Method*

The CSB understands the threshold limit established under EPA's list of RMP chemicals reflects a quantity that would "cause or may reasonably be expected to cause death, injury, or serious adverse effects to human health and the environment," as EPA has mentioned in previous public notices.<sup>15</sup> While the CSB cannot provide a definitive suggestion for a threshold quantity for pure ammonium nitrate (AN), the agency can provide some information to assist EPA in determining the threshold quantity.

EPA stated in this RFI that it could "determine a threshold amount for AN, based on a Trinitrotoluene (TNT)-equivalent weight calculation adjusted for AN." The TNT equivalence quantifies the energy released from an explosion and equates that to an equivalent mass of TNT. TNT equivalence is a numerical value that estimates the quantity of explosive material required to produce blast effects at different distance points from the source of the explosion. The CSB finds that when using the TNT equivalent model, however, there are some factors that should be considered when applying this model to non-ideal explosives such as AN. Current EPA guidance for a vapor cloud explosion requires the use of a 10% yield factor if using a TNT equivalent method, (meaning 10% of the flammable cloud participates in the explosion). The CSB, however, does not agree with this percentage with respect to ammonium nitrate based on blast modeling of the WFC incident commissioned by the CSB, which found that more than 10% of the ammonium nitrate stored at WFC detonated during the 2013 incident. Other countries such as Australia use a TNT equivalence of 25% for land use purposes when trying to determine siting distances.<sup>16</sup> The CSB will release details from its blast modeling analysis in its final investigation report. The CSB urges EPA to conduct additional scientific research and testing or seek assistance from ammonium nitrate and blast modeling experts, as appropriate, to determine adjusted values for TNT equivalent weight calculations to develop AN threshold quantities.

**1d. Adding Reactive Substances and Reactivity Hazards**

The CSB strongly urges EPA to update its Accidental Release Prevention Requirements to expand coverage and requirements for reactivity hazards consistent with the intent of CSB Recommendation No. 2001-H-R3, which the CSB issued to EPA upon publication of our 2002

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<sup>14</sup> Regulators have some authority to enforce requirements of voluntary consensus standards under RAGAGEP provisions; however, enforcement is currently limited and citations can be difficult to sustain.

<sup>15</sup> EPA federal registers: 58 FR 11, January 19, 1993, p.5103, 63 FR 3, January 6, 1998, p. 640.

<sup>16</sup> Code of Practice, Safe Storage of Solid Ammonium Nitrate, 3<sup>rd</sup> edition, Government of Western Australia, Department of Mines and Petroleum (2013).

hazard investigation study, *Improving Reactive Hazard Management*.<sup>17</sup> The text of that recommendation is as follows:

*Revise the Accidental Release Prevention Requirements, 40 CFR 68, to explicitly cover catastrophic reactive hazards that have the potential to seriously impact the public, including those resulting from self-reactive chemicals and combinations of chemicals and process-specific conditions. Take into account the recommendations of this report to OSHA on reactive hazard coverage. Seek congressional authority if necessary to amend the regulation.*

This recommendation is currently designated with the status “Open- Unacceptable Response”, which reflects the CSB’s determination that EPA has not sufficiently fulfilled the intent of this recommendation.<sup>18</sup>

The CSB’s study identified 167 serious incidents in the United States between January 1980 and June 2001 involving uncontrolled chemical reactivity. Nearly 50 of the incidents impacted the public via harm (injury or fatality), offsite evacuation, or shelter-in-place. Yet, at least 60% of the 167 incidents involved chemicals that were not covered under EPA’s RMP regulation.<sup>19</sup> Since issuing its reactive hazard investigation study in 2002, the CSB has continued to learn of significant industrial accidents resulting from reactive chemistry, many of which involved chemical processes not subject to the RMP regulation. Among the reactive chemical incidents investigated by the CSB are:

- the October 31, 2002, fire and explosion at the First Chemical Corporation facility in Pascagoula, Mississippi, which injured two, caused significant offsite property damage, and had the potential to have resulted in significant releases of flammable and toxic chemicals including anhydrous ammonia, chlorine, and sulfuric acid,<sup>20,21</sup>

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<sup>17</sup> CSB Hazard Investigation, “Improving Reactive Hazard Management.” Report No. 2001-01-H. October 8, 2002. Available at: <http://www.csb.gov/assets/1/19/ReactiveHazardInvestigationReport.pdf>.

<sup>18</sup> The rationale for the Board’s March 11, 2014, decision concerning the status of CSB Recommendation No. 2001-1-H-R3 is elaborated in a Status Change Summary document available at: [http://www.csb.gov/assets/recommendation/Status\\_change\\_summary-Reactives\\_R3.pdf](http://www.csb.gov/assets/recommendation/Status_change_summary-Reactives_R3.pdf).

<sup>19</sup> In 20 percent of the incidents, the chemicals were covered under RMP; in the remaining 20 percent, it could not be determined whether RMP-listed chemicals were involved.

<sup>20</sup> This accident was caused by a decomposition reaction in a mononitrotoluene distillation column. Mononitrotoluene is not covered by the RMP standard. See CSB Investigation Report, “Explosion and Fire: First Chemical Corporation.” Report No. 2003-01-I-MS. October 15, 2003. Available at: [http://www.csb.gov/assets/1/19/First\\_Report.pdf](http://www.csb.gov/assets/1/19/First_Report.pdf).

<sup>21</sup> A crude MNT storage tank at FCC (which contained para-MNT) was hit by shrapnel and caught fire. The explosion propelled large fragments from the vicinity of the column. A piece of shrapnel struck a pipe rack directly above a 500,000-pound anhydrous ammonia tank onsite. A 6-ton piece of column sidewall was hurled approximately 1,100 feet onto the site of a nearby Chevron refinery; it landed an estimated 50 feet from a 250,000-barrel crude oil storage tank. A valve and portions of piping were also found on Chevron property as far as 1,700 feet from the column. Within this radius of potential impact were several pieces of equipment that contained flammable and toxic material, including tanks and piping. Other potential receptors, included chlorine cylinders and sulfuric acid tanks. See CSB Investigation Report, “Explosion and Fire: First Chemical Corporation,” *Ibid*.

- the April 12, 2004, release of toxic allyl alcohol at MFG Chemical in Dalton, Georgia, which forced a community evacuation of nearly 200 families and necessitated decontamination of 154 people, five of whom were subsequently hospitalized,<sup>22</sup>
- the July 31, 2007, flammable vapor release and explosion at Synthron, LLC in Morganton, North Carolina,<sup>23</sup> which killed one worker, injured 14, destroyed the facility, and caused offsite property damage,
- the December 19, 2007, explosion and fire at T2 Laboratories in Jacksonville, Florida,<sup>24</sup> which killed four workers, leveled the facility, and had significant off-site impacts, including major property damage and injuries to 27 employees of nearby businesses.
- the August 28, 2008, explosion and fire at the Bayer CropScience facility in Institute, West Virginia,<sup>25</sup> which killed two, injured eight, resulted in a shelter-in-place order for more than 40,000 people, and could have led to a catastrophic release of toxic methyl isocyanate,<sup>26</sup> and
- the April 17, 2013, fire and explosion involving ammonium nitrate at the West Fertilizer facility in West, Texas,<sup>27</sup> which killed fourteen, injured hundreds, and destroyed or heavily damaged much of the surrounding community including three schools, a nursing home, an apartment block, and many residences.

The CSB's 2002 study noted that the RMP regulation has significant gaps in coverage of reactive hazards in part because in developing the list of substances to be covered under RMP, EPA considered only the inherent characteristics of chemicals that individuate a severe threat due to exposure (e.g., toxicity, flammability). Though the list could be expanded by incorporating more chemicals, the CSB has concluded that a list-based approach is fundamentally insufficient

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<sup>22</sup> This accident occurred during the production of triallyl cyanurate. CSB found that the process was covered by EPA's RMP regulation because an isotainer containing 35,000 pounds of toxic allyl alcohol (more than twice the threshold quantity) was attached to the process. However, MFG was not in compliance with the regulation. See CSB Investigation Report, "Toxic Chemical Vapor Cloud Release: MFG Chemical, Inc." Report No. 2004-09-I-GA. April 11, 2006. Available at: [http://www.csb.gov/assets/1/19/MFG\\_Report.pdf](http://www.csb.gov/assets/1/19/MFG_Report.pdf).

<sup>23</sup> CSB Case Study, "Runaway Chemical Reaction and Vapor Cloud Explosion: Synthron, LLC." Report No. 2006-04-I-NC. July 31, 2007. Available at: [http://www.csb.gov/assets/1/19/Synthron\\_Final\\_Report1.pdf](http://www.csb.gov/assets/1/19/Synthron_Final_Report1.pdf).

<sup>24</sup> This accident occurred during the production of methylcyclopentadienyl manganese tricarbonyl (MCMT), a gasoline additive. The process was not covered by the RMP standard. See CSB Investigation Report, "T2 Laboratories, Inc. Runaway Reaction." Report No. 2008-3-I-FL. September 15, 2009. Available at: [http://www.csb.gov/assets/1/19/T2\\_Final\\_Copy\\_9\\_17\\_09.pdf](http://www.csb.gov/assets/1/19/T2_Final_Copy_9_17_09.pdf).

<sup>25</sup> The pesticide manufacturing process at the Bayer CropScience facility was covered by the RMP regulation because it used highly toxic chemicals (e.g. phosgene and methyl isocyanate) at/above threshold quantities. The CSB found that the unit's Process Hazard Analysis "failed to identify significant unmitigated scenarios that needed recommendations." See CSB Investigation Report, "Pesticide Chemical Runaway Reaction; Pressure Vessel Explosion: Bayer CropScience, LP." Report No. 2008-08-I-WV. January 20, 2011. Available at: [http://www.csb.gov/assets/1/19/Bayer\\_Report\\_Final.pdf](http://www.csb.gov/assets/1/19/Bayer_Report_Final.pdf).

<sup>26</sup> Methyl isocyanate (MIC) was released from the Union Carbide pesticide-manufacturing facility in Bhopal, India, on December 3, 1984, resulting in the immediate deaths of over 3,000 people. See National Research Council. *The Use and Storage of Methyl Isocyanate (MIC) at Bayer CropScience*. Washington, DC: National Academies Press, 2012.

<sup>27</sup> West Fertilizer's anhydrous ammonia bullet tanks were covered by the RMP regulation because they exceeded the threshold quantity of this toxic substance. Ammonium nitrate is not on the RMP Listed of Regulated Chemicals. The CSB's investigation of this incident is ongoing. Additional information is available at: <http://www.csb.gov/west-fertilizer-explosion-and-fire/>.

to address reactive hazards since chemical reactivity is not necessarily an intrinsic property of a single substance. Rather, the severity of a reactive hazard may be influenced by process-specific factors, such as incompatibility with other chemicals or the presence of impurities with catalytic effects, process operating temperatures and pressures, and the quantities and/or concentrations of chemicals in use.

Therefore, the CSB suggests that EPA consider augmenting 48 CFR §68.67, *Process hazard analysis*, to explicitly require an evaluation of factors contributing to reactive hazards, including but not limited to:

- Rate and quantity of heat or gas generated.
- Maximum operating temperature to avoid decomposition
- Thermal stability of reactants, reaction mixtures, byproducts, waste streams, and products
- Effect of variables such as changing rates, catalyst addition, and possible contaminants
- Consequences of runaway reactions or toxic gas evolution.

The CSB is aware that the state of New Jersey's Toxic Catastrophic Prevention Act (TCPA) regulation<sup>28</sup> uses both a list of reactive hazard substances (RHS) and a list of Reactive Hazard Substance Mixtures (RHSM), as determined by functional groups that have been identified as highly reactive based on scientific research and accident history. The CSB considers the NJ approach to be a step in the right direction in that it may result in the coverage of processes whose chemicals are not inherently reactive but may present reactivity hazards under process-specific conditions. We are also aware of an assessment<sup>29</sup> by Liu, Rogers, and Mannan of the Mary Kay O'Connor Process Safety Center at Texas A&M University that examined the chemicals involved in 152 of the original 167 incidents<sup>30</sup> identified in the CSB's 2002 study. The study concluded that the TCPA lists would have correctly identified the hazards in 86 incidents. This finding suggests that the presence of functional groups can be a useful predictor of a reactive hazard. The CSB has not, however, undertaken a study of, nor are we aware of any studies or research documenting the extent to which New Jersey's approach has reduced the incidence or severity of reactive chemical incidents. We appreciate that EPA has requested information on the New Jersey program, and urge the agency to consider whether adopting this approach would sufficiently reduce reactivity hazards in the RMP-regulated community.

Given the impact and diversity of reactive hazards, optimum progress in the prevention of reactive incidents requires a combination of enhanced regulatory and nonregulatory programs, guidance, and initiatives.

Indeed, utilizing multiple information resources can assist in identifying reactive chemical hazards at relatively low cost. Liu et al., for example, consulted four resources — the New Jersey TCPA lists, the National Atmospheric and Oceanic Administration's (NOAA) Chemical

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<sup>28</sup> New Jersey Administrative Code (N.J.A.C) 7:31

<sup>29</sup> Liu, Yen-Shan; Rogers, William J.; Mannan, M. Sam. Screening reactive chemical hazards. *CEP Magazine* (May 2006): 41-47.

<sup>30</sup> Liu et al. state that "in 15 cases either the chemicals were unknown or could not be determined, so 152 incidents could be evaluated." (p. 45).

Reactivity Worksheet, *Bretherick's Handbook of Reactive Hazards*, and Material Safety Data Sheets — and found that they collectively identified reactive hazards in nearly all of the incidents identified in the CSB's 2002 study.<sup>31</sup>

The CSB therefore urges EPA consider expanding 48 CFR §68.65, *Process safety information*, to require that the owner/operator to consult multiple sources of information to understand and control potential reactive hazards. These resources should include, but are not limited to:

- Literature surveys (e.g., *Bretherick's Handbook of Reactive Chemical Hazards*, *Sax's Dangerous Properties of Industrial Materials*)
- Information developed from computerized tools (e.g., ASTM International's CHETAH software and the National Oceanic and Atmospheric Administration's (NOAA's) Chemical Reactivity Worksheet).
- Chemical Safety data sheets (SDSs)
- Chemical reactivity test data produced by employers or obtained from other sources (e.g., differential scanning calorimetry, thermogravimetric analysis, accelerating rate calorimetry).
- Relevant incident reports from the plant, the corporation, industry, and government.
- Chemical Abstracts Service.

The Center for Chemical Process Safety's (CCPS's) October 2003 publication, *Essential Practices for Managing Chemical Reactivity Hazards*,<sup>32</sup> produced pursuant to a recommendation from the CSB's study,<sup>33</sup> also provides valuable guidance to both small and large facilities for identifying reactive hazards and managing these hazards throughout the life of the facility. The National Fire Protection Association's NFPA 400: *Hazardous Materials Code* provides good guidance for managing reactive hazards once they are identified, though it does not provide clear guidance on how to identify whether a substance may present a reactive hazard.

Though various important informational resources and guidance exist, the CSB remains concerned that chemical reactivity testing data is not readily available, and that no publicly available database exists that allows the sharing of reactive chemical test data or reactive chemical incident reports. As part of the CSB's 2002 study, the Board recommended that two chemical industry trade associations, the American Chemistry Council (ACC) and the Society of Chemical Manufacturers and Affiliates (SOCMA), collaborate with the National Institute for Standards and Technology (NIST) to "develop and implement a publicly available database for reactive hazard test information" structured to "encourage submission of data by individual

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<sup>31</sup> Liu et al. (2006) evaluated 152 out of the original 167 incidents; the four screening tools used together identified the hazards in all but six.

<sup>32</sup> Johnson, Robert W.; Rudy, Steven W.; Unwin, Stephen D. (2003). *Essential Practices for Managing Chemical Reactivity Hazards*. Center for Chemical Process Safety/AIChE. Available at: [http://www.knovel.com/web/portal/browse/display?\\_EXT\\_KNOVEL\\_DISPLAY\\_bookid=898&VerticalID=0](http://www.knovel.com/web/portal/browse/display?_EXT_KNOVEL_DISPLAY_bookid=898&VerticalID=0).

<sup>33</sup> See CSB Recommendation No. 2001-1-H-R6 to the CCPS. In June 2004, the Board voted to designate this recommendation with the status "Closed- Exceeds Recommended Action" based on CCPS's publication of this guidance and pursuance of additional actions promoting reactive hazard management.

companies and academic and government institutions that perform chemical testing.”<sup>34</sup> To date, these recommendations have not been implemented. The CSB encourages EPA to support such initiatives as appropriate.

In response to a second recommendation issued by the CSB to EPA pursuant to its 2002 study (Recommendation No. 2001-H-R4), EPA modified the format of its RMP\*Info system in 2004 to allow owners/operators to indicate whether a release event that was already covered under the existing, list-based program involved an “uncontrolled/runaway reaction.” The CSB urges EPA to use the information about the 29 reactive incidents reported since that time,<sup>35</sup> obtaining additional information about those accidents where appropriate, to inform its efforts to regulate reactive chemical hazards under RMP. If important trends are identified in these incidents, EPA might also consider publishing guidance or bulletins to communicate “lessons learned” to the regulated community. In addition, since more than ten years have passed since EPA amended RMP\*Info, the CSB urges EPA to examine whether further changes to RMP\*Info or the associated RMP\*eSubmit Users’ Manual may be useful in promoting accurate reporting of reactive accidents and/or collection of sufficient information to inform EPA’s efforts to prevent future releases resulting from reactive chemistry.

## **2. Additional Risk Management Program Elements**

The CSB supports the EPA’s consideration of incorporating additional management system elements into the RMP regulation, and agrees that the Center for Chemical Process Safety’s *Guidelines for Risk Based Process Safety* includes additional elements whose adoption into the RMP regulation could further safeguard against major chemical releases.

