NATIONAL STRIKE FORCE (NSF) RESPONSE CASE STUDY: HAZARDOUS MATERIALS RELEASE AT INTERCONTINENTAL TERMINAL COMPANY, DEER PARK, TEXAS

CDR Shaun Edwards
Commanding Officer
USCG Gulf Strike Team

LCDR Jessica Thornton
Executive Officer
USCG Gulf Strike Team

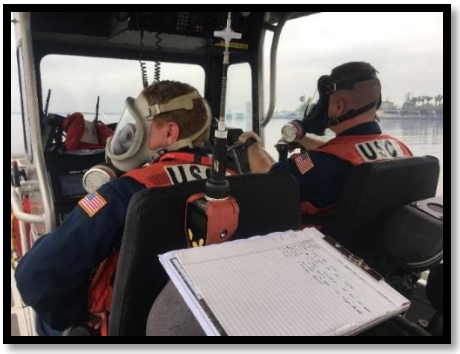
Mr. Kenneth "KP" Pounds
Industrial Hygienist
USCG Gulf Strike Team

ABSTRACT [#689421]

On March 17th, 2019 the Intercontinental Terminal Company (ITC) Deer Park, Texas river terminal and storage facility, comprised of 242 above ground storage tanks with a site capacity of 13.1 million barrels of hazardous products, experienced a tank fire. This incident would also become known as the "2nd 80s Fire" based on the identification of tanks impacted. The fire was contained to a single grouping of 15 tanks, with stored products including Naphtha, Toluene, Xylene, Benzene, Pyrolysis Gasoline, and Gasoline Blend stocks. Extended firefighting efforts resulted in volumes of water and firefighting foam that exceeded the capacity of the containment systems, resulting in the subsequent containment failure on March 22nd, which enabled the hazardous chemicals and mixture of various products to eventually reach the Houston Ship Channel. The surrounding industrial and residential communities experienced shelter-in-place orders due to the air quality concerns, and the vital waterway was shut down to commercial traffic.

On-water benzene levels exceeded 20 parts per million (ppm) during the initial phases of the response near the facility while many areas within five miles exceeded the Occupational Safety Health Agency (OSHA) Permissible Exposure Limit (PEL) for benzene exposures. Benzene remained the primary chemical hazard to response crews seeking to contain, remove, and reopen the waterways for more than two weeks past the initial chemical release events. An

interagency agreement was developed between the Environmental Protection Agency (EPA) and the U.S. Coast Guard (USCG) to assist in response activities, which included containing, collecting, recovering and disposing of the released materials from the shoreline and the surface water. The National Strike Force (NSF) deployed 52 personnel from each of the three Strike Teams, Public Information Assist Team (PIAT) and CG-Incident Management and Assistance Team (CG-IMAT). Due to the elevated presence of benzene, the NSF was the only USCG trained, experienced and qualified organic response resource prepared to respond to environmental threats with elevated concentrations of products that represented an inhalation hazard requiring respiratory protection devices. This paper demonstrates the significance of NSF's respiratory protection program, and how their capabilities can be used for both technical operations support, and also for site safety management, especially during complex spills or releases.



BMC Travis Rogers & MK1 Tal Hipps in APRs patrolling Houston Ship Channel in one of GST's 26' TAN-B smallboats. Photo taken by MST1 Brett Chmiel.

INTRODUCTION & BACKGROUND RESEARCH

We are often raised with age-old euphemisms that have lasted throughout the generations – catchphrases that our parents learned from their parents, who learned from their parents, and so-on. Phrases like, "learn from others' mistakes," and "every cloud has a silver lining" have been passed on to Baby Boomers and Generations, X, Y and Z alike. In a fortuitous turn of events, the U.S. government let those two euphemisms guide their environmental legislation achievements in the 1960s and 70s. To set the stage, it was a fateful day in March 1967 when the *SS Torrey Canyon*, considered a supertanker in her prime, was en route to Wales from Kuwait when she ran aground on the Seven Stones reef off the southwestern coast of England (Vaughan,

2017). After she let go of more than 30 million gallons of crude oil that impacted approximately 120 miles of rural southern England coastline, the UK was faced with immense pressure to solve one of their largest environmental disasters in its history (Wells, 2016; EPA, 2019).