### Metrics

One essential management system element described by the Center for Chemical Process Safety (CCPS) and highlighted in the EPA’s RFI is the use of “Measurement and Metrics.” The CSB encourages EPA to require the reporting of leading and lagging process safety indicators to promote a culture of continuous improvement in the RMP-regulated community.

The CSB’s investigation of the March 23, 2005, explosions and fire at the BP Texas City refinery, which resulted in 15 deaths, 180 injuries, and significant offsite impacts,<sup>36</sup> determined that the oil refining and chemical industry sectors did not have an effective system of indicators in place to both evaluate performance and promote the continuous improvement of management of process safety risks. Instead, the company and industry sectors were relying on personal safety indicators (i.e. data regarding “slips, trips, and falls”) rather than on indicators that could be used to prevent catastrophic incidents. In some instances, the company collected information that could serve as process safety indicators, but the data were not systematically used to drive performance improvements. The CSB’s investigation further concluded that

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<sup>34</sup> See CSB Recommendation Nos. 2001-1-H-R10 and R14. In March 2008, the Board voted to designate CSB Recommendation No. 2001-1-H-R5 (to NIST) with the status “Closed- Reconsidered”, because NIST expressed general support for the intent of the recommendation but was unable to implement it as envisioned by the Board due to legal and financial obstacles.

<sup>35</sup> EPA’s RFI (at 49 FR 44612) indicated that 29 reactive incidents have been reported since EPA amended the format.

<sup>36</sup> See CSB Investigation Report, “Refinery Explosion and Fire: BP Texas City.” Report No. 2005-04-O-TX. March 20, 2007. Available at <http://www.csb.gov/assets/1/19/CSBFinalReportBP.pdf>.

standardized and demonstrably effective process safety indicators were not available in the refinery and petrochemical industries as a whole and emphasized in particular the preventative impact of leading performance metrics. Moreover, the investigation found that public reporting of the performance of the firms and individual sites in the area of process safety was extremely weak or non-existent.

Based on these findings, the Board recommended that the American Petroleum Institute (API) and the United Steelworkers of America (USW) jointly lead the development of an American National Standards Institute (ANSI) voluntary consensus standard for leading and lagging process safety indicators for refining and petrochemical industries.<sup>37</sup> Ultimately, the USW withdrew from the standards development process;<sup>38</sup> however, API proceeded and in April 2010, issued Recommended Practice (RP) 754: *Process Safety Performance Indicators for the Refining and Petrochemical Industries*.

Though the Board has significant reservations about the current edition of RP 754 that have precluded closure of these recommendations,<sup>39</sup> the document is significant in its establishment of the collection and use of both leading and lagging indicator data to promote process safety across broad industry sectors. Therefore, an examination of the strengths and weaknesses of the RP may inform EPA's efforts with regard to process safety indicators.

The Board appreciates that RP 754 created a useful framework of four tiers of process safety-related indicators (Tiers 1 and 2 for "lagging" indicators; Tiers 3 and 4 for "leading" indicators). The RP also established public reporting requirements<sup>40</sup> for standardized and normalized Tiers 1 and 2 data.<sup>41</sup> The Board also appreciates that the RP calls for the collection of data about contract workers, which is highly significant since as much as 50% of the workforce in these sectors may be comprised of contract workers who often work during high-risk periods (e.g. start-ups and shutdowns.)

Unfortunately, the RP also has significant shortcomings which we urge EPA to seriously consider in the development of any process safety indicators reporting system.

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<sup>37</sup> CSB Recommendations 2005-4-I-TX-R6A and R6B, to the API and USW, respectively, read as follows: *"Work together to develop [a] consensus American National Standards Institute (ANSI) standard[ ] In the first standard, create performance indicators for process safety in the refinery and petrochemical industries. Ensure that the standard identifies leading and lagging indicators for nationwide public reporting as well as indicators for use at individual facilities. Include methods for the development and use of the performance indicators. In the development of each standard, ensure that the committees*  
*a. are accredited and conform to ANSI principles of openness, balance, due process, and consensus;*  
*b. include representation of diverse sectors such as industry, labor, government, public interest and environmental organizations and experts from relevant scientific organizations and disciplines."*

<sup>38</sup> See USW Press Release: "USW Withdraw from Talks with American Petroleum Institute, Oil Industry." August 4, 2009. Available at: <http://www.usw.org/news/media-center/releases/2009/usw-withdraw-from-talks-with-american-petroleum-institute-oil-industry>.

<sup>39</sup> The Board designated CSB Recommendations 2005-4-I-TX-R6A and R6B with the status "Open-Acceptable Response" on June 27, 2012 and February 7, 2013, respectively. A summary of the Board's decision is available at: [http://www.csb.gov/assets/recommendation/SCS\\_Indicators1.pdf](http://www.csb.gov/assets/recommendation/SCS_Indicators1.pdf).

<sup>40</sup> Conformance with RP 754 is voluntary; therefore, only parties who claim to be in conformance with the standard are obligated to conform its requirements.

<sup>41</sup> The CSB has noted that the data collected from Tier 1 and Tier 2 indicators is likely too infrequent to use to measure performance or trend.

First, RP 754 fails to address the central issue of the usefulness of the data collected for measuring progress or trending statistical validity and power of its proposed indicators. Though there are public reporting requirements for standardized and normalized Tier 1 and Tier 2 indicators, recently published research<sup>42</sup> indicates the number of incidents and events reported are likely to be too small to provide effective performance indicators for individual sites or possibly most companies. Additionally, the Tier 3 and 4 indicators are not standardized or normalized, nor are there clear public reporting requirements for these indicators. These factors will seriously limit their effectiveness in assessing trends and improving industry performance.

As the CSB's recommendations communicated, the CSB believes strongly that the development of process safety indicators and the reporting system to be utilized must be achieved via a consensus process involving a balanced group of stakeholders from industry, labor, government, public interest and environmental organizations, and experts from relevant scientific organizations and disciplines. Even before the withdrawal of the USW from the process, the composition of the RP 754 committee was far too heavily weighted towards industry representatives. The committee also lacked representatives from civic or community leaders, regulatory agencies or environmental groups. Moreover, the committee did not include sufficient expertise from relevant scientific disciplines (e.g., statistics or epidemiology) or other relevant expertise (e.g., senior managers, risk communicators, legal experts).

The CSB is also concerned that the indicator definitions in RP 754 fail to comprehensively count and report a sizeable number of events that could reasonably be considered to be predictors of serious process failures, such as loss of containment events that do not exceed thresholds because control systems functioned effectively, and "routine emissions that are allowable under permit or regulation." The CSB has noted from its BP Texas City investigation that significant releases of hazardous materials can be classified as allowable environmental "upset emissions" but should still be considered serious incidents or near misses from a process safety perspective. This represents another missed opportunity to collect data useful for improving process safety performance.

Finally, the CSB believes that the public can play an important role in monitoring safety management systems and promoting industry accountability for process safety performance. As CCPS noted in its *Guidelines for Process Safety Metrics*:

Sharing performance metrics and results broadly can engage the public as a partner in holding the organization accountable for process safety performance. Making metrics and performance public can be an especially powerful way of maintaining upper management commitment since it will likely be the CEO or other senior managers who will be called to account by the public if goals are not met or performance declines.

When the CSB recommended as part of its interim report on the August 6, 2013, fire at the Chevron Richmond Refinery<sup>43</sup> that the state of California identify and require the state's petroleum refineries to report leading and lagging process safety indicators, the agency also

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<sup>42</sup> J. Mendeloff, B. Han, L.A. Fleishman-Mayer and J.V. Vessely. "Evaluation of process safety indicators collected in conference with ANSI/API Recommended Practice 754." *Journal of Loss Prevention in the Process Industries*. November 2013. 26(6): pp. 1008-1014.

<sup>43</sup> CSB Interim Investigation Report, "Chevron Richmond Refinery Fire." Report No. 2012-03-I-CA. Issued April 19, 2013. Available at:

called for public reporting of indicators in order to promote accountability. Public reporting of metrics also provides an opportunity for high-performing facilities to demonstrate commitment to improving or maintaining good performance. On September 9, 2014, the state of California released its Draft *Process Safety Management for Refinery* Proposed General Industrial Safety Order 5189.1, which would require companies to document leading process safety performance indicators and make them available to the regulator upon request.<sup>44</sup>

### Stop Work Authority

The CSB believes that workforce involvement is a key element of improving process safety and accident prevention. As CCPS's *Guidelines for Risk Based Process Safety* notes:

[W]orkers are potentially the most knowledgeable people with respect to the day to-day details of operating the process and maintaining the equipment and facilities and may be the sole source for some types of knowledge gained through their unique experience.

Because of the high hazards present in RMP-regulated facilities, the CSB supports EPA's consideration of the development and implementation of a stop-work authority that authorizes workers to stop work where they identify imminent risks or dangerous activities. We would emphasize, however, that stop-work authority is a less effective measure for incident prevention than good planning, and that its success is contingent upon the existence of a "culture of safety" wherein workers are encouraged and empowered to advocate for their safety on the job. As the CSB noted during our investigation of the February 23, 1999, crude unit fire at the Tosco Avon refinery,<sup>45</sup> stop-work authority must often be exercised when pressures to get a job completed are significant, and delays may result in significant financial costs to the facility. In an environment where production pressures trump safety, this authority is often underutilized, and therefore, of limited value.

To improve the effectiveness of workforce participation and the use of stop-work authority, the CSB urges EPA to establish a framework for the rights and responsibilities of workers and their representatives on health and safety-related matters, and the election of safety representatives and establishment of safety committees to serve health and safety-related functions. The elected representatives should have a legally recognized role that goes beyond consultation in activities such as the development of process hazard analyses, management of change, incident investigation, audits, and identification and effective control of hazards. The representatives should also have the authority to stop work that is perceived to be unsafe or that presents a serious hazard until the regulator intervenes to address the safety concern.<sup>46</sup> Finally, workforce participation practices should be documented by the covered facility and submitted to the EPA.

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[http://www.csb.gov/assets/1/19/Chevron\\_Interim\\_Report\\_Final\\_2013-04-17.pdf](http://www.csb.gov/assets/1/19/Chevron_Interim_Report_Final_2013-04-17.pdf). The CSB's investigation of this incident is ongoing. See <http://www.csb.gov/chevron-refinery-fire/>.

<sup>44</sup> See CA Draft PSM Regulatory Text, September 9, 2014. Available at: <http://www.dir.ca.gov/dosh/DoshReg/Process-Safety-Management-for-Refineries/PSM-Draft-Regulation.2014-09-09.pdf> (accessed October 8, 2014).

<sup>45</sup> CSB Investigation Report, "Refinery Fire Incident: Tosco Avon Refinery." Report No. 99-014-I-CA. March 28, 2001. Available at: [http://www.csb.gov/assets/1/19/Tosco\\_Final\\_Report.pdf](http://www.csb.gov/assets/1/19/Tosco_Final_Report.pdf).

<sup>46</sup> See Regulations Relating to Health, Safety and the Environment in the Petroleum Activities and at Certain Onshore Facilities (The Framework Regulations) Section 35. [http://www.ptil.no/frameworkhse/category403.html#\\_Toc357595266](http://www.ptil.no/frameworkhse/category403.html#_Toc357595266) (accessed April 14, 2014).

Inherent Safety and the Hierarchy of Controls

The CSB encourages EPA to consider mandating evaluations for inherent safety as an additional management system element when revising the RMP Regulation. On April 2, 2010, the Tesoro Refining and Marketing Company LLC (“Tesoro”) petroleum refinery in Anacortes, Washington, experienced a catastrophic rupture of a heat exchanger in the Naphtha Hydrotreater (NHT) unit.<sup>47</sup> Seven Tesoro employees were fatally injured. The rupture of the heat exchanger was the result of the carbon steel exchanger being severely weakened by a damage mechanism known as high temperature hydrogen attack (HTHA).<sup>48</sup>

As a result of its investigation, the CSB found that the Anacortes refinery relied on mechanical integrity programs, such as inspection, to identify HTHA damage to equipment. However, this strategy failed to prevent a major process safety incident. The CSB noted that since HTHA is very difficult to inspect for, inspection is not a sufficient safeguard for ensuring continued mechanical integrity of equipment. Inherently safer design (such as the use of high chromium steels that are resistant to HTHA) is higher on the hierarchy of controls and thus a better approach to prevent HTHA.<sup>49</sup>

The CSB also found that Process Hazard Analyses (PHAs) conducted on the NHT heat exchangers failed to effectively evaluate and control hazards associated with the NHT heat exchangers. The CSB noted that although under both the PSM and RMP regulations, an employer must “control” hazards when conducting a PHA of a covered process, neither regulation contains a requirement to address the effectiveness of the controls or to use the hierarchy of controls. The CSB also noted that even though industry good practice guidance provides<sup>50</sup> that inherently safer technology (IST) is the preferable and often the most effective safety precaution in the hierarchy of controls to prevent major accidents, it is not enforced by the EPA through its RMP program or through its General Duty Clause or other provisions of the Clean Air Act (CAA).<sup>51</sup> In addition, the CSB stated in its investigation report that while the Clean Air Act (CAA) directed the EPA to promulgate the RMP regulations “to provide, to the greatest extent practicable, for the prevention and detection of accidental releases of regulated substances,”<sup>52</sup> there is no RMP requirement to reduce risks to “as low as reasonably practicable,”<sup>53</sup> or ALARP. (This is discussed in more detail below in Section D11, *The “Safety Case” Model*). Thus, a PHA can satisfy the regulatory requirements even though it might inadequately identify or control major hazards.

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<sup>47</sup> See CSB Investigation Report, “Tesoro Anacortes Refinery: Catastrophic Rupture of Heat Exchanger.” Report. No. 2010-08-I-WA. May 1, 2014; p 35. Available at [http://www.csb.gov/investigations/completed-investigations/?F\\_InvestigationId=97](http://www.csb.gov/investigations/completed-investigations/?F_InvestigationId=97)

<sup>48</sup> HTHA is a damage mechanism that results in fissures and cracking and occurs when carbon steel equipment is exposed to hydrogen in high temperatures and pressures.

<sup>49</sup> An effectiveness ranking of techniques used to control hazards and their associated risks can be described as a hierarchy of controls. Upgrading the equipment material of construction to a more HTHA-resistant steel is a high-ranking, inherently safer choice in material selection. See CSB Investigation Report, “Tesoro Anacortes Refinery: Catastrophic Rupture of Heat Exchanger.” *Ibid.*

<sup>50</sup> CRC Press, *Process Plants: A Handbook for Inherently Safer Design Second Edition*; Kletz, Trevor and Amyotte, Paul; 2010; pp 15-16.

<sup>51</sup> CSB Investigation Report, “Tesoro Anacortes Refinery: Catastrophic Rupture of Heat Exchanger.” *Ibid.*

<sup>52</sup> *Ibid* at 10. See also 42 USC §7412(r)(7)(B)(i) (1990).

<sup>53</sup> *Ibid* at 10.

In the Tesoro Investigation Report, the CSB noted that New Jersey is the only state with inherent safety requirements.<sup>54</sup> The CSB found that while New Jersey's inherent safety regulations contain positive features, they are primarily focused on the activity of producing an inherent safety report and they lack rigorous goal-setting elements such as requiring facilities to reduce risks to a specified risk target such as "as low as reasonably practicable," or ALARP, or requiring the use of inherently safer systems analysis or the hierarchy of controls.<sup>55</sup>

The CSB has spent much time researching, studying, and evaluating the United Kingdom's (UK) regulatory approach for regulating high hazards on and offshore. The UK employs a goal-setting regulatory approach that provides the regulator with the tools and authority to evaluate a regulated facility's process hazard analysis for each covered process and require facilities to reduce risk to ALARP. In addition, unlike in the US, the UK regulatory approach requires the implementation of inherently safer systems analysis.<sup>56</sup>

As a result of its investigation, the CSB made the following recommendations to the EPA:

CSB Recommendation No. 2010-08-I-WA-R1:

*Revise the Chemical Accident Prevention Provisions under 40 CFR Part 68 to require the documented use of inherently safer systems analysis and the hierarchy of controls to the greatest extent feasible when facilities are establishing safeguards for identified process hazards. The goal shall be to reduce the risk of major accidents to the greatest extent practicable, to be interpreted as equivalent to as low as reasonably practicable (ALARP). Include requirements for inherently safer systems analysis to be automatically triggered for all management of change, incident investigation, and process hazard analysis reviews and recommendations, prior to the construction of a new process, process unit rebuilds, significant process repairs, and in the development of corrective actions.*

CSB Recommendation No. 2010-08-I-WA-R2:

*Until Recommendation 2010-08-I-WA-R1 is in effect, enforce through the Clean Air Act's General Duty Clause, section 112(r)(1), 42 U.S.C. §7412(r)(1) the use of inherently safer systems analysis and the hierarchy of controls to the greatest extent feasible when facilities are establishing safeguards for identified process hazards.*

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<sup>54</sup> Contra Costa County, California has a guidance document entitled "Attachment C: Inherently Safer Systems Checklist" which is provided as a tool for facilities to utilize during the PHA process. The actual use of the checklist is not required. See [http://cchealth.org/hazmat/pdf/iso/attachment\\_c.pdf](http://cchealth.org/hazmat/pdf/iso/attachment_c.pdf) (accessed September 29, 2014).

<sup>55</sup> See CSB Investigation Report, "Tesoro Anacortes Refinery: Catastrophic Rupture of Heat Exchanger." *Ibid.*

<sup>56</sup> According to the Health and Safety Executive (HSE), essential considerations for determining whether a duty holder has reduced risks to ALARP include "the adoption of inherently safer designs...". HSE. *The Safety Report Assessment Manual, Sections 8 to 15.* p. 30. <http://www.hse.gov.uk/comah/sram/s8-15.pdf> (accessed September 14, 2014). The HSE also notes that the guidance to COMAH Regulation 4 (General Duty) "describes the application of all measures necessary to reduce risk of a major accident to ALARP based on a hierarchical approach (inherent safety, prevention, control, mitigation.)" *Ibid* at 8. For more information see CSB Investigation Report, "Tesoro Anacortes Refinery: Catastrophic Rupture of Heat Exchanger." *Ibid.*

CSB Recommendation No. 2010-08-I-WA-R3:

*Develop guidance for the required use of inherently safer systems analysis and the hierarchy of controls for enforcement under 40 CFR Part 68 and the Clean Air Act's General Duty Clause, section 112(r)(1), 42 U.S.C. §7412(r)(1).*

The CSB urges the EPA to implement the CSB's recommendations from its Tesoro investigation, and offers three additional examples from our investigation history which support inclusion of inherent safety and hierarchy of controls analysis requirements:

- In 2008, an explosion at the Bayer CropScience facility in Institute, West Virginia, resulted in the deaths of two employees, a fire within the production unit, and extensive damage to nearby structures. Debris from the blast hit a shield surrounding the methyl isocyanate (MIC) storage tank. Although the tank was not damaged, the CSB investigation<sup>59</sup> determined that debris could have struck the relief valve vent pipe and caused a release of MIC to the atmosphere. As the National Research Council noted in the aftermath of the incident, however, Bayer had not performed a complete inherent safety assessment on the MIC manufacturing process, which could have resulted in a reduction or elimination of the MIC inventory and therefore a significant reduction in catastrophic risk potential.<sup>60</sup>
- In 2010, an explosion at the Kleen Energy power plant then under construction in Middletown, Connecticut, resulted in 6 deaths, at least fifty injuries, and significant economic impacts.<sup>61</sup> The incident occurred during an operation known as a "gas blow," whereby significant quantities of flammable natural gas are forced through piping at high pressure and velocity to remove debris that may have accumulated during construction. The CSB found that although gas blows are commonly used in the power generation industry, the practice presents an inherent fire and explosion hazard, and safer, non-flammable methodologies are readily available and equally efficient.
- On August 6, 2012, the Chevron U.S.A. Inc. Refinery in Richmond, California, experienced a catastrophic pipe failure in a crude unit.<sup>62</sup> The pipe ruptured, releasing flammable, hydrocarbon process fluid which partially vaporized into a large vapor cloud that engulfed nineteen Chevron employees. All of the employees escaped, narrowly avoiding serious injury. The flammable portion of the vapor cloud ignited just over two minutes after the pipe ruptured. The ignition and continued burning of the hydrocarbon process fluid resulted in a large plume of unknown and unquantified particulates and vapor traveling across the Richmond, California, area. In the weeks following the incident, nearby medical facilities received over 15,000 members of the public seeking treatment for ailments including breathing problems, chest pain, shortness of breath, sore throat, and headaches. Approximately 20 people were admitted to local hospitals

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<sup>59</sup> CSB Investigation Report, "Pesticide Chemical Runaway Reaction; Pressure Vessel Explosion." *Ibid.*

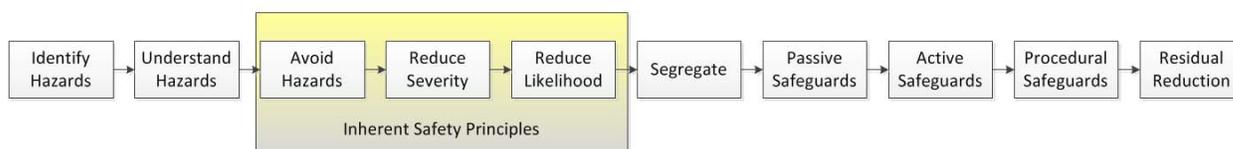
<sup>60</sup> National Research Council. *The Use and Storage of Methyl Isocyanate (MIC) at Bayer CropScience.* *Ibid.*, page 136.

<sup>61</sup> CSB Urgent Recommendations: Kleen Energy. Report No. 2010-07-I-CT. June 28, 2010. Available at: <http://www.csb.gov/assets/1/19/KleenUrgentRec.pdf>.

<sup>62</sup> CSB Interim Investigation Report, "Chevron Richmond Refinery Fire." *Ibid.* The CSB's investigation of this incident is ongoing. See <http://www.csb.gov/chevron-refinery-fire/>.

as inpatients for treatment. The CSB found that the Chevron Richmond refinery failed to implement an inherently safer, more corrosion resistant piping metallurgy in its crude unit high temperature service despite numerous internal recommendations to do so.

While the RMP regulation contains mandatory elements to proactively identify, evaluate, mitigate or prevent chemical releases of highly hazardous chemicals, it does not contain an element for determining the effectiveness of contemplated controls or whether or not there are safer options available for processing and/or using the highly hazardous chemicals. One approach to ensuring the identification and utilization of safer options is to require RMP-regulated entities to consider the entire hierarchy of hazard controls. As the CSB noted in its Chevron Interim Report<sup>63</sup> and Tesoro Anacortes Investigation Report,<sup>64</sup> an effectiveness ranking of techniques used to control hazards and the risk they represent can be described as a hierarchy of controls. The further up the hierarchy, the more effective the risk reduction achieved (Figure 1). All concepts in the hierarchy of controls should be included in the process of risk assessment and reduction. Upgrading metallurgy to a more corrosion resistant material may be a high ranking, inherently safer choice for certain corrosion mechanisms, such as sulfidation corrosion. Holding other variables constant, upgrading the material of construction may reduce the severity of corrosion and the likelihood of a failure.



**Figure 1.** Hierarchy of controls. The boxes reflect inherently safer controls from left to right, based on *Process Plants: A Handbook for Inherently Safer Design Second Edition*; Kletz, Trevor Amyotte, Paul; CRC Press 2010.

This hierarchy is composed of four tiers of controls: inherent, passive, active and procedural. Currently, PHAs conducted to satisfy PSM and RMP focus on only the passive, active and procedural tiers; there is no requirement to evaluate the inherent tier. The inherent approach to hazard control is to minimize or eliminate the hazard rather than accepting the existence of hazards and designing safety systems to control them.

Four strategies need to be considered in attempting to make a process inherently safer:

- Substitution – Are there materials, chemistry or processes that can be used that are less hazardous than the current process?
- Minimization – Is the smallest quantity of hazardous material being used in the process?
- Moderation – Can we reduce hazards using dilution, refrigeration, process alternatives or distance?

<sup>63</sup> CSB Interim Investigation Report, “Chevron Richmond Refinery Fire.” *Ibid.*

<sup>64</sup> See CSB Investigation Report, “Tesoro Anacortes Refinery: Catastrophic Rupture of Heat Exchanger.” *Ibid.*

- Simplification – Can we eliminate unnecessary complexity and design “user friendly” plants?

As the National Research Council noted in its study on the use and storage of MIC at Bayer CropScience,<sup>65</sup> the inherent safety approach can be applied at all stages of the life cycle in the manufacturing plant. In addition to evaluating for inherent safety during the initial process design review, the Council noted that inherent safety can also be reviewed in a number of ongoing PSM-related activities, such as management of change, incident investigation, pre-startup safety reviews, operating procedures and training. As the RMP regulation requirements are similar to those of the PSM standard, this finding can be applied to EPA and RMP-related activities as well.

Moreover, the study also noted that a number of decision aids are available for assisting plants in analyzing whether or not proposed inherent safety alternatives are viable. Thus EPA should require inherent safety evaluations when revising the RMP regulation and list the National Research Council study as a mandatory reference.

EPA should also note that a committee of the National Research Council recently published *A Framework to Guide Selection of Chemical Alternatives*,<sup>66</sup> which explains how inherent safety assessments may be used to identify alternative chemicals or approaches that are safer and have reduced environmental impacts.

#### Process Hazard Analysis Requirements

##### a. Damage Mechanism Hazard Reviews

The CSB urges EPA to consider revising Paragraph (a) of the RMP regulation at 40 CFR §68.50 (Hazard Review) to explicitly require conduct of a documented damage mechanism hazard review to identify and evaluate damage mechanisms that may affect covered processes. Sometimes referred to as a corrosion review, a damage mechanism hazard review analyzes risks presented by process failure mechanisms, such as corrosion and cracking. It is intended to ensure that all potential hazards caused by process conditions, process materials, and external mechanisms, are properly identified and analyzed, and that systems are put in place to control or eliminate identified hazards.

The CSB concluded that the August 6, 2012, fire at the Chevron Richmond Refinery was caused by the catastrophic failure of piping due to sulfidation corrosion, a common damage mechanism in refineries.<sup>67</sup> A Process Hazard Analysis (PHA) was conducted in accordance with California’s Process Safety Management regulation and EPA’s RMP regulation; however, corrosion was *not* identified as a potential cause of a leak or rupture in the piping. Although Chevron has significant expertise with regard to sulfidation corrosion, neither California’s PSM standard nor EPA’s RMP explicitly required conducting a damage mechanism hazard safety

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<sup>65</sup> National Research Council. *The Use and Storage of Methyl Isocyanate (MIC) at Bayer CropScience*. *Ibid*, pp. 65-67.

<sup>66</sup> National Research Council. *A Framework to Guide Selection of Chemical Alternatives*. Washington, DC: National Academies Press, 2014.

<sup>67</sup> CSB Interim Investigation Report, “Chevron Richmond Refinery Fire.” *Ibid*. The CSB’s investigation of this incident is ongoing. See <http://www.csb.gov/chevron-refinery-fire/>.

review, and the CSB found that Chevron PHA teams do not typically seek assistance from corrosion experts. Therefore, damage mechanisms were only identified and appropriate safeguards implemented when the PHA team happened to have knowledge of the mechanism. As a result, many damage mechanisms that occur in various processes are not properly addressed.

b. Evaluation of Controls

The CSB encourages EPA to explicitly require regulated entities to both evaluate and document the technical basis for and the sufficiency of the controls selected to safeguard against identified hazards as part of a Hazard Review.

At present, the RMP regulation requires Program 2 facilities to conduct a “Hazard Review” that addresses the “safeguards used or needed to control the hazards or prevent equipment malfunction or human error.” (40 CFR 65.50(a)(3)). Program 3 facilities are required to conduct a “process hazard analysis” that must “identify, evaluate, and control the hazards involved in the process.” (40 CFR §68.67(a)). The process hazard analysis must also address “[e]ngineering and administrative controls applicable to the hazards and their interrelationships such as appropriate application of detection methodologies to provide early warning of releases.” (40 CFR §68.67(c)(3)). However, there is no explicit requirement in either case that the regulated entity evaluate the effectiveness of the safeguards or controls selected and document the basis(es) for concluding that the safeguards selected are sufficiently protective against the hazards identified.

A recognized methodology for consistently and objectively making these determinations could include the use of quantitative, semi-quantitative, or qualitative tools. The CSB’s Interim Investigation report on the August 6, 2012, fire at the Chevron Richmond Refinery<sup>68</sup> identified Layer of Protection Analysis (LOPA) as one possible hazard analysis methodology that may be used to determine if sufficient safeguards are in place to protect against a particular hazard or accident scenario; in addition, California’s Interagency Refinery Task Force (established following the August 6, 2012, incident) recommended LOPA as one of six prevention strategies for promoting refinery safety.<sup>69</sup> This methodology requires that the effectiveness of safeguards in place be proportionate to the severity of the potential consequences they are intended to prevent, and can help an organization decide whether the risk has been reduced to a level that is as low as reasonably practicable, or ALARP. ALARP is a risk reduction goal, where risk reduction efforts are continued until the incremental effort to further reduce risk becomes grossly disproportionate to the level of additional risk reduction.<sup>70</sup> By rigorously reviewing accident or hazard scenarios, evaluating the potential consequence of the scenario, and identifying the safeguards or layers of protection necessary to drive risk to as low as reasonably practicable, LOPA becomes an effective organizational tool for implementing a Process Safety Management (PSM) mechanical integrity program.<sup>71</sup>

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<sup>68</sup> CSB Interim Investigation Report, “Chevron Richmond Refinery Fire.” *Ibid.*

<sup>69</sup> *Improving Public and Worker Safety at Oil Refineries: Report of the Interagency Working Group on Refinery Safety*. State of California, 2014. Available at: <http://www.calepa.ca.gov/publications/Reports/2014/Refineryrpt.pdf>.

<sup>70</sup> *Ibid* at Page 46.

<sup>71</sup> *Ibid* at Page 27.

c. Siting and Human Factors

The CSB encourages EPA to incorporate more explicit requirements for identifying, evaluating, and addressing facility siting and human factors issues during a process hazard analysis (per 40 CFR §68.67(c)(5) and (6)). For example, the PHA methodologies listed in the RMP regulation (at §68.67(b)) are not easily adaptable to review of either of these issues, and EPA should provide more guidance within the text of the regulation as to what methodologies should be utilized to evaluate these issues.

The CSB has noted within several of its investigations that improper facility siting has contributed to significant worker injuries and deaths.

For example:

- The October 13, 2002, explosion in a chemical distillation tower at the First Chemical Corporation in Pascagoula, Mississippi,<sup>72</sup> knocked down three operators who were standing inside the unit control room, located only 50 feet away. All received cuts and abrasions from shattering glass, and one reported seeing a fireball move past the door. Several other buildings on site were also significantly damaged, including a nearby administration building.
- The August 19, 2004, explosion in an ethylene oxide sterilization chamber at the Sterigenics facility in Ontario, California, resulted in four injuries and rendered the facility unusable. All injuries were caused by shattering glass in the control room, which was located 75 feet away.<sup>73</sup>
- The March 23, 2005, explosions and fires at the BP Texas City refinery killed fifteen workers and injured 180; most of the victims were located in and around temporary office trailers that had been sited near a blowdown drum and stack open to the atmosphere as part of ongoing turnaround activities in an adjacent site. Forty-four trailers were damaged; thirteen were totally destroyed. In addition, workers were injured in trailers located as far as 479 feet away from the release.<sup>74</sup>
- The May 4, 2009, explosion and fire at Veolia ES Technical Solutions, in West Carrollton, Ohio,<sup>75</sup> damaged every structure on the site and injured four workers. The most severely injured workers were located in a lab/operations building located less than 30 feet from an operating unit. One worker in a control room was enveloped in a fireball and received first-degree burns; a second had his pelvis broken by falling personnel lockers.<sup>76</sup>
- The March 21, 2011, electric arc furnace explosion at the Carbide Industries facility in Louisville, Kentucky,<sup>77</sup> broke the double-pane reinforced glass window of a control room

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<sup>72</sup> CSB Investigation Report, "Explosion and Fire: First Chemical Corporation." *Ibid.*

<sup>73</sup> See CSB Investigation Report, "Sterigenics: Ontario, California." Report No. 2004-11-I-CA. August 30, 2006. Available at: [http://www.csb.gov/assets/1/19/Sterigenics\\_Report.pdf](http://www.csb.gov/assets/1/19/Sterigenics_Report.pdf).

<sup>74</sup> CSB Investigation Report, "Refinery Explosion and Fire: BP Texas City." *Ibid.*

<sup>75</sup> CSB Case Study, "Explosion and Fire in West Carrollton, Ohio. Veolia Technical Solutions, LLC." Report No. 2009-10-I-OH. July 21, 2010. Available at: [http://www.csb.gov/assets/1/19/Veolia\\_Case\\_Study.pdf](http://www.csb.gov/assets/1/19/Veolia_Case_Study.pdf).

<sup>76</sup> M Kaszniak and D Holmstrom. 2008. "Trailer siting issues: BP Texas City." *Journal of Hazardous Materials* 159: 105-111.

<sup>77</sup> CSB Case Study, "Carbide Industries, LLC, Louisville, KY Electric Arc Furnace Explosion." Report No. 2011-05-I-KY. February 7, 2013. Available at [http://www.csb.gov/assets/1/19/Final\\_Report\\_small.pdf](http://www.csb.gov/assets/1/19/Final_Report_small.pdf).

located only 12 feet away from the furnace. Two workers inside the control room were fatally burned.

Additional CSB comments on siting appear in Section D4 (*Additional Stationary Source Location Requirements*), below.

With regard to human factors, the CSB urges EPA to incorporate requirements to manage human fatigue in high hazard facilities during the upcoming RMP regulation revision process. A key finding of the CSB's investigation of the March 2005 explosions and fire at the BP Texas City Refinery was that operators were likely fatigued from working 12-hour shifts—some for as many as 29 consecutive days during the turnaround. The CSB concluded that this likely degraded their judgment and problem solving skills and hindered their ability to detect the tower overflow during start-up that precipitated the explosions and fire. Following the incident, the CSB recommended that API and the USW collaborate to produce two ANSI standards applicable to the refining and petrochemical industries—one addressing process safety indicators (as discussed above), and the other addressing fatigue prevention.<sup>78</sup> The USW withdrew from the standards development process; however, API proceeded and in April 2010, issued Recommended Practice (RP) 755: *Fatigue Prevention Guidelines for the Refining and Petrochemical Industries*.

Though the Board has yet to change the status of the CSB's recommendations, CSB staff have proposed that the Board vote to designate its recommendations to both parties with the status of "Open- Unacceptable Response" due to significant shortcomings in the current edition.<sup>79</sup> An examination of the strengths and weaknesses of the RP may inform EPA's efforts with regard to fatigue. For example:

- A comprehensive fatigue risk management system must:
  - establish preventive limits on hours and days of work that are consistent with scientifically-established limits;
  - ensure sufficient staffing levels, and
  - establish management responsibility for the implementation of these and other measures for fatigue prevention.
- "Soft" or "personal" components of fatigue control, such as employee training and education on fatigue and effective rest and sleep techniques, and self-evaluation and reporting requirements may supplement (but not serve as the backbone of) a fatigue risk management system.
- As discussed above, requirements for managing human fatigue *must* be developed via a consensus process involving a balanced group of stakeholders from industry, labor,

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<sup>78</sup> CSB Recommendations 2005-4-I-TX-R7A and R7B, to the API and USW, respectively, read as follows: *Work together to develop [a] new consensus American National Standards Institute (ANSI) standard[.]. In the second standard, develop fatigue prevention guidelines for the refining and petrochemical industries that, at a minimum, limit hours and days of work and address shift work. In the development of each standard, ensure that the committees*

*a. are accredited and conform to ANSI principles of openness, balance, due process, and consensus;*

*b. include representation of diverse sectors such as industry, labor, government, public interest and environmental organizations and experts from relevant scientific organizations and disciplines.*

<sup>79</sup> The CSB plans to have a public meeting at which the Board will vote on the staff's evaluation; the date of that meeting has yet to be announced.

government, public interest and environmental organizations, and experts from relevant scientific organizations and disciplines.