But a silver lining was created; other governments wanted to learn how to be better prepared. In response to the *SS Torrey Canyon* disaster, the U.S. developed its initial version of the National Oil and Hazardous Substances Pollution Contingency Plan, also known as the National Contingency Plan (NCP), in 1968. The NCP would continue to be modified by Congress over the following years, and remains today as the U.S.'s framework for environmental threat contingencies, in addition to a few other key pieces of legislation, such as the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 and the Oil Pollution Act of 1990. One of the many great things born from a revision of the NCP was the creation of the USCG's NSF in 1973, a federally mandated "Special Team" created to support USCG and EPA pre-designated Federal On-Scene Coordinators (FOSCs), as well as the Department of Defense, in executing their authorities – a team that is capable of stabilizing and containing a pollution event, providing incident management, and contractor oversight during response operations.

The NSF is comprised of the National Strike Force Coordination Center (NSFCC; Elizabeth City, NC), Atlantic Strike Team (AST; Fort Dix, NJ), Gulf Strike Team (GST; Mobile, AL), Pacific Strike Team (PST; Novato, CA), CG-IMAT (Norfolk, VA), and the PIAT (Elizabeth City, NC). The mission of the NSF is to develop and maintain a cadre of highly trained professionals with specialized equipment and crisis leadership skills who can rapidly deploy to assist FOSCs and interagency Incident Commanders in preparing for and minimizing adverse impacts from oil discharges, hazardous materials releases, and Weapons of Mass Destruction

incidents. The NSF has grown and expanded as new federal legislation has been enacted, assuming a plethora of additional responsibilities during its 40-plus year history. Unique among USCG Deployable Specialized Forces (DSF), the NSF has numerous regulatory authorities outlining its mission and customer base. For example, under National Response Framework (NRF), the USCG is one of the primary agencies designated for coordinating a response to oil and hazardous substance incidents under Emergency Support Function (ESF) #10. The NSF is further listed as a resource in providing technical advice, assistance, and communication support for response action under ESF #10 activation throughout the U.S. The NSF is also listed as a federal resource to be utilized under activation of the NRF's Catastrophic Incident Annex as a result of national hazards, as well as Chemical, Biological, Radiological, Nuclear, and Explosive (CBRNE) incidents. Furthermore, the NSF is listed as a federal resource for decontamination during a response to a catastrophic incident.

The capabilities and support services that NSF teams train for are extensive. To name just a few, some of which will be expanded on in the following case study, include the ability to provide Incident Command System (ICS) and emergency management support, as well as deploy responders with Personal Protective Equipment (PPE) to safely assess, mitigate, control, and remove chemical, oil, and CBRN hazards. The Strike Teams have over 300 pieces of hazardous material and CBRN detection equipment, as well as hundreds of pieces of mitigation equipment, including boom, pumps, temporary storage devices, and skimming systems. Strike Teams are also considered a USCG Boat Forces unit and help ensure teams can provide a full, adaptive force package to meet any on-water crisis. The NSF's customer base can call with a problem, and the teams will be ready to respond to help mitigate whatever hazard they're facing. The following case study will showcase specific NSF response capabilities, especially as the only

organic USCG asset ready to respond during environmental threats with elevated concentrations of products that represent an inhalation hazard requiring respiratory protection devices. This case study will also demonstrate the value of unity of effort with federal, state, local and industry partners throughout the response and mitigating efforts.

Special Emphasis on Elevated Benzene during Response Efforts

The ITC Deer Park response event of March 2019 was unique in several ways. Not only were commercial activities impacted due to the elevated airborne concentrations of Volatile Organic Compounds (VOCs), specifically benzene, that surrounded the facility during response efforts, but shore-side and on-water mitigation efforts were also severely hampered due to hazardous atmospheres present. Special emphasis on safety and mitigation measures was applied throughout the response due to the elevated values of benzene detected, which remained at high levels during the emergent phase of the response. The human health hazards associated with benzene, thus it's classification as a known carcinogen through its cancer-causing outcomes, are well known and captured in numerous occupational and specific post emergency response case studies, and will remain an underlying theme of concern throughout this paper.

Adverse Health Effects from Benzene Exposure Research

Petroleum products are an important part of everyday life, and are necessary to fuel automobiles, power a myriad of appliances, heat homes, and make it possible for cargo ships to deliver commodities all over the world. Global demand brings with it the need to transport those petroleum products through numerous means - pipelines, trucks, and ships to name a few. With the lifecycle and transport of these products come inherent risks of spilled products in the global environment. Minor spills or hazardous materials releases happen throughout the world daily and

require minimal cleanup measures. However, a multitude of major pollution disasters such as the 1989 Exxon Valdez Oil Spill, Enbridge Pipeline Disaster and Deepwater Horizon (DWH) have plagued the United States over the past few decades. First responders from federal, state and local agencies, as well as private organizations, contractors, and volunteers, all face exposure risks and suffer associated side effects when they respond to all types of pollution events.