The CSB notes that nearly all other high hazard occupations already have fatigue standards in place (e.g., airlines, railroads, trucking, nuclear, pipeline, etc.) so there are plenty of examples to draw upon for suggested regulatory language and justification. The fatigue standards issued by the Nuclear Regulatory Commission for nuclear power plants (10 CFR Part 26, Subpart I) and by Pipeline and Hazardous Materials Safety Authority (49 CFR Parts 192 and 195) for controlling fatigue in control rooms appear to have the most applicability to the chemical and refining sectors based on similarity of job tasks.

### Contractor Safety

On October 2, 2007, a chemical fire inside a permit-required confined space<sup>81</sup> at Xcel Energy's hydroelectric plant in a remote mountain location 45 miles (72 kilometers) west of Denver, Colorado, killed five and injured three workers. Industrial painting contractors were in the initial stages of recoating the 1,530-foot (466-meter) steel portion of a 4,300-foot (1,311-meter) enclosed penstock tunnel with an epoxy coating product when a flash fire occurred. Flammable solvent being used to clean the epoxy application equipment in the open penstock atmosphere ignited, likely from a static spark. The initial fire quickly grew as it ignited additional buckets of solvent and substantial amounts of combustible epoxy material, trapping and preventing five of the 11 workers from exiting the single point of egress within the penstock. Fourteen community emergency response teams responded to the incident. The five trapped workers communicated using handheld radios with co-workers and emergency responders for approximately 45 minutes before succumbing to smoke inhalation.

In its investigation of the incident, the CSB found that Xcel awarded a contract for the recoating work to RPI Coating, Inc., despite the fact that RPI received the lowest score of zero in the safety category, which, according to Xcel's evaluation form, meant that RPI's proposal should have been automatically rejected. However, RPI's proposal received the highest ranking in the evaluation process, based primarily on low price, and RPI was awarded the contract.

The CSB noted in the Xcel Investigation Report that several organizations and industry associations, including the Construction Users Roundtable,<sup>82</sup> the American National Standards Institute (ANSI), the American Industrial Hygiene Association (AIHA), and FM Global, have developed guidelines and recommended practices addressing the use of safety criteria for selecting contractors. One common method is prequalification, typically a pass/fail system that ensures that only contractors who meet specific requirements, including safety, are allowed to compete for contracts.<sup>83</sup> The AIHA has published safety guidelines, "Health and Safety

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<sup>81</sup> See CSB Investigation Report, "Xcel Energy Hydroelectric Plant Penstock Fire." Report No. 2008-01-I-CO. August 25, 2010. Available at [http://www.csb.gov/assets/1/19/Xcel\\_Energy\\_Report\\_Final.pdf](http://www.csb.gov/assets/1/19/Xcel_Energy_Report_Final.pdf).

<sup>82</sup> CURT is an industry organization that promotes advocacy by users of construction services on national issues that includes —developing industry standards and owner expectations with respect to safety, training and worker qualifications. See [http://www.curt.org/2\\_0\\_about\\_curt.html](http://www.curt.org/2_0_about_curt.html), accessed 10/27/09. CURT is composed of 66 member companies, organizations, and government entities that represent some of the largest industrial corporations and users of construction services in the U.S. including DuPont, ExxonMobil, Dow Chemical, Intel, Proctor & Gamble, Duke Energy, General Motors, Shell, the U.S. General Services Administrations, and the U.S. Army Corp of Engineers.

<sup>83</sup> See CSB Investigation Report, "Xcel Energy Hydroelectric Plant Penstock Fire." *Ibid*; pp 84-85.

Requirements in Construction Contract Document” which identify a number of specific prequalification criteria including OSHA injury and illness logs, OSHA citations, and training certifications. ANSI Standard Z-10, “Occupational Health and Safety Management Systems” also recommends that the contractor prequalification process include consideration of safety criteria for successful contractor safety performance management.<sup>84</sup>

As a result of its findings, the CSB made a recommendation to the Colorado Public Utilities Commission to require that competitive bidding and contractor selection rules for construction, maintenance or repair of regulated utilities include procedures for prequalifying or disqualifying contractors based on specific safety performance measures and qualifications. The CSB made a similar recommendation to Xcel, as well as another recommendation to require a comprehensive review and evaluation of contractor safety policies and procedures such as the permit-required confined space program and safety performance of contractors working in confined spaces to ensure that any bidding contractor meetings or exceeds Xcel Energy safety requirements.

The CSB also recommended that Xcel conduct periodic safety audits of contractor selection and oversight at its power-generating facilities to ensure adherence to corporate contractor procurement and safety policies.

The CSB urges EPA to add requirements to the RMP regulation that are similar to the recommendations made in the Xcel Investigation Report concerning contractor selection and oversight, including a requirement that a company periodically audit the contractor’s safety performance, policies, and procedures.

The CSB’s investigation of the Donaldson Enterprises, Inc. (DEI) fireworks explosion and fire that fatally injured five DEI employees also focused on contractor safety, this time at the federal level. The CSB made recommendations in its final investigation report on the incident to the Federal Acquisition Regulatory (FAR) Council and the Department of Treasury to incorporate rigorous safety-related contractor selection and oversight provisions for contracts concerning hazardous or explosive materials.<sup>85</sup>

### **3. Define and Require Evaluation of Updates to Applicable Recognized and Generally Accepted Good Engineering Practices**

The CSB advocates that the RMP regulation should require employers to evaluate updates to applicable RAGAGEP (recognized and generally accepted good engineering practices) and to examine new RAGAGEP after evaluating and documenting compliance with either 40 CFR §68.65(d)(2) or (d)(3). RAGAGEP is beneficial in that it requires operators to identify, develop, evaluate, and implement applicable standards, codes, regulations, and laws that affect process safety. However, RAGAGEP fails to require that operators evaluate updates to applicable RAGAGEP or to examine new RAGAGEP after evaluating and documenting compliance with either 40 CFR §68.65(d)(2) or (d)(3). Given continual changes in the chemical sector, the consequences of a process safety incident, and the interaction of RAGAGEP with every

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<sup>84</sup> ANSI/AIHA Z-10, 2005, p. 20.

<sup>85</sup> See CSB Investigation Report, “Donaldson Enterprises, Inc. Fireworks Disposal Explosion and Fire.” *Ibid.*

element of RMP, EPA should mandate that the RMP regulation require the evaluation of updates applicable to RAGAGEP.

The CSB also notes that certain industry standards, such as API RP 941<sup>86</sup> (see the CSB Tesoro Investigation Report), are written with permissive language, thus making the RAGAGEP requirement ineffective. Therefore, RAGAGEP should be a mechanism for implementing effective safety requirements and not be couched in permissive language.

Failing to require operators to evaluate updates to applicable RAGAGEP after compliance with either 40 CFR §68.65(d)(2) or (d)(3) amounts to a static approach to oversight. This presents a significant concern as the chemical sector handles non-standard operations that are complex and continually changing. These changes can be seen at the technical, organizational, and legal levels of the sector. Furthermore, this static approach prevents RAGAGEP from functioning as a performance-based regulation. A key aspect of a performance-based regulation is its focus on continual improvement to meet the specified goal. In this instance, failing to require updates to applicable RAGAGEP fails to effectively encourage continual improvement and therefore increases process risk.

The CSB has investigated accidents in which requiring evaluation of updates to certain RAGAGEP's could have prevented a process safety incident. A prime example was the propylene explosion at the Formosa Plastics facility in Point Comfort, TX, on October 6, 2005.<sup>87</sup> The incident occurred when a trailer being towed by a forklift snagged and pulled a small drain valve out of a strainer in a liquid propylene system. Escaping propylene rapidly vaporized, forming a large flammable vapor cloud. The vapor ignited, creating an explosion, which resulted in injuries to 16 individuals. The extensive damage shut down a process unit for five months. Had fireproofing materials been used on the steel structure supporting the pressure relief valves and emergency vent piping, the consequences of this incident would likely have been less severe. However, the designs for the unit were never updated to incorporate the latest RAGAGEP. The likelihood of these types of incidents can be significantly reduced if operators are required to evaluate updates to applicable RAGAGEP after compliance with either 40 CFR §68.65(d)(2) or (d)(3).

The chemical sector faces an unlimited number of inherently hazardous situations which are complex and continually changing. RAGAGEP is intended to address these incidents through a performance-based approach to the regulation of process safety. Moreover, RAGAGEP's importance can be seen throughout the RMP regulation as the usage of RAGAGEP in §40 CFR §68.65(d)(2) or (d)(3) affects all other elements in the regulation. The RMP regulation's failure to require an evaluation of updates to RAGAGEPs is a significant concern. Such an approach contributes to an increase in process safety risk. Therefore, the RMP regulation should require that operators evaluate updates to applicable RAGAGEP (recognized and generally accepted good engineering practices) and to examine new RAGAGEP after evaluating and documenting compliance with either 40 CFR §68.65(d)(2) or (d)(3).

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<sup>86</sup> American Petroleum Institute (API) Recommended Practice (RPI) 941, *Steels for Hydrogen Service at Elevated Temperatures and Pressures in Petroleum Refineries and Petrochemical Plants*. See CSB Investigation Report, "Tesoro Anacortes Refinery: Catastrophic Rupture of Heat Exchanger." *Ibid*.

<sup>87</sup> See CSB Case Study, "Fire at Formosa Plastics Corporation: Evaluating Process Hazards." Report No. 2006-01-I-TX. July 20, 2006. Available at [http://www.csb.gov/assets/1/19/Formosa\\_Report.pdf](http://www.csb.gov/assets/1/19/Formosa_Report.pdf).

#### 4. Extend Mechanical Integrity Requirements to Cover Any Safety Critical Equipment

##### *Performance Standards for Safety Critical Equipment*

Rather than using a list-based approach, the RMP regulation should require companies to identify their safety critical equipment/elements (SCE) and demonstrate to the regulator that each SCE has a performance standard that addresses functionality, availability, reliability, survivability, and interactions with other systems as well as a verification scheme. The CSB made such a recommendation pursuant to its issuance of Volume 2 of the CSB's report on the April 20, 2010 explosion and fire at on the Macondo oil rig in the Gulf of Mexico, and the subsequently issued recommendations to the Bureau of Safety and Environmental Enforcement in the U.S. Department of the Interior.<sup>88</sup>

A performance standard is a qualitative or quantitative statement that describes the required performance of an SCE in order to prevent or mitigate a major accident event and it applies throughout the SCE's lifecycle. The verification scheme, or assessment scheme, identifies those activities necessary to sustain the SCE in a suitable condition, including maintenance, inspection, and testing. A verification scheme should ensure the SCE performance is met by:<sup>89</sup>

- Identifying those assurance activities, such as maintenance, inspection, and testing that are required to sustain the SCE in a suitable condition;
- Ensuring that assurance activities are carried out at the appropriate time by competent people;
- Maintaining a record of these activities and any findings that arise; and
- Addressing any deficiencies arising from assurance activities as soon as possible and taking any temporary measure(s) that may be necessary to maintain risk ALARP until deficiencies have been recertified. Any temporary measures should be subject to review and comment by an independent competent person.

The regulator could provide a list of common suggested SCE and/or criteria for what constitutes a SCE to assist the company in ensuring all SCE are identified and managed.

##### *Emergency Shutdown Systems*

EPA notes in its RFI that the mechanical integrity requirements of Section 68.73 are applicable to emergency shutdown systems; however, the regulation does not explicitly require covered sources to *install* emergency shutdown systems. The CSB urges EPA to specify situations where covered sources should be required to install emergency shutdown systems (and maintain them per the existing requirements in §68.73). For example, the CSB is concerned by the potential for large, uncontrolled releases of highly toxic chlorine during railcar unloading operations—a risk that may be substantially reduced by the presence of well-maintained, remotely operable emergency isolation devices capable of quickly isolating leaks in any of the flexible hoses (or piping components) used to unload a chlorine railcar.<sup>90</sup> A single railcar of

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<sup>88</sup> See, in particular, CSB Recommendation No. 2010-10-I-OS-R1 in CSB Investigation Report, Volume 2, "Explosion and Fire at the Macondo Well." Report No. 2010-10-I-OS. June 5, 2014. Available at: [http://www.csb.gov/assets/1/7/20140605\\_Macondo\\_Vol2\\_%280605v1%29.pdf](http://www.csb.gov/assets/1/7/20140605_Macondo_Vol2_%280605v1%29.pdf). The CSB is completing its investigation of the Macondo incident. See <http://www.csb.gov/macondo-blowout-and-explosion/>.

<sup>89</sup> *Guidelines for the Management of Safety Critical Elements*. 2<sup>nd</sup> ed. London, UK: Energy Institute, March 2007.

<sup>90</sup> The installation of emergency shutdown systems is already considered best industry practice. The Chlorine Institute, the trade organization for distributors, users, and disposers of chlorine and related compounds, outlines recommended practices for emergency shutdown systems in Pamphlet 57,

chlorine can contain up to 90 tons of this highly toxic, corrosive chemical, and a release of this magnitude could have catastrophic off-site consequences.

In August 2002, the CSB investigated a chlorine release at the DPC Enterprises facility in Festus, Missouri.<sup>91</sup> During a routine operation wherein chlorine was being transferred from a 90-ton railcar a chlorine transfer hose catastrophically ruptured, initiating a sequence of events that led to the release of 48,000<sup>92</sup> pounds of chlorine over a three hour period. Evacuating employees tried to activate the emergency shutdown system as they exited the area; however, the system was poorly maintained and malfunctioned, allowing the release to continue unabated. The release affected hundreds of nearby residents, 63 of whom sought evaluation at the local hospital for respiratory distress. Three were admitted for overnight observation.

Three years later, in August 2005, a chlorine transfer hose ruptured during the transfer of chlorine from a 90-ton railcar to a refrigeration manufacturing process. In this case, however, the remotely operable emergency shutdown system functioned as designed. Though some contractors working in the area were exposed to chlorine and taken to the hospital where they were treated and released, this incident had no offsite consequences, which demonstrates that the installation and maintenance of emergency shutdown systems is essential to protecting workers, adjacent communities, and the environment from major chlorine releases.<sup>93</sup>

In 2007, the CSB issued a safety bulletin emphasizing the importance of installing, testing, and maintaining chlorine detection and emergency shutdown devices on chlorine railcar transfer systems. The Board also recommended that the U.S. Department of Transportation promulgate requirements for these systems.<sup>94</sup> DOT has indicated, however, that its regulatory authority does not extend to the unloading of railcars at fixed facilities (in the absence of a carrier) and that this authority instead rests with EPA and OSHA. The CSB therefore urges EPA to specify situations where RMP-covered sources should be required to install emergency shutdown systems and maintain them per the existing requirements in §68.73. We also urge EPA to continue to collaborate with OSHA and the DOT in promoting the safety of hazardous materials loading and unloading operations.

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“Emergency Shut-off Systems for Bulk Transfer of Chlorine.” The CI states explicitly that emergency shutdown systems “significantly reduc[e] the potential for release of chlorine in the event of any failure in the transfer connections” and “must be operational during each transfer.”

<sup>91</sup> See CSB Investigation Report, “Chlorine Release: DPC Enterprises, L.P.” Report No. 2002-04-I-MO. May 1, 2003. Available at [http://www.csb.gov/assets/1/19/DPC\\_Report.pdf](http://www.csb.gov/assets/1/19/DPC_Report.pdf)

<sup>92</sup> 48,000 pounds is equivalent to 24 tons. This is just over a quarter of the capacity of a chlorine railcar.

<sup>93</sup> See CSB Safety Bulletin, “Emergency Shutdown Systems for Chlorine Transfer.” Report No. 2005-06-I-LA. June 8, 2007. Available at: <http://www.csb.gov/emergency-shutdown-systems-for-chlorine-transfer/>

<sup>94</sup> *Ibid.* CSB Recommendation No. 2005-6-I-LA-R1 reads as follows: *Expand the scope of DOT regulatory coverage to include chlorine railcar unloading operations. Ensure the regulations specifically require remotely operated emergency isolation devices that will quickly isolate a leak in any of the flexible hoses (or piping components) used to unload a chlorine railcar. The shutdown system must be capable of stopping a chlorine release from both the railcar and the facility chlorine receiving equipment. Require the emergency isolation system be periodically maintained and operationally tested to ensure it will function in the event of an unloading system chlorine leak.*

## 5. Require Owners and Operators to Manage Organizational Changes

The CSB strongly recommends that EPA revise 40 CFR §68.75 *Management of Change* to incorporate an explicit requirement that Management of Change (MOC) analyses be conducted for organizational changes (e.g., mergers, leadership changes, budget cuts, etc.) that may affect a covered process. While the CSB appreciates that the RMP regulation standard is intended to be a performance standard as opposed to a list of prescriptive requirements, we remain concerned that the standard does not provide sufficient warning to the regulated community that they may be fined for failing to conduct MOC analyses for organizational changes.

The CSB formally recommended that OSHA clarify this requirement in paragraph (l) of the Process Safety Management Standard (29 CFR §1910.119) following our investigation of the March 2005 fires and explosions at the BP Texas City Refinery, which killed 15 workers, injured 180, and caused significant economic losses.<sup>95</sup> The incident had significant offsite impacts, with windows shattered in homes and businesses located north of the refinery up to three miles away. The CSB investigated the root and contributing causes of the incident and concluded that poorly managed corporate mergers, leadership and organizational changes, and budget cuts greatly increased the risk of catastrophic accidents at the site. The CSB found that although the need to manage organizational changes was recognized in several sets of good practices guidelines,<sup>96</sup> a 2002 survey indicated that only 41% of the MOC programs of U.S. chemical companies assessed the impact of organizational changes.<sup>97</sup>

Meanwhile, additional CSB investigations have illustrated that the failure to manage significant organizational changes may increase the likelihood of catastrophic incidents. In investigating the April 2010 rupture of a heat exchanger at the Tesoro refinery in Anacortes, Washington,<sup>98</sup> the CSB found that the site had not conducted an MOC analysis pursuant to staffing changes for exchanger startup activities.

## 6. Require Third-Party Compliance Audits

The CSB generally supports revising 40 CFR §68.58 and § 68.79 to require third-party compliance audits. The CSB has noted in several of its investigations, most notably First

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<sup>95</sup> See CSB Investigation Report, "Refinery Explosion and Fire: BP Texas City." *Ibid.* CSB Recommendation No. 2005-4-I-TX-R9 to OSHA reads as follows: *Amend the OSHA PSM standard to require that a management of change (MOC) review be conducted for organizational changes that may impact process safety including a. major organizational changes such as mergers, acquisitions, or reorganizations; b. personnel changes, including changes in staffing levels or staff experience; and c. policy changes such as budget cutting.* This recommendation is currently designated with the status "Open- Unacceptable Response." The rationale for the Board's July 25, 2013, decision concerning this recommendation is elaborated in a Status Change Summary document available at: [http://www.csb.gov/assets/recommendation/Status\\_Change\\_Summary\\_OSHA\\_BP\\_TXC\\_R9\\_O-UR.pdf](http://www.csb.gov/assets/recommendation/Status_Change_Summary_OSHA_BP_TXC_R9_O-UR.pdf).

<sup>96</sup> See, for example: Chemical Manufacturers Association, *Management of Safety and Health During Organization Change – A Resource Kit for Organizations Facing Change* (1998); UK Health and Safety Executive, *Organisational Change and Major Accident Hazards* (2003); and Canadian Society for Chemical Engineers, *Managing the Health and Safety Impacts of Organizational Change* (2004).

<sup>97</sup> Keen, West and Mannan, "Benchmarking MOC practices in the process industries," *Process Safety Progress*, 2002: 21(2): pp. 103-112.

<sup>98</sup> See CSB Investigation Report, "Tesoro Anacortes Refinery: Catastrophic Rupture of Heat Exchanger." *Ibid.*

Chemical,<sup>99</sup> BP Texas City,<sup>100</sup> and Valero McKee<sup>101</sup> that internal company process safety management audits often fail to identify systematic process safety deficiencies. While a third-party audit can be a positive step towards valuable gap assessments and action items for improvement, there are several areas that raise our concerns:

- Third-party audits should not be a substitute for a cadre of sufficiently resourced, competent regulatory staff who are inspecting and auditing facilities directly on a consistent basis focusing on prevention.
- A third-party approach may lead to EPA contracting out what it should be doing as a regulator to a third-party; if that were to occur, this would have a detrimental impact on the regulator's ability to oversee industry.
- Third-parties hired by industry may not be completely objective unless there are requirements for ensuring and maintaining their independence.
- Third-party audits may be used to augment the activities of an independent, well-resourced, competent regulator.

#### **7. Effects of OSHA PSM Coverage on RMP Applicability**

Prior to the explosion at the West Fertilizer Company (WFC) on April 17, 2013, the company was storing more than 10,000 pounds of anhydrous ammonia, the listed threshold quantity for both EPA's RMP and OSHA's PSM standard.<sup>102</sup> The company was required only to comply with Program 2 requirements under RMP because the facility was not covered under the PSM standard due to the retail exemption and did not fall under one of the ten specified NAICS codes for Program 3.

The CSB submitted comments to OSHA on March 31, 2014, regarding retail exemption and how it impacted WFC.<sup>103</sup> Had WFC been PSM-covered for its anhydrous ammonia, the company would have conducted a process hazard analysis and addressed facility siting. A facility siting analysis would have identified that a warehouse storing ammonium nitrate, was in close proximity to the anhydrous ammonia storage tanks and precipitated the need to ensure that if an incident occurred with one hazardous chemical, another incident would not occur with other hazardous chemicals stored nearby. Program 3 requirements under RMP mirror this same PSM requirement but WFC was Program 2, which does not require facility siting as part of its hazard review.<sup>104</sup>

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<sup>99</sup> See CSB Investigation Report, "Explosion and Fire: First Chemical Corporation." *Ibid.*

<sup>100</sup> See CSB Investigation Report, "Refinery Explosion and Fire: BP Texas City." *Ibid.*

<sup>101</sup> See CSB Investigation Report, "LPG Fire at Valero-McKee Refinery." Report. No. 2007-5-I-TX. July 9, 2008. Available at <http://www.csb.gov/assets/1/19/CSBFinalReportValeroSunray.pdf>.

<sup>102</sup> WFC reported to the CSB that at the time of the incident, they were storing 34,000 lbs of anhydrous ammonia.

<sup>103</sup> See CSB's response to OSHA's December 9, 2013 Request for Information (78 FR 73756), *Ibid.*

<sup>104</sup> EPA. *Guidance for Facilities on Risk Management Programs*. Ch. 6. Prevention Program (Program 2). April 2004. Available at: <http://www2.epa.gov/sites/production/files/2013-11/documents/chap-06-final.pdf>.

**Section D: Additional Items for Which EPA Requests Information**

**1. Safer Technology and Alternatives Analysis**

The CSB addressed inherent safety and hierarchy of controls in Section C2 (*Additional Risk Management Program Elements*), above. The CSB strongly encourages the EPA to use its authority under the Clean Air Act to promulgate new rules or guidance to require the application of inherently safer technology and design for covered facilities. The CSB welcomes further dialogue with the EPA on this matter.

**2. Emergency Drills to Test a Source's Emergency Response Plan, and 5. Compliance with Emergency Response Program Requirements in Coordination with Local Responders**

The CSB strongly supports revisions to the RMP regulation that would enhance or improve pre-emergency planning and collaboration between owners/operators of stationary sources and local emergency response facilities. The CSB has found in a number of our investigations that workers, emergency responders, and members of the community have been killed, injured, or at risk of physical harm because of insufficient pre-emergency planning and coordination between facilities and local emergency response authorities. Examples include:

- The CSB investigated the April 12, 2004, release of toxic allyl alcohol resulting from a runaway chemical reaction at MFG Chemical, a specialty chemical manufacturer in Dalton, Georgia. The facility was unaware that the process was subject to the RMP regulation. The facility planned to rely on local emergency response authorities in the event of significant release; however, it did not sufficiently coordinate with local emergency-response authorities to insure incident preparedness.<sup>114</sup> The local responding authorities did not possess appropriate personal protective equipment (PPE) and air monitoring equipment to safely enter the process area to stop the release or to carry out the evacuation order in the surrounding community. As a result, responding police and emergency medical personnel were exposed to toxic vapors and required medical treatment for respiratory distress and eye and skin irritation. The company had also not sufficiently coordinated with local emergency-response authorities to ensure a community notification system was in place and that community members were prepared to evacuate safely. As a result, more than a hundred community members were exposed to toxic vapors and required medical treatment, including five residents who were hospitalized overnight.
- The CSB investigated the October 5, 2006, explosions and fire at the EQ hazardous waste facility in Apex, North Carolina.<sup>115</sup> As part of its investigation, the CSB found that the facility had not provided emergency responders with detailed information regarding the types, quantities, and location of hazardous materials on site. The facility was also unoccupied at the time and no emergency coordinator was on site to initiate the facility's emergency plan or assess the extent of the release or emergency.

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<sup>114</sup> In interviews with CSB investigators, fire department personnel indicated that they had explained to MFG that the company needed to make provisions for a major release since the fire department was not sufficiently qualified or equipped to respond to such an event. See CSB Investigation Report, "Toxic Chemical Vapor Cloud Release: MFG Chemical, Inc."

<sup>115</sup> This facility was not subject to the RMP regulation.

- The CSB investigated the August 28, 2008, pesticide waste tank explosion at the Bayer CropScience facility in Institute, West Virginia. As part of its investigation, the CSB found that Bayer personnel did not provide local emergency response personnel with timely and reliable information regarding the status of the incident; as a result, responding personnel may have been exposed to toxic substances in performing their duties. This also negatively impacted the shelter-in-place decision making process for the local community.
- The CSB investigated three incidents within a 36-hour period at the DuPont facility in Belle, West Virginia, in late January 2010.<sup>116</sup> One of these incidents involved the exposure and subsequent death of an employee sprayed with highly toxic liquid phosgene. Similar to the August 2008 Bayer CropScience investigation, which also occurred in WV's Kanawha Valley, CSB investigators found that DuPont personnel did not provide local emergency response authorities with sufficient and timely information regarding the nature of the emergency. Although this did not appear to delay the emergency response efforts in this case, local emergency response authorities raised the need not only to ensure that emergency responders and their equipment are not exposed to contaminants during response efforts, but also to ensure that exposure victims being assisted receive optimum care in transit for medical treatment.
- The CSB is currently investigating the anhydrous ammonia release from the Millard Refrigerated Services facility in Theodore, Alabama, on August 23, 2010.<sup>117</sup> A release of 32,000 pounds of ammonia from the roof of the facility formed a hazardous vapor cloud and traveled offsite, injuring 152 members of the public working at a Deepwater Horizon oil spill clean-up facility.<sup>118</sup> Though the CSB has not completed the Millard investigation, investigators have identified issues with the emergency notification system following the release that resulted in confusion when the shelter-in-place order was activated for areas far beyond the hazard zone.
- The CSB is currently investigating the April 17, 2013, ammonium nitrate fire and explosion at the West Fertilizer plant, in West, Texas, which claimed the lives of twelve firefighters who were not adequately trained on how best to respond to the fire at the plant.<sup>119</sup>

The CSB appreciates EPA's recognition that owners/operators of Program 2 and 3 facilities often claim to be "non-responding" and therefore exempt the emergency response program requirements specified at §68.95; however, these facilities often fail to properly coordinate with local emergency response authorities upon whom they would rely in the event of a significant release. Though we believe strongly that this problem can and should be addressed through better enforcement (which would likely require additional agency resources), we also support EPA's consideration of revision(s) to §68.90(b) which would:

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<sup>116</sup> See CSB Investigation Report, "E.I. DuPont de Nemours & Co., Inc. Belle, West Virginia." Report No. 2010-06-I-WV. September 2011. <http://www.csb.gov/assets/1/19/CSB%20Final%20Report.pdf>.

<sup>117</sup> Additional information is available at: <http://www.csb.gov/millard-refrigerated-services-ammonia-release/>.

<sup>118</sup> The Deepwater Horizon Cleanup efforts were subsequent to the April 20, 2010 explosion and fire at on the Macondo oil rig located approximately 50 miles southeast of Venice, Louisiana. The accident resulted in the deaths of 11 workers and caused a massive oil spill into the Gulf of Mexico. The CSB is completing its investigation of this incident and released the first two volumes of its report in June 2014. See <http://www.csb.gov/macondo-blowout-and-explosion/>.

<sup>119</sup> Additional information is available at: <http://www.csb.gov/west-fertilizer-explosion-and-fire/>.

- State explicitly that this exemption may only be used where local emergency responders are both capable (i.e., have sufficient equipment, expertise, and staffing) and willing to respond to releases of regulated substances at the facility. This section should make clear that where local responders are not capable or unwilling to respond to a release at a facility, the owner or operator of the facility is required to provide for an effective response. This may be achieved by complying with the emergency response program requirements specified in §68.95, hiring response contractors, developing a mutual aid agreement with nearby facilities, or other equivalent means.
- Specify minimum requirements for the information “non-responding” owners or operators must provide to local responding authorities to aid in the development of community emergency response plans and indicate the frequency and/or circumstances (e.g., new processes, significant process changes) that require submission of new or updated information. This should include periodic conduct of emergency response drills/exercises with local responding authorities to identify planning gaps and other potential areas of improvement.

The CSB also supports EPA’s consideration of revisions to the emergency response program requirements in §68.95 to require internal emergency response drills/exercises to identify planning gaps and other potential areas of improvement. We would encourage EPA to require facilities to keep records pertaining to these drills and to document the lessons learned and corrective actions taken.

### **3. Automated Detection and Monitoring for Releases of Regulated Substances**

*a.1 Should facilities be required to install monitoring equipment or sensors to detect releases of RMP regulated substances, or the conditions that could lead to such a release?*

Yes. CSB encourages EPA to require monitoring equipment and sensors to detect releases of RMP regulated substances and to monitor process conditions that could lead to a release or other process upsets, such as a pressure surge or rapid, unanticipated temperature spikes. As a first step, EPA, OSHA and all interested stakeholders should work to develop reasonable requirements for high hazard facilities such as refineries<sup>120</sup> and Program 3 facilities that pose the highest risks to workers and surrounding communities.

At a minimum, any requirement should provide for an adequate fence line network to provide continuous, real time data on certain hazardous emissions.<sup>121</sup> Information from such a fence line system should be available through a public web site. Several such systems have already

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<sup>120</sup> The CSB has documented and reported on a considerable problem with significant and deadly incidents at petroleum refineries over the last decade. See e.g., CSB *Chevron Draft Regulatory Report*, May 2014, p.11 (hereafter “*CSB Chevron Draft Regulatory Report*”).

[http://www.csb.gov/assets/1/19/Chevron\\_Regulatory\\_Report\\_06272014.pdf](http://www.csb.gov/assets/1/19/Chevron_Regulatory_Report_06272014.pdf). (Accessed October 27, 2014). In its recent proposed rule concerning refineries, EPA counted a total of 142 U.S. Refineries.

<sup>121</sup> In the RFI, EPA noted a concern that “automated detection and monitoring technologies may not be available for particular chemical hazards.” While the CSB has not attempted to document all potential hazards and available monitoring technologies, it notes that, as with other technology, there has been rapid progress in developing a broad range of sensors for a variety of chemical hazards in the past few years alone. CSB suggests that EPA consider a supplemental request for information asking for comments concerning any chemical hazards for which there is no off the shelf monitoring solution.

been in operation at several refineries<sup>122</sup> and public pressure for such systems by fence line communities continues.

Further, EPA has already committed to this approach in its enforcement program and has already proposed a form of fence line monitoring in its current proposal to amend its refinery NESHAP rule.<sup>123</sup> An amendment to the RMP to require real time fence line monitoring is consistent with ongoing EPA prevention,<sup>124</sup> enforcement,<sup>125</sup> emission control,<sup>126</sup> environmental justice,<sup>127</sup> geospatial mapping,<sup>128</sup> and advanced air monitoring technology initiatives.<sup>129</sup> Such a requirement would also support a number of goals outlined in the recently issued interagency report, *Executive Order 13650 Actions to Improve Chemical Safety and Security-a Shared Commitment* (May 2014) (hereafter “E.O. 13650 Report”).<sup>130</sup>

A number of CSB investigations have illustrated the importance of tracking and analyzing pertinent process safety performance indicators, including fugitive emissions (accidental releases) and other process anomalies.<sup>131</sup> The CSB conducted a conference on process safety indicators in 2012 and a number of speakers presented useful insights and papers on the use of indicators.<sup>132</sup> The significance of pertinent process safety performance indicators has been

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<sup>122</sup> Publicly accessible fence line monitoring information is available for at least three U.S., Phillips Rodeo Refinery (<http://www.fenceline.org/rodeo/data.php>), Chevron’s Richmond California refinery (<http://www.fenceline.org/richmond/data.php>), and for BP’s Whiting Indiana facility <http://raqis.radian.com/pls/raqis/bpw.whiting>. Fenceline monitoring with a public web site is also planned for a fourth U.S. refinery. See *U.S. v. Deer Park Refining*, 4:13-cv-02009, U.S. District Court for the Southern District of Texas, Document 2-1, filed 07/10/13 (requiring fence line monitoring at Shell’s Deer Park Refinery in Texas).

<sup>123</sup> *Petroleum Refinery Sector Risk and Technology Review and New Source Performance Standards* (Proposed Rule), *Federal Register* / Vol. 79, No. 125 / Monday, June 30, 2014.

<sup>124</sup> EPA “believes providing actual emissions data to communities living close to refining facilities will serve as a deterrent to serious noncompliance.” *EPA IG report on National Petroleum Refinery Initiative*, 2014.

<sup>125</sup> U.S. Environmental Protection Agency, *Office of Inspector General, EPA Needs to Demonstrate Whether It Has Achieved the Goals It Set Under the National Petroleum Refinery Initiative*, Report No. 14-P-0184 April 15, 2014, at 6-7, 20.

<sup>126</sup> “Petroleum Refinery Sector Risk and Technology Review and New Source Performance Standards,” *Federal Register*, Vol. 79, No. 125, Monday, June 30, 2014 (“Historically, improved information has often led to emission reductions.”)

<sup>127</sup> The population living within 50 km of 142 U.S. petroleum refineries has a higher percentage of minority, lower income and lower education persons when compared to the nationwide percentages of those groups. Proposed Rule, 79 FR at 36938; See also EC/R Incorporated, *Risk and Technology Review -Analysis of Socio-Economic Factors for Populations Living Near Petroleum Refineries*, January 6, 2014. (Prepared for EPA under Contract No. EP-W-12-011).

<sup>128</sup> <http://www.epa.gov/geospatial/about.html>.

<sup>129</sup> E.G. Snyder *et al.*, “The Changing Paradigm of Air Pollution Monitoring,” *Environmental Science and Technology*, August 27, 2013, Vol. 47, pp. 11369-1137. See also Wayland, Richard A., *Monitoring, Modeling & Emissions Inventory Update*, U.S. EPA Office of Air Quality Planning & Standards, Association of Air Pollution Control Agencies September 11, 2014.