Specific components of oil have been found to be quite dangerous. Benzene, toluene, and xylene are VOCs that are considered to be some of the main components of crude oil, which are known to cause symptoms of respiratory and central nervous system (CNS) illnesses (Solomon and Janssen, 2010). Benzene, has been linked to increased risks of cancer, particularly leukemia, and has also been linked to causing DNA damage (Glass et al., 2003; Carugno et al., 2012). While benzene is a known leukemogen (causes Leukemia), toluene is a known teratogen (causes harm to a fetus). Other components of oil include toxic substances such as naphthalene, which is also a known carcinogen through its cancer causing outcomes in animals such as tumors and lung cancers (Solomon and Janssen, 2010). Benzene exposure is arguably one of the most chronically dangerous, and one of the most probable, present day hazardous threats that first responders and industry workers tied to the oil industry face frequently.

In 2003, authors Glass et al. published research conducted on leukemia risk associated with low-level benzene exposure, during which the authors sought to expand on research involving potential links between occupational benzene exposure and cancer. A case-control study was conducted within a previously existing cohort study of Australian petroleum industry workers that had a history of increased lymph-hematopoietic cancer to further identify the role occupational benzene exposure may have had in causing cancer (Glass et al., 2003). The research conducted showed that there was an increased risk of cancer, specifically leukemia, in workers

who had exposure of 2 ppm collectively in a year timeframe, or a one-time exposure of over 0.8 ppm (Glass et al., 2003). Evidence showed that the higher the exposure amount, the more increased risk of cancer, with a possible correlation found between an increased risk of cancer associated with higher short-term exposures when compared to the same cumulative amount of exposure spread out over time. The authors found evidence of a strong connection between both acute and chronic leukemia to occupational benzene exposure, and that general risk to leukemia was increased if cumulative exposures reached over 1 ppm/year (Glass et al., 2003).

In 2012, another study was done that built on the work of risks associated with occupational benzene exposure when authors Carugno et al. published their article *Increased Mitochondrial DNA Copy Number in Occupations Associated with Low-Dose Benzene Exposure*. By 2012, when the study was published, it was already well known that exposure of benzene was tied to an increased risk of leukemia. However, there has not been a lot of research done on biological dysfunctions from low-level benzene exposure (Carugno et al., 2012). The authors conducted a cross-sectional study of 341 individuals in occupations with low-level benzene exposure to find if there was a connection to DNA damage caused by exposure. Based on their study, Carugno et al. found that there was a direct link between those in occupations with low-level benzene exposure and increased DNA damage (Carugno et al., 2012).

Table 1 below condenses the findings from a review of 12 studies on the topic of general occupational exposure, and the success rate of PPE. The table portrays a snapshot of the most significant conclusions from the literature review on occupational exposure, and the importance of proper PPE. Of note, it's important to remember that during any response activities that require the use of respiratory protection, NSF team leads determine the appropriate levels and types of protection. During this response, NSF responders determined that use of "Level C" air

purifying respirators (APRs) in conjunction with the NIOSH approved P-100 filtration cartridges were to be utilized to help protect against VOCs, including benzene. These PPE ensembles met the "safe for entry" requirements into environments with elevated benzene concentrations. NSF requires that its responders follow a "Respirator Wear" protocol to ensure members are appropriately fit tested, and have the physical capabilities to employ APRs while in potentially hazardous working environments. The American Conference of Governmental Industrial Hygienist (ACGIH) eight hour work days' Time Weighted Average (TWA) is 0.5ppm, while the OSHA PEL is 1.0 ppm.