<sup>130</sup> The E.O. 13650 Report focuses in part on strengthening community planning and preparedness. The report reflected broad stakeholder concerns that there was insufficient facility information available to the public. See e.g., E.O. 13650 Report at 93-94.

<sup>131</sup> See e.g. CSB’s BP Texas City, Bayer, and Dupont Belle Reports all available at [www.csb.gov](http://www.csb.gov).

<sup>132</sup> See <http://www.csb.gov/events/csb-public-hearing-safety-performance-indicators>.

recognized by many safety authorities, including among others, the API,<sup>133</sup> CCPS,<sup>134</sup> the U.K.'s HSE,<sup>135</sup> and the Norway's Petroleum Safety Authority.<sup>136</sup>

Ongoing advances in sensor technology, wireless communications, and data analysis since 2012 have created a unique opportunity to capture a variety of indicators in real time that can be analyzed in the short term for corrective actions and over the longer term to analyze trends that could point to trouble. An active monitoring system for toxic releases could dramatically improve the ability to use such releases as a key process safety indicator to analyze the cause of the accident (lagging indicator) and more importantly, in the case of smaller releases, as a leading indicator which can be studied to spot problems before they become catastrophic.

Unfortunately, the CSB has noted that "in virtually every incident it investigates in the U.S., process safety indicators are either not used at all or not used effectively."<sup>137</sup> Similarly, the *E.O. 13650 Report* indicates that some facilities do not adequately collect or share important process safety information including information on accidental releases.<sup>138</sup>

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CSB has perhaps a unique insight into this issue. Since it commenced operations in 1998, the CSB has conducted dozens of investigations and issued hundreds of recommendations to address a number of chemical disasters. A number of CSB investigations have illustrated the importance of tracking and analyzing pertinent process safety indicators, including fugitive emissions and process anomalies.

To cite just one example, the failure to ensure that pertinent information from sensors was collected and analyzed at Dupont's Belle West Virginia plant contributed to three serious incidents on January 22 and 23, 2010, involving three RMP covered substances- methyl chloride,<sup>139</sup> oleum,<sup>140</sup> and phosgene.<sup>141 142</sup> The Dupont facility lacked sensors to detect methyl chloride in the area where the methyl chloride release occurred. As a result, plant personnel did not detect the release for approximately five days.<sup>143</sup> DuPont estimated that between January 17 and 22, 2010, 2,045 pounds of methyl chloride; 25 pounds of hydrogen chloride; and trace

<sup>133</sup> API RP-754, *Process Safety Performance Indicators for the Refining & Petrochemical Industries*. *Ibid.*

<sup>134</sup> See Center for Chemical Process Safety (CCPS), *Guidelines for Process Safety Metrics*, October 2009 at 109.

<sup>135</sup> On the UK outer continental shelf, operators are required to report the uncontrolled release of a hazardous substance. See also, HSE. *Developing process safety indicators: A step-by-step guide for chemical and major hazard industries*; 2006. <http://www.hse.gov.uk/pubns/books/hsg254.htm> (accessed October 26, 2014).

<sup>136</sup> The Norwegian Petroleum Safety Authority has published a number of reports on the topic. <http://www.psa.no/list-of-reports/category913.html>.

<sup>137</sup> See CSB's Chevron Draft Regulatory Report at 59.

<sup>138</sup> E.O. 16350 report at vii.

<sup>139</sup> Methyl chloride is extremely flammable, has a potent narcotic effect and is listed as a Group 3 carcinogen by the International Agency for Research on Cancer (IARC).

<sup>140</sup> Oleum or fuming sulfuric acid is a solution of various compositions of sulfur trioxide in sulfuric acid, or sometimes more specifically to disulfuric acid (also known as pyrosulfuric acid).

<sup>141</sup> Phosgene is a highly toxic chemical compound produced by chlorine and carbon monoxide. Phosgene is acutely toxic through inhalation and was used as a chemical warfare agent in WWI. Phosgene is used in the production of pesticides, plastics and other industrial chemicals

<sup>142</sup> See CSB Investigation Report, E.I. DuPont de Nemours & Co., Inc. Belle, West Virginia, (hereafter "*Dupont Belle Report*") accessible at [www.csb.gov/dupont-corporation-toxic-chemical-releases/](http://www.csb.gov/dupont-corporation-toxic-chemical-releases/).

<sup>143</sup> On the fifth day, the methyl chloride vapors interfered with the chemical sensor configured to detect ethylchloroformate (ECF), which finally alerted plant personnel of the problem. *DuPont Belle Report* at 22.

amounts of DMA were released to the atmosphere.<sup>144</sup> Because there were no sensors, there was no data from which to determine the concentration of chemicals released to the atmosphere. Similarly, there was insufficient data to determine whether the chemicals entered the community in sufficient concentrations to result in adverse health impacts.

Had methyl chloride monitors been present, the release could have been promptly identified and addressed. If monitoring information had been recorded, a more accurate estimate of chemical concentration would have provided data about when the release started and the potential for offsite impact.

Fence line phosgene monitors were in place at the facility and did capture pertinent data during the release that occurred the next day.<sup>145</sup> However, the information regarding the potential for an offsite release was not made available in a timely manner to first responders or to community emergency response officials.<sup>146</sup>

*a.2 Should the systems provide for continuous detection and monitoring?*

Yes. The preventative value of a monitoring system would be greatly diminished if it did not provide for continuous monitoring because insufficient data would be available to determine the significance of such releases. Similarly, there would be little value in terms of emergency response and community notification with a system that did not provide for continuous detection and monitoring. For example, early detection allows for a number of critical countermeasures including the activation of local and remote alarms, isolation of process fluids by automatically closing valves or initiating additional emergency response services.

The CSB examined three air monitoring systems which post real time fence line data to a web site.<sup>147</sup> All three systems provide continuous detection and monitoring.<sup>148</sup>

*a.3 How should any such requirements be crafted to provide appropriate site-specific flexibility?*

EPA should establish minimum requirements for such systems but allow for site specific flexibility depending on the chemicals involved and the location of the facility in relation to population centers and ecologically sensitive areas.<sup>149</sup> Ideally, any such requirement will address the government and public need for information relevant to worker and public safety,

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<sup>144</sup> *Id.* at 29.

<sup>145</sup> CSB Dupont Belle Report at 56.

<sup>146</sup> CSB Dupont Belle Report at 59.

<sup>147</sup> Publicly accessible fence line monitoring information is available for at least three U.S., Phillips Rodeo Refinery (<http://www.fenceline.org/rodeo/data.php>), Chevron's Richmond California refinery (<http://www.fenceline.org/richmond/data.php>), and for BP's Whiting Indiana facility <http://raqis.radian.com/pls/raqis/bpw.whiting>. Fence line monitoring with a public web site is also planned for a fourth U.S. refinery. See *U.S. v. Deer Park Refining*, 4:13-cv-02009, U.S. District Court for the Southern District of Texas, Document 2-1, filed 07/10/13 (requiring fence line monitoring at Shell's Deer Park Refinery in Texas).

<sup>148</sup> *Id.*

<sup>149</sup> A consent decree governs the installations and specifications of a fence line monitoring system for BP's Whiting Indiana Refinery. See *U.S. et al. v BP Products*, Civ. Act No. 2:12-cv-00207 (Northern District of Indiana) filed November 6, 2012, Appendix A, p. 277 (Hereafter BP Whiting Agreement). The consent decree provided BP with the flexibility to present a detailed monitoring plan consistent with the broad terms of the overall agreement.

emissions control, and security.<sup>150</sup> As noted above, an appropriate starting point for such a requirement would be to focus any requirement on high hazard facilities such as refineries and Program 3 RMP facilities. Any requirement should also take into account participation by the immediate community. For example, on its public monitoring web site for Whiting Indiana, BP acknowledges the assistance of local groups in helping to develop the system.<sup>151</sup>

*b. Are there specific issues that need to be considered for unmanned and/or remote facilities?*

Depending on the proximity to population centers and/or ecologically sensitive areas, EPA should determine the level of monitoring requirements appropriate to remote facilities based on the risks involved.

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*c. 1. Should an automated mechanism to notify, alert and warn the local responders and surrounding public of an incident be considered as part of any detection and monitoring system requirement?*

Yes. Based on previous investigations involving the release of RMP covered chemicals, the CSB suggests that automated notification systems should be part of a detection and monitoring system. Specifically, during the methyl chloride and phosgene releases at DuPont's Belle, West Virginia facility, localized monitors did not automatically trigger plant-wide or community notification, increasing risk to employees working outdoors on other units and the public.<sup>152</sup> Similarly, although the facility had three fence line monitors which detected phosgene, there was no automatic community notification system to ensure water traffic in the vicinity was aware of a toxic release.<sup>153</sup> The community surrounding DuPont was not timely notified of a potential phosgene release.<sup>154</sup> Emergency medical personnel were not informed of the phosgene release until they arrived onsite to care for the exposed worker.<sup>155</sup>

Similarly, the CSB's investigation of an explosion and fire at the Bayer CropScience facility revealed a number of emergency communications deficiencies.<sup>156</sup> The explosion and fire prompted a shelter-in-place due to a lack of information about the chemicals released at the time of the incident which impacted 40,000 residents.<sup>157</sup> Worse, the explosion took place within 80 feet of an aboveground storage tank of methyl isocyanate (MIC), the same chemical involved in the death of thousands of people in Bhopal, India in 1984, but there was no useful information provided by plant authorities regarding the constituents of the release.<sup>158</sup>

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<sup>150</sup> The *E.O. 13650 Report* and stakeholder input documented in that report appear to reflect a clear consensus that the government should harmonize a number of existing regulatory schemes which call for data from the regulated community. A well designed fence line monitoring system can capture information of importance to a number of federal safety and security rules which govern high risk facilities.

<sup>151</sup> <http://raqis.radian.com/pls/raqis/bpw.whiting>.

<sup>152</sup> *CSB Dupont Belle Report* at 60.

<sup>153</sup> *Id.* at 61.

<sup>154</sup> *Id.* at 59.

<sup>155</sup> *Id.*

<sup>156</sup> See CSB Investigation Report, "Pesticide Chemical Runaway Reaction; Pressure Vessel Explosion: Bayer CropScience, LP." *Ibid.*

<sup>157</sup> *Id.* at 47-48.

<sup>158</sup> *Id.*

In August 2010, the CSB deployed to an anhydrous ammonia release at the Millard Refrigerated Services facility in Theodore, AL.<sup>159</sup> The release of 32,000 lbs of ammonia from the roof of the facility exposed a Millard employee and over 150 members of the public working outside ¼-mile away. The facility did not have outdoor perimeter monitors to detect ammonia releases from rooftop equipment. The presence of these alarms could have assisted in a more timely notification to outdoor workers that could have initiated evacuation prior to the workers being fully engulfed in the toxic ammonia cloud. Over 150 outside contractors reported symptoms of ammonia exposure, including respiratory irritation and burning eyes. Of the 150 that reported symptoms, 32 were hospitalized.<sup>160</sup>

Accordingly, the EPA should establish minimum criteria based on a facility's storage of acutely hazardous chemicals and the proximity of offsite receptors such as residences, interstate highways, and schools, in order to determine how automated detection can best be incorporated into community emergency notification systems. This suggestion is consistent with the E.O. Working Group's commitment to "expand the public notification of incidents at local chemical facilities via the Integrated Public Alert and Warning System (IPAWS)."<sup>161</sup>

*c. 2 If so, how should the potential for false alarms be addressed within such a requirement?*

An alarm verification step should be established that would prompt an employee to review process information, conduct additional monitoring using a recently calibrated instrument, and/or if possible, a visual inspection of the area with the suspected release. Based on this information, the company can notify the emergency response community if the alarm is valid and the emergency response community or LEPC can initiate the appropriate notifications.

Recently, EPA entered into a consent decree with Dupont which addressed, in part, the issue of maintaining the reliability of equipment designed to detect hazardous releases.<sup>162</sup> The consent decree includes a number of terms that could be incorporated into a rule to address false alarm issues.<sup>163</sup> There is also a large body of research literature concerning safety and false alarms which EPA can consider in developing a proposed rule.

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*d.1 How can a requirement for automated detection and monitoring systems be best coordinated with the community emergency response plan?*

Such a requirement should include continuous fence line monitoring for RMP regulated substances available in real time to local first responders, the LEPC and the SERC. The information provided by automated detection and monitoring systems on the fence line should be available on a public web site.

In addition, facilities should develop a standard operating procedure for the appropriate notification of federal, state and local emergency responders in the event of a chemical release,

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<sup>159</sup> Additional information about the Millard investigation is available at: <http://www.csb.gov/millard-refrigerated-services-ammonia-release/>.

<sup>160</sup> Docket No. 11-0717, *Secretary of Labor v. Millard Refrigerated Services*. Occupational Safety and Health Review Commission [http://www.oshrc.gov/decisions/pdf\\_2012/11-0717.pdf](http://www.oshrc.gov/decisions/pdf_2012/11-0717.pdf).

<sup>161</sup> *E.O. 13650 Report* at 19.

<sup>162</sup> See *U.S. v E.I. Dupont de Neumours and Co.*, Civil Action. No. 2:14-cv-24143, U.S. District Court for the Southern District of West Virginia, [Proposed Consent Decree filed on August 27, 2014 Doc. No. 3 and 3-1 (hereafter "Dupont Consent Decree") and Unopposed Motion to Enter Dupont Consent Decree filed on October 17, 2014].

<sup>163</sup> See *Dupont Consent Decree* at 7.

fire or explosion, and share information promptly with LEPCs and SERCs in addition to providing notification for EHS substances exceeding the reportable quantity as required by EPCRA. The procedures should include contact information and should be updated on a regular basis to ensure accuracy. In addition, training exercises should be regularly conducted with local emergency responders.

*d.2 What are the advantages/disadvantages between continuous monitoring conducted by automated systems in contrast to third-party alarm agencies?*

In terms of the community emergency response, a continuous fence line monitoring system which provides real time web-accessible information to first responders and to the community is the quickest way to transmit critical information to those impacted by a potentially catastrophic release. A consistent theme in the recent *E.O. 13650 Report* was that critical information was not shared in a consistent and timely manner with first responders, emergency planners, or the public.<sup>164</sup> CSB investigations confirm the concern about prompt notification to emergency response authorities. For example, the CSB report on an incident at the Dupont Belle facility in West Virginia determined that Kanawha County Metro 9-1-1 was not informed of the methyl chloride release until 9 hours after its discovery by plant personnel.<sup>165</sup> Accordingly, the CSB suggests that continuous monitoring conducted by automated systems is preferable to filtering information through third party alarm agencies.

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*e. How would a requirement for appropriate detection thresholds be best established for activating alarms and/or alerts?*

The CSB suggests EPA establish risk-based criteria to set appropriate detection thresholds for activating local and/or community alarms.<sup>166</sup> This suggestion is consistent with the E.O. 16350 working group's commitment to "using acute exposure guidelines to recalculate RMP reporting thresholds."<sup>167</sup>

While it is important to set an appropriate detection threshold for purposes of triggering an alarm, the EPA should also require that monitors, to the extent feasible, gather data on actual chemical concentrations once an appropriate alarm threshold is surpassed. In several investigations, CSB has noted that sensors in the vicinity of a release were set to detect chemical concentrations only up to a minimal range that was well below the capabilities of the detector.

For example, CSB determined that of phosgene monitoring devices at DuPont's Belle, West Virginia facility were only programmed to detect readings up to 1 part-per-million (ppm) even though the detector had a broader range. With a preset monitor range of 0 to 1 ppm phosgene, plant personnel had no information available on the actual concentration of phosgene beyond 1

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<sup>164</sup> *E.O. 13650 Report* at 24.

<sup>165</sup> *Dupont Belle Report* at 29.

<sup>166</sup> As discussed in Section D9 below, the CSB supports the EPA switching to Acute Exposure Guideline Levels (AEGLs) developed by the National Research Council to recalculate RMP thresholds and toxic endpoints for offsite consequence analysis for use in predicting the potential adverse effects of an accidental release upon a community. The CSB also supports using the American Industrial Hygiene Association's Emergency Response Planning Guideline (ERPG) where no AEGL has been developed and, in turn, the use of the National Institute of Occupational Safety and Health's Immediately Dangerous to Life or Health (IDLH) value if there is no ERPG.

<sup>167</sup> *E.O. 13650 Report* at xvi.

ppm. The collection of additional data once the alert threshold had been reached would have provided information important to other plant personnel and emergency responders.

Similarly, the CSB investigation of a 2010 ammonia release at Millard Refrigerated Services in Theodore, Alabama, concluded that monitoring equipment in the freezer containing leaked anhydrous ammonia recorded 200 ppm but did not record levels beyond that. Later that day, industrial hygiene technicians sampled readings over 7,000 ppm.

A particularly important area of concern is fence line monitors. Of course, such monitors should trigger an alarm at a low enough limit to provide members of the public time to evacuate from the immediate area or shelter-in-place before experiencing adverse effects. However, such monitors should continue to collecting actual concentration levels after the alert limit has been reached. This information is important in terms of assessing the extent of the release and the duration of an evacuation or shelter-in-place order as well as other emergency response actions to prevent employee or public exposures.

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*f. How would the significance and appropriate protective response action of the alarms/alerts be best communicated to responders and the public (including shelter-in-place and evacuations)?*

Under current RMP requirements, facilities are required to provide information to LEPCs on the types of materials stored and handled and what the potential impacts would be to the surrounding community in a release scenario. Based on the characteristics of site-specific chemicals and consideration of prevailing winds and public receptors, the method of communication may vary site-to-site. Local emergency response officials and LEPCs should be directly notified of a possible release so resources are in place to assist in a community response if the facility verifies the release. Shelter-in-place or evacuation notifications should be made through the Integrated Public Alert and Warning System (IPAWS)<sup>168</sup> or by phone, radio, TV, cell-phone messages through the established local emergency broadcast system.

On the night of the Bayer CropScience incident, little information was known about the chemicals being released during the explosion and fire.<sup>169</sup> The incident commander claimed that all chemicals were being consumed in the fire; however the emergency response community had no additional information to verify that the community was safe.<sup>170</sup>

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*g. What involvement should LEPCs and SERCs have in the development of the emergency response plan, particularly with respect to what actions are to be taken in the event of an incident where an alarm/alert is activated?*

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<sup>168</sup> <https://www.fema.gov/integrated-public-alert-warning-system>: "Federal, State, territorial, tribal and local alerting authorities can use IPAWS and integrate local systems that use Common Alerting Protocol standards with the IPAWS infrastructure. IPAWS provides public safety officials with an effective way to alert and warn the public about serious emergencies using the Emergency Alert System (EAS), Wireless Emergency Alerts (WEA), the National Oceanic and Atmospheric Administration (NOAA) Weather Radio, and other public alerting systems from a single interface."

<sup>169</sup> See CSB Investigation Report, "Pesticide Chemical Runaway Reaction; Pressure Vessel Explosion: Bayer CropScience, LP." *Ibid.*, at 8, 45, 47 and 84.

<sup>170</sup> *Ibid* at 47- 48.

For purposes of this question, the CSB assumes that EPA is referring to a facility's obligation to prepare an emergency response plan pursuant to 40 C.F.R. § 68.95.<sup>171</sup> LEPCs and SERCs should be able to work with the facilities to ensure facility emergency response plans provide for prompt notification to emergency response authorities in the event that a hazardous chemical release triggers an alarm indicating that chemicals have travelled or may travel beyond the facility's fence line and into the community. EPA recently entered into a consent decree with Dupont concerning the releases at its facility in Belle, West Virginia. A number of provisions in the consent decree could be used by EPA in a revision to the RMP to ensure appropriate notification to local emergency response officials.<sup>172</sup>

The EPA should also take steps to build-up the technical capacity and competence of LEPCs and SERCs to enhance the usefulness of the readings of fence line monitors in terms of both emergency planning and longer term impact in relation to Clean Air Act standards.

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*h. 1 How frequently should monitoring equipment or sensors to detect releases of RMP-regulated substances be tested?*

At a minimum, monitoring equipment should be tested and calibrated at set intervals as suggested by the manufacturer. Depending on the chemical involved, more frequent testing may be appropriate to ensure the reliability of equipment, proper calibration, and the ability of workers and management to process and communicate critical information in the event of an emergency. The BP Whiting Indiana Refinery system states that "each analyzer is tested daily to verify that it is able to measure the desired compound with precision and accuracy."<sup>173</sup>

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CSB investigative findings underscore the importance of regularized testing of monitoring equipment. On August 28, 2008, an explosion and fire at a pesticide production unit at the Bayer CropScience facility killed two workers.<sup>174</sup> The explosion took place within 70 feet of an aboveground storage tank of methyl isocyanate (MIC), the chemical released in Bhopal India in 1984.<sup>175</sup>

The Bayer facility had 16 localized monitoring devices for MIC that would activate alarms if concentrations exceeded 1 ppm.<sup>176</sup> Three months prior to the explosion, the monitors were turned off due to a malfunction and the issue was not resolved.<sup>177</sup> On the night of the incident, the personnel in the Bayer emergency operations center were unaware that the MIC monitoring system was not active and assumed no MIC or other detectable chemicals were escaping into the air.<sup>178</sup> There was no program in place to ensure the monitors were functioning prior to the startup of the process before the explosion and verifying the functionality of the monitors was not specifically listed in the pre-start-up safety review<sup>179</sup> Had the monitors been functioning on

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<sup>171</sup> See also 40 C.F.R. §68.180 (addressing emergency response program requirements in a facility risk management plan.)

<sup>172</sup> Dupont Consent Decree at pages 7-10 (i.e., paragraph 14 of the consent decree provides in part:

<sup>173</sup> <http://raqis.radian.com/pls/raqis/bpw.whiting> (accessed October 27, 2014).

<sup>174</sup> See CSB Investigation Report, "Pesticide Chemical Runaway Reaction; Pressure Vessel Explosion: Bayer CropScience, LP." *Ibid.* at 2-3.

<sup>175</sup> *Id.* at 7.

<sup>176</sup> *Id.* at 49.

<sup>177</sup> *Id.* at 49-50.

<sup>178</sup> *Id.* at 50.

<sup>179</sup> *Id.*

the night of the incident, it is likely that more information would have been available to assist in the notification to the community.

Even though not only trace concentrations of MIC may have been released during the incident<sup>180</sup> concerns grew as the cloud of uncharacterized smoke from the combustion of toxic pesticide waste traveled across the Kanawha River into a neighboring community.<sup>181</sup> Had there been a release on the night of the incident, real-time monitoring and notification would have been vital to ensuring the safety of the surrounding community.

*h. 2. How should these tests be documented?*

EPA has entered into a number of consent decrees, some of which at least provide useful starting points for addressing this issue.<sup>182</sup>

*h. 3 How long should records of such tests be maintained?*

As data storage has become relatively inexpensive, the duration such records should be maintained should not present an issue in terms of cost. Accordingly, the CSB suggests that such records be maintained for as long as the system is in operation and then summarized and archived at set intervals to be determined by interested stakeholders.

*h.4 Should automated monitoring records for periods of normal operations be maintained, so that past records may serve as an aid in determining what may have gone wrong prior to an accident (e.g., a gradual increase in emissions)?*

Yes. This data should for the reasons suggested in the comment. The data will be critical in determining the cause of a specific incident. More importantly, such data represents a critical leading process safety indicator which can be tracked and analyzed to prevent accidents in the first place. For example, if a sensor array is in place to detect release of methyl chloride, minor periodic releases detected by the array would be a clear signal that there is an anomaly in the safety system designed to contain the methyl chloride within process equipment. Had this equipment existed at Dupont Belle in 2010, it may have resulted in earlier detection and notification of the methyl chloride release.

*h.5 Should EPA specify requirements in this area, or are these aspects of program implementation best left to the facility?*

EPA should set specific requirements for periodic testing of monitoring equipment as well as requirements for the percentage of time the system must be online and functioning.<sup>183</sup> However, these requirements may need to be somewhat flexible to account for the nature of the equipment of substance involved in the sensor system.

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*i. 1. Leak detection and repair programs are common under the CAA's routine emission programs. Can these programs be integrated with the accidental release prevention program to reduce accidental releases and to simplify requirements for stationary sources subject to both the RMP and these other programs?*

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<sup>180</sup> “[T]he liquid in the residue treater contained significant quantities of methomyl and MSAO products of decomposition and possibly some quantity of methyl isocyanate. MIC might have also been released from ruptured process piping and vent piping. *Id.* at 8.8.

<sup>181</sup> *Id.* At 75

<sup>182</sup> See e.g., *U.S. v BP Product North America*, Civil No. 2:12 CV 207, United States District Court for the District of Indiana, filed September 28, 2012. (Hereafter, “BP Whiting Consent Decree.”)

<sup>183</sup> See e.g., *BP Whiting Consent Decree*.

Yes. Leaks of hazardous substances are considered an important process safety indicator in terms of accidental release prevention. In this respect, data from sensors used to monitor routine emissions under various LDAR authorities represent critical information for purposes of the prevention of a catastrophic accidental release. As the RFI correctly notes:

Automated detection and monitoring systems can be used not only to assess the effectiveness of existing control measures, but also to provide early warning of system upsets which could be acted upon to prevent a more serious or catastrophic incident.

Accordingly, the CSB suggests that monitoring requirements under leak detection and accidental release prevention authorities should be closely integrated to meet the objectives of both programs and to simplify requirements for stationary sources subject to both the RMP and to routine emissions programs.

*i. 2. Are there jurisdictional issues that prevent integration?*

No. EPA has regulatory authority pursuant to its emissions program and under the accidental release program to require a stationary source to monitor the release of certain hazardous substances. CSB suggests that the EPA has the authority to harmonize these requirements to simplify requirements for stationary sources subject to both the RMP and to emissions programs.

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*j. What would be the economic impacts of specifying additional monitoring and detection requirements in the RMP?*

The CSB recognizes the complexity of this issue for all concerned, particularly the regulated entities who may need to bear considerable capital costs. Accordingly, the following comments represent very preliminary thoughts concerning this issue.

Off the shelf technology and software exists to provide for a very broad set of installation options. Certain advances in technology have driven down the cost and improved the reliability of industrial sensors, wireless communications, and data analysis software. There are now sensors available for a broad range of well-established chemical hazards at a reasonable cost in relation to the revenues of the companies or parent companies of refineries and Program 3 RMP facilities that are not small entities.

A general touchstone in considering these issues is EPA's recently issued economic impact analysis for proposed amendments to its refinery emissions rule.<sup>184</sup> That analysis suggests that modest monitoring requirements for refineries should not have adverse economic impacts even for small entities.<sup>185</sup> EPA estimated that the economic impacts of those amendments, which included certain monitoring requirements, would have an annualized cost impact of less than \$100 million dollars. Of that total, a small fraction of costs were related to fence line monitoring.<sup>186</sup>

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<sup>184</sup> See generally EPA Office of Air and Radiation and Office of Air Quality Planning Standards, *Economic Impact Analysis Petroleum Refineries Proposed Amendments to the National Emissions Standards for Hazardous Air Pollutants and New Source Performance Standards*, February 2014.

<sup>185</sup> *Id.*

<sup>186</sup> *Id.* at 3-7 to 3-10.

Further, as EPA has recognized in its proposed refinery rule, enhanced monitoring of fugitive emissions results in certain costs savings due to less lost product.<sup>187</sup> Through time, refineries may also lessen their risk profile and recoup certain expenses through insurance savings.

Finally, every modern high risk facility in the United States and around the world will be investing enormous amounts of money in the next decade on extensive sensor networks as what has been called the *internet of things* becomes a reality and necessity in the industrial sector.<sup>188</sup> Accordingly, the CSB suggests that a critical issue is not whether money will be invested on extensive sensor/monitoring networks but *on whether sensor networks will be utilized to obtain valuable process safety indicators and who will have access to the collected information*. The CSB suggests that EPA and OSHA ensure that the anticipated investment in this new infrastructure include the ability for the government to collect critical process safety data and for the facilities to share appropriate information to enhance the safety of nearby communities. With respect to data sharing, the CSB is not focused on data that may reveal confidential business information but rather common process safety indicators such as fugitive emissions.

Furthermore, EPA should consider as part of any analysis how an appropriate monitoring requirement for purposes of RMP could potentially result in some compliance savings by eliminating overlapping regulatory requirements that may be less effective than a comprehensive monitoring requirement.

To the extent any thorough cost benefit analysis reveals that such a system would impose an unreasonable cost on a regulated facility, EPA and other interested stakeholders should begin now to consider appropriate options to defray the initial cost of the capital outlay required to install such a system. Addressing that cost issue may be beyond the scope of any revision to the RMP but nevertheless all interested parties should begin a dialogue concerning any cost benefit issues.

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*k. Are there any special circumstances involving small entities that EPA should consider with respect to such monitoring and detection requirements?*

As noted above, any requirement for active monitoring would need to take into account appropriate site specific criteria, including proximity to population centers and ecologically sensitive areas. For example, a small refinery that is isolated from population centers or ecologically sensitive areas might only need limited monitoring, similar to the model proposed in EPA's current proposed refinery rule.<sup>189</sup> In contrast, a refinery that uses hydrofluoric acid (HF) as a catalyst in its alkylation process and has residential neighbors should have some form of active and reliable monitoring system to detect even small releases on a continuous basis both near the alkylation unit and on the fence line

Of course, EPA may also be required to conduct a small business impacts analysis. For the reasons cited above in comment j, the CSB suggests that certain important considerations be

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<sup>187</sup> "Petroleum Refinery Sector Risk and Technology Review and New Source Performance Standards," *Federal Register*, Vol. 79, No. 125, Monday, June 30, 2014 ("Historically, improved information has often led to emission reductions.")

<sup>188</sup> See e.g., Harbor Research. *IBM Oil and Gas Seminar*, December 2013 and PWC, *Sixth Annual Digital IQ Survey*, March 2014, <http://www.pwc.com/us/en/advisory/digital-iq-survey/assets/6th-annual-digital-iq.pdf> (accessed October 26, 2014).

<sup>189</sup> *Petroleum Refinery Sector Risk and Technology Review and New Source Performance Standards* (Proposed Rule), *Federal Register* / Vol. 79, No. 125 / Monday, June 30, 2014

taken into account in such any economic impact analysis. In support of its proposed amendment to its recently proposed refinery emissions rule, EPA conducted an economic impact analysis which included consideration of the economic impacts on 28 refineries which were considered small entities.<sup>190</sup> EPA determined that “the incremental compliance costs imposed on small refineries are not estimated to create significant impacts on a cost-to-sales ratio basis at the firm level.”<sup>191</sup> EPA concluded “that the cost impacts for the risk and technology reviews for existing MACT 1 and MACT 2 standards will not have a significant economic impact on a substantial number of small entities (SISNOSE).”<sup>192</sup> This analysis does not cover the entire population of facilities that are small entities and within the scope of the RMP of course. However, this recent analysis is a useful starting point.

#### **4. Additional Stationary Source Location Requirements**

The CSB encourages EPA to incorporate more explicit requirements for identifying, evaluating, and addressing facility siting during a process hazard analysis (per § 40 CFR 68.67(c)) to assess both offsite consequences and onsite receptors within that stationary source that may be impacted by chemical fire, explosion or release. For example, the PHA methodologies listed in the RMP are not easily adaptable to review either of these issues, and EPA should provide more guidance within the text of the regulation as to what methodologies should be utilized to evaluate address hazards that may impact both onsite workers and the community. The CSB has noted within several of its investigations that improper facility siting has contributed to significant injuries and deaths to onsite workers and members of the public in the surrounding community.

Significant incidents affecting onsite workers include the following:

- The October 13, 2002, explosion in a chemical distillation tower at the First Chemical Corporation in Pascagoula, Mississippi, knocked down three operators who were standing inside the unit control room, located only 50 feet away. All received cuts and abrasions from shattering glass, and one reported seeing a fireball move past the door. Several other buildings on site were also significantly damaged, including a nearby administration building.<sup>198</sup>
- The August 19, 2004, explosion in an ethylene oxide sterilization chamber at the Sterigenics facility in Ontario, California, resulted in four injuries and rendered the facility unusable. All injuries were caused by shattering glass in the control room, which was located 75 feet away.<sup>199</sup>
- The March 23, 2005, explosions and fires at the BP Texas City refinery killed fifteen workers and injured 180; most of the victims were located in and around temporary office trailers that had been sited near a blowdown drum and stack open to the atmosphere as part of ongoing turnaround activities in an adjacent site. Forty-four

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<sup>190</sup> EPA, Office of Air and Radiation Office of Air Quality Planning and Standards, *Economic Impact Analysis Petroleum Refineries Proposed Amendments to the National Emissions Standards for Hazardous Air Pollutants and New Source Performance Standards*. U.S. Environmental Protection Agency, February 2014, at 4-21 to 4-22.

<sup>191</sup> *Id.*

<sup>192</sup> *Id.*

<sup>198</sup> See CSB Investigation Report, “Explosion and Fire: First Chemical Corporation.” *Ibid.*

<sup>199</sup> See CSB Investigation Report, “Sterigenics: Ontario, California.” *Ibid.*

trailers were damaged; thirteen were totally destroyed. In addition, workers were injured in trailers located as far as 479 feet away from the release.<sup>200</sup>

- The May 4, 2009, explosion and fire at Veolia ES Technical Solutions, in West Carrollton, Ohio, damaged every structure on the site and injured four workers. The most severely injured workers were located in a lab/operations building located less than 30 feet from an operating unit. One worker in a control room was enveloped in a fireball and received first-degree burns; a second had his pelvis broken by falling personnel lockers.<sup>201</sup>
- The March 21, 2011, electric arc furnace explosion at the Carbide Industries facility in Louisville, Kentucky, broke the double-pane reinforced glass window of a control room located only 12 feet away from the furnace. Two workers were fatally burned.<sup>202</sup>

Significant incidents affecting surrounding communities include the following:

- During the early morning hours of November 22, 2006, a powerful explosion destroyed the CAI/Arnel ink and paint manufacturing facility in Danvers, Massachusetts. Scores of nearby homes and businesses were damaged, some beyond repair. A number of residents were hospitalized.<sup>203</sup>
- On December 7, 2009, a catastrophic rupture of a pressure vessel at the NDK Crystal facility in Belvidere, Illinois resulted in one public fatality and one public injury. A building fragment propelled by the force of the blast traveled across and interstate and killed a member of the public at a highway rest stop parking lot nearly 650 feet away. An 8600 pound vessel fragment traveled 435 feet and impacted a neighboring business, injuring one offsite worker and caused significant property damage.<sup>204</sup>
- On April 17, 2013, a fire and explosion of the West Fertilizer Company ammonium nitrate storage facility in West, Texas resulted in the death of 15 members of the public and emergency responders. Residences, businesses and schools in the town of West were severely damaged in the blast. Over the years, the population of West grew and residences, schools and businesses were built in close proximity to the West Fertilizer plant.

#### *Siting Criteria and Guidance for Stationary Sources*

In the recent investigations of the explosions at Veolia LLC and Carbide Industries, the CSB found that occupied areas, such as control rooms, locker rooms and laboratories were positioned dangerously close to highly hazardous processes. During those incidents, the proximity of those occupancies to the blast heavily contributed to the severity of worker injuries and fatalities. In the case of Veolia, the CSB found that no record existed of a PHA to evaluate the siting of the lab and operations building so close to the operating units. The CSB reviewed the CCPS *Guidelines for Evaluating Process Plant Buildings for External Explosions, Fires and*

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<sup>200</sup> See CSB Investigation Report, "Refinery Explosion and Fire: BP Texas City." *Ibid.*

<sup>201</sup> See CSB Case Study, "Explosion and Fire in West Carrollton, Ohio. Veolia Technical Solutions, LLC." *Ibid.*

<sup>202</sup> See CSB Case Study, "Carbide Industries, LLC, Louisville, KY Electric Arc Furnace Explosion." *Ibid.*

<sup>203</sup> See CSB Investigation Report, "Confined Vapor Cloud Explosion: CAI, Inc. and Arnel Company, Inc." Report No. 2007-03-I-MA. May 13, 2008. Available at:

<http://www.csb.gov/assets/1/19/CSBFinalReportCAIExplosion.pdf>.