Table 1: Summary of Studies Reviewed

Authors (Year)	Title	Sample	Methods Used	Conclusions
Carugno et al. (2011)	Increased mitochondiral DNA copy number in occupations associated with low-dose benzene exposure	N = 341	Cross-sectional study	- Direct correlation between those in occupations with low-level benzene exposure and increased DNA damage/dysfunction
Farfel et al. (2008)	An overview of 9/11 experiences and respiratory and mental health conditions among World Trade Center health registry enrollees	N = 135,450	Multiple exposed populations after 9/11 within close proximity to WTC towers	- 67% of adults had increasing, or new symptoms of respiratory illnesses - 4.1% of enrollees included first responders who worked on the debris pile had newly diagnosed asthma
Farooqui et al. (n.d.)	Addressing the issue of compliance with personal protective equipment on construction worksites: A workers' perspective	N/A	Research regarding PPE use at construction sites	- Only only 64% of workers wear proper PPE - insufficient PPE use was due to lack of training, lack of supplies, not enforced, hindered ability to do the job, uncomfortable, too hot and inappropriate fit
Glass et al. (2003)	Leukemia risk associated with low-level benzene exposure	N = 79	Case-control study was conducted within a previously existing cohort study of Australian petroleum industry workers	- was an increased risk of cancer, specifically leukemia, in workers who had exposure of 2 parts per million (ppm) collectively in a year timeframe, or a one-time exposure of over 0.8 ppm - higher the exposure, the more increased risk of cancer - possible correlation between higher risk associated with higher short term exposures then prolonged exposure of the same amount - strong interrelation between both acute and chronic leukemia to occupational benzene exposure - general risk to leukemia was increased if cumulative exposures reached above one ppm/year
Jackson et al. (2004)	Protecting emergency responders, volume 3	N/A	Non-profit company coordinated research efforts with DHHS, CDC, and NIOSH	- covers recommendations, best practices and lessons learned for PPE use by first responders
King & Gibbins (2011)	Health hazard evaluation of deepwater horizon response workers	N/A	HHEs conducted at multiple DWH response sites after	- Evaluations and air monitoring reports showed exposure risk for individual substances below the OELs - mixed and pro-longed low-level exposures to crude oil, dispersant chemicals, volatile hydrocarbons, or cleaning

			hospitalization/exposure of 7 fisherman	agent chemicals, combined with heat stress exposure risks, compounded health risk concerns
Krstev et al. (2007)	Mortality among shipyard coast guard workers: A retrospective cohort study	N = 4,702	Retrospective cohort study	- Coast Guard shipyard workers had excess mortality death from all causes, respiratory and lung cancers, as well as emphysema and mesothelioma - those who were more likely to be exposed had increased occurrences of mesothelioma, likely from occupational asbestos exposure
Michaels & Howard (2012)	Review of the OSHA-NIOSH response to the deepwater horizon oil spill: Protecting the health and safety of cleanup workers	N/A	Provided a review of OSHA-NIOSH Response to DWH	- leaders in the DWH oil spill response effort were successful in ensuring workers were protected, but safety and health practices as well as information should be communicated clearly, immediately and with full disclosure
Rusiecki et al. (2009)	Mortality among United States Coast Guard marine inspectors: A follow up	N = 3,681	Follow-up comparison study based an 1970 cohort study	- Coast Guard inspectors and non-inspectors had significantly lower mortality rates than rest of the US population - exposure to chemicals for inspectors during marine inspections of commercial vessels may attribute to increased mortality rates compared to non-inspectors
Solomon & Janssen (2010)	Health effects of the Gulf oil spill	N/A	Oil exposure related health impacts to those exposed during DWH	- benzene, toluene, and xylene are VOCs cause symptoms of respiratory and CNS illnesses - Benzene is a leukemogen - 15% of the 1811 *Exxon Vladez* responders' compensation claims were for respiratory illnesses - 63% of 6,780 fisherman who worked as responders during oil spills had increased lower respiratory tract illnesses - *Prestige* cleanup workers that found significant DNA damage had resulted from the oil exposure
Weinhold (2010)	Emergency responder health: What have we learned from past disasters?	N/A	Responder exposure and health impacts from WTC attack, *Prestige* oil spill, *Exxon Valdez* oil spill, and DWH oil spill	- 6,500 WTC first responders had new or worsening respiratory illnesses - *Prestige* volunteers that did not receive instructions were less likely to use PPE, which led to increased illnesses (headaches, dizziness, vomiting, nausea, and respiratory illnesses) - Volunteers had elevated levels of metals in their blood and significant DNA damage, - 19% of responders who cleaned oiled birds had adverse health impacts - 1,000 DWH responders reported illnesses within the first two months - dangers of exposure to oil from its makeup of benzene, toluene, ethylbenzene, and xylene
Wilson et al. (2015)	A targeted health risk