<sup>204</sup> See CSB Case Study, "NDK, Crystal, Inc., Belvidere, IL High-Pressure Vessel Rupture." Report No. 2010-04-I-IL. November 14, 2013. Available at:

[http://www.csb.gov/assets/1/19/CSB\\_CaseStudy\\_NDK\\_1107\\_500PM.pdf](http://www.csb.gov/assets/1/19/CSB_CaseStudy_NDK_1107_500PM.pdf).

*Toxic Releases* and made a recommendation to CCPS based on the findings from the Veolia incident. CCPS reported to the CSB that it revised and issued a second edition of the guideline. The revised publication provides improved guidance for building siting analysis by calling for an examination of the inherent properties and quantities of chemicals to determine if there is an explosion, fire or toxic hazard. This information is then used with consideration of site conditions such as nearby congestion, confinement, and ignition sources to determine if there are any serious consequences to property and human health and safety. The CSB encourages EPA to consider the CCPS guidance, in addition to other referenced guidance in the RFI, such as API 752 and 753 to be incorporated into revised requirements for stationary source siting.

#### **7. Worse Case Release Scenario Quantity Requirements for Processes Involving Numerous Small Vessels Stored Together**

EPA is seeking information on whether to revise RMP to calculate worst case scenarios for processes involving numerous small containers stored together using the sum, subset or individual containers within a storage area. EPA also asked whether coverage would trigger more process safety controls and protective barriers to prevent a major incident from occurring. Based on two CSB investigations, the agency would conclude that had a worst case scenario been based on individual containers within one storage area of the process, this would have triggered additional safeguards that would have reduced the likelihood of a major incident from occurring.

The CSB investigated a major fire at the Praxair Distribution site in St. Louis, Missouri, which stored thousands of compressed gas cylinders that caught fire and launched exploding cylinders into the community, damaging residences and threatening harm to members of the public. This incident started with the ignition of one cylinder that vented gas during high temperatures and direct sunlight and spread to other cylinders. This resulted in a larger, uncontrolled fire and launched cylinders outside property lines and also triggered other fires in the neighboring community, causing severe property damage. The CSB also investigated a fire at the Environmental Quality Co. (EQ) hazardous waste facility in Apex, North Carolina on October 5, 2006. This fire destroyed the facility and led to the evacuation of thousands of residents, and shutdown access to certain roads and airspace above the facility. Eyewitnesses reported that a small fire originated in the hazardous waste bay that stored oxidizers. The fire quickly spread within minutes to other bays where flammable and toxic wastes, such as chlorine, were stored. Both investigations reflect that worst case scenarios can occur from just one or a handful of containers or vessels in a storage area.

The CSB noted that automatic fire protection such as suppression, detection, or fire barriers had not been installed at either facility. At Praxair, an employee was present to witness the initial fire, and firefighters arrived soon after the 9-1-1 call but were unable to approach the fire because of the intense heat and exploding cylinders. They instead directed a water stream towards the fire from a distance, established a five block perimeter, and evacuated residents. Similarly at EQ, a small fire was first observed by a citizen driving by, but by the time firefighters arrived soon after, the fire had already spread throughout the facility. Due to the lack of information available on the hazardous waste on site, the incident commander took a defensive posture and evacuated thousands of residents, shutdown roads and the airspace above the facility.

Had these facilities been required to develop a worst case scenario for smaller vessels, companies would be required to implement the necessary safeguards to prevent a smaller incident that may lead to a larger one. Examples of process safety controls that would have reduced the likelihood of either the Praxair or EQ incident from occurring, include deluge systems, fire barriers, and gas or smoke detectors, as noted in the CSB's investigation reports.

**8. Public Disclosure of Information To Promote Regulatory Compliance and Improve Community Understanding of Chemical Risks**

The CSB noted in its first report on the Chevron Richmond Refinery explosion and fire that occurred in August 2012 the important role of transparency between industry and the public in improving health and safety for the facility and the surrounding communities. Following the Chevron incident, various community organizations, worker representatives, regulators, and governmental bodies played a key role in driving transparency, accountability, and improved risk reduction during the decision-making process related to crude unit piping repairs. The CSB recommended to the California State Legislature to establish a multi-agency process safety regulatory program for all California petroleum refineries to further improve public accountability and transparency by establishing a system to report to the regulator methodologies, findings, conclusions, and corrective actions related to refinery mechanical integrity inspection and repair work arising from California petroleum refinery PHAs, turnarounds, and maintenance-related shutdowns.<sup>205</sup> This system would require reporting of information such as damage mechanism hazard reviews, establish procedures for greater workforce and public participation, and provide mechanisms for federal, state, and local agency operational coordination, sharing of data, and joint accident prevention activities. The exact recommendation language is as follows:

CSB Recommendation No. 2012-03-I-CA-R11:

*Establish a multi-agency process safety regulatory program for all California oil refineries to improve the public accountability, transparency, and performance of chemical accident prevention and mechanical integrity programs. This program shall:*

- 1. Establish a system to report to the regulator the recognized methodologies, findings, conclusions and corrective actions related to refinery mechanical integrity inspection and repair work arising from Process Hazard Analyses, California oil refinery turnarounds and maintenance-related shutdowns;*
- 2. Require reporting of information such as damage mechanism hazard reviews, notice of upcoming maintenance-related shutdowns, records related to proposed and completed mechanical integrity work lists, and the technical rationale for any delay in work proposed but not yet completed;*
- 3. Establish procedures for greater workforce and public participation including the public reporting of information; and*
- 4. Provide mechanisms for federal, state and local agency operational coordination, sharing of data (including safety indicator data), and joint accident prevention activities. The California Department of Industrial Relations will be designated as the lead state*

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<sup>205</sup> Under the existing federal and California state PSM standards, this information is not currently made publicly available.

*agency for establishing a repository of joint investigative and inspection data,  
coordinating the sharing of data and joint accident prevention activities.*

California is actively working to implement this recommendation. The CSB urges the EPA to examine this recommendation made to the state of California and to consider implementing a similar recommendation for its RMP regulation. The CSB welcomes further dialogue with the EPA on this matter.

#### **9. Threshold Quantities and Off-Site Consequence Analysis Endpoints for Regulated Substances Based on Acute Exposure Guideline Level Toxicity Values**

The CSB supports the EPA switching to Acute Exposure Guideline Levels (AEGLs) developed by the National Research Council (NRC) to recalculate RMP thresholds and toxic endpoints for offsite consequence analysis for use in predicting the potential adverse effects of an accidental release upon a community. The CSB also supports using the American Industrial Hygiene Association's (AIHA) Emergency Response Planning Guideline (ERPG) where no AEGL has been developed and, in turn, the use of the National Institute of Occupational Safety and Health's (NIOSH) Immediately Dangerous to Life or Health (IDLH) value if there is no ERPG.

As the AEGLs have been established using five different exposure periods (10 minutes, 30 minutes, 1 hour, 4 hours and 8 hours) and ERPG-2 values used for toxic endpoints represent an exposure period of 1 hour, the AEGL exposure period should therefore be equivalent. Moreover, special circumstances should not be made for small entities with respect to recalculating threshold quantities. The threshold quantity must be based on the hazard of the regulated substance being released, not the size of the business it is released from.

The last investigation in which the CSB comprehensively examined these issues was a flammable/toxic chemical release at MFG Chemical in Dalton, GA in 2004.<sup>206</sup> In that case, a runaway chemical reaction during the first large batch production of triallyl cyanurate released highly toxic and flammable allyl alcohol and toxic allyl chloride vapors into the nearby business/residential community forcing the evacuation of over 200 families from their homes. One worker sustained chemical burns and 154 people, including 15 police and ambulance personnel, required decontamination and treatment for chemical exposure. Five residents required overnight hospitalization for breathing difficulties. Although MFG Chemical failed to develop and file the required Risk Management Plan for its process, based on the dispersion modeling results of the release contracted by the CSB and locations of traceable 911 calls of residents adversely affected by it, the CSB determined that both the AEGL-2 and ERPG-2 values when used as toxic endpoints covered a majority of the residents affected by this release.<sup>207</sup>

RMP worst case scenarios are currently based on 10-minute or 60-minute release times. If the EPA adopts AEGL-2 values, four and eight hour exposure periods can also be potentially evaluated. Whether EPA should mandate additional release scenarios in RMP submissions for these time periods for particular regulated substances may be dependent on the type of release.

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<sup>206</sup> See CSB Investigation Report, "Toxic Chemical Vapor Cloud Release: MFG Chemical, Inc." *Ibid.*

<sup>207</sup> See Appendix B of CSB Investigation Report, "Toxic Chemical Vapor Cloud Release: MFG Chemical, Inc." *Ibid.*

For example, sudden ruptures or punctures of containers holding pressurized regulated substances may result in short duration releases while other failure scenarios, such as a runaway chemical reaction in a vessel, or a pipe leak from a long pipeline, may exceed the 60-minute release time. For example, in the MFG Chemical incident described above, the release time was calculated to be 74 minutes and the CSB determined that at the time the incident occurred both employer and fire department attempted mitigation efforts were largely ineffective. EPA should consider requiring additional scenarios for the longer AEGL exposure periods when the type of release is likely to exceed the currently mandated 10 or 60 minute release times.

### **11. The “Safety Case” Regulatory Model**

The CSB believes that there are attributes of more robust goal-setting regulatory approaches that could effectively augment existing regulation of petroleum refineries to prevent major accidents. Through investigation of the Chevron Richmond<sup>210</sup> and Tesoro Anacortes<sup>211</sup> refinery incidents the CSB identified existing regulatory regimes for onshore petroleum refineries in the United States and California:

- a. Rely on a safety and environmental management system framework that is primarily activity-based rather than goal-based risk reduction to as low as reasonably practicable (ALARP) or equivalent.
- b. Are static, unable to adapt to innovation and advances in the management of major hazard risks and technology.
- c. Place the burden on the regulator to verify compliance with the regulations rather than shifting the burden to industries by requiring duty holders to effectively manage the risks they create and also ensure regulator acceptance of their plans for controlling those risks.
- d. Do not effectively incorporate lessons learned from major accidents; nor do they have the regulatory authority to require duty holders to address newly-identified safety issues resulting from such incidents.
- e. Do not effectively collect or promote industry use of major accident performance indicators to drive industry to reduce risks to ALARP.
- f. Do not require the use or implementation of inherently safer systems analysis or hierarchy of controls.
- g. Do not effectively involve or empower the workforce in hazard analysis and prevention of major accidents.
- h. Do not provide the regulator with the authority to accept or reject a company’s hazard analysis, risk assessment, or proposed safeguards; and
- i. Do not employ the requisite number of regulator staff members with the technical skills, knowledge, and experience necessary to provide sufficient direct safety oversight of petroleum refineries.

Under the existing US regulatory systems, including the PSM standard and the U.S. Environmental Protection Agency (EPA) Risk Management Program (RMP), there is no requirement to reduce risks to ALARP. While the Clean Air Act (CAA) directed the EPA to

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<sup>210</sup> See CSB Interim Investigation Report, “Chevron Richmond Refinery Fire.” *Ibid.* The CSB’s investigation of this incident is ongoing. See <http://www.csb.gov/chevron-refinery-fire/>.

<sup>211</sup> See CSB Investigation Report, “Tesoro Anacortes Refinery: Catastrophic Rupture of Heat Exchanger.” *Ibid.*

promulgate the RMP regulations “to provide, *to the greatest extent practicable*, for the prevention and detection of accidental releases of regulated substances,” (emphasis added)<sup>212</sup> there is no RMP ALARP requirement or other risk reduction goal. Under both the PSM and RMP regulations, an employer must “control” hazards when conducting a PHA of a covered process. However, there is no requirement to address the effectiveness of the controls or to use the hierarchy of controls. Thus, a PHA can satisfy the regulatory requirements even though it might inadequately identify or control major hazards. Inadequate controls would typically only be identified upon failure—resulting in a regulatory regime that focuses on post-incident enforcement rather than ensuring effective control measures are in place to prevent potential major accidents. In addition, there is no requirement to submit PHAs to the regulator, and the regulator is not responsible for assessing the quality of the PHA or the effectiveness of proposed safeguards, resulting in a regulatory system that is often reactive and frequently becomes involved in examining the details of process safety programs only after a major process accident.

Mechanical integrity programs at both Tesoro and Chevron emphasized inspection strategies rather than the use of inherently safer design to control the damage mechanisms that ultimately caused the major process safety incidents. These inspections were unreliable and failed to prevent the incidents. Since the Richmond and Anacortes incidents, both Chevron and Tesoro have upgraded the materials of construction for the equipment that failed, using inherently safer design that significantly reduced the risk of the applicable damage mechanism hazards.

Both Tesoro and Chevron PHAs were ineffective in identifying the significant hazards of HTHA and sulfidation corrosion, respectively. Rather than performing rigorous analyses of damage mechanisms during the PHA process, both companies simply cited non-specific, judgment-based qualitative safeguards to reduce the risk of damage mechanisms. The effectiveness of these safeguards was neither evaluated nor documented; instead, the PHA merely listed general safeguards.

Neither the Washington nor the California process safety regulations were successful in preventing major process safety incidents. Neither set of regulations required damage mechanism hazard reviews, reduction of risk to ALARP, evaluation of effectiveness of controls, or use of the hierarchy of controls. In addition, there is no requirement to submit PHAs to the regulator, and the regulator is not responsible for assessing the quality of the PHA or the proposed safeguards.

Furthermore, neither Washington nor California required the use of inherently safer design to the greatest extent practicable. A regulatory system that contains more robust goal-setting attributes would help to ensure that all petroleum refineries rigorously apply process safety concepts that focus more effectively on prevention. Such a regulatory framework could also emphasize the implementation of inherently safer designs and the hierarchy of controls to prevent major process safety incidents.

At the completion of the Tesoro Anacortes refinery investigation, the CSB made recommendations to augment the existing process safety management regulatory framework with the more rigorous safety management attributes identified by the investigation for petroleum refineries in the state of Washington.

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<sup>212</sup> 42 USC §7412(r)(7)(B)(i) (1990).

The exact recommendation language is as follows:

CSB Recommendation No. 2010-08-I-WA-R5:

*Based on the findings in this report, augment your existing process safety management regulations for petroleum refineries in the state of Washington with the following more rigorous goal-setting attributes:*

- a. *A comprehensive process hazard analysis written by the company that includes:
  - i. *Systematic analysis and documentation of all major hazards and safeguards, using the hierarchy of controls to reduce those risks to as low as reasonably practicable (ALARP);*
  - ii. *Documentation of the recognized methodologies, rationale and conclusions used to claim that safeguards intended to control hazards will be effective;*
  - iii. *Documented damage mechanism hazard review conducted by a diverse team of qualified personnel. This review shall be an integral part of the Process Hazard Analysis cycle and shall be conducted on all PSM-covered process piping circuits and process equipment. The damage mechanism hazard review shall identify potential process damage mechanisms and consequences of failure, and shall ensure effective safeguards are in place to control hazards presented by those damage mechanisms. Require the analysis and incorporation of applicable industry best practices and inherently safer design to the greatest extent feasible into this review; and*
  - iv. *Documented use of inherently safer systems analysis and the hierarchy of controls to the greatest extent feasible in establishing safeguards for identified process hazards. The goal shall be to drive the risk of major accidents to As Low As Reasonably Practicable (ALARP). Include requirements for inherently safer systems analysis to be automatically triggered for all Management of Change and Process Hazard Analysis reviews, prior to the construction of new processes, process unit rebuilds, significant process repairs, and in the development of corrective actions from incident investigation recommendations.**
- b. *A thorough review of the comprehensive process hazard analysis by technically competent regulatory personnel;*
- c. *Required preventative audits and preventative inspections by the regulator;*
- d. *Require that all safety codes, standards, employer internal procedures and recognized and generally accepted good engineering practices (RAGAGEP) used in the implementation of the regulations contain adequate minimum requirements;*
- e. *Require an increased role for workers in management of process safety by establishing the rights and responsibilities of workers and their representatives on health and safety-related matters, and the election of safety representatives and establishment of safety committees (with equal representation between management and labor) to serve health and safety-related functions. The elected representatives should have a legally recognized role that goes beyond consultation in activities such as the development of the comprehensive process hazard analysis, management of change, incident investigation, audits, and identification and effective*

*control of hazards. The representatives should also have the authority to stop work that is perceived to be unsafe or that presents a serious hazard until the regulator intervenes to resolve the safety concern. Workforce participation practices should be documented by the company to the regulator; and*

*f. Requires reporting of information to the public to the greatest extent feasible such as a summary of the comprehensive process hazard analysis which includes a list of safeguards implemented and standards utilized to reduce risk, and process safety indicators that demonstrate the effectiveness of the safeguards and management systems.*

Washington Governor Jay Inslee has committed to reviewing federal, state, and industry best practices to identify opportunities to further reduce or eliminate hazards associated with the catastrophic release of highly hazardous chemicals for all work places covered under Washington's Process Safety Management of Highly Hazardous Chemicals rules. According to Governor Inslee in a letter to the CSB, "the goal would be to significantly reduce the likelihood that this level of tragedy happens again."

The CSB strongly encourages the EPA to use its authority under the Clean Air Act to promulgate new rules or guidance that enhance existing process safety regulations with attributes of more robust goal-setting regulatory approaches for covered facilities. The CSB welcomes further dialogue with the EPA on this matter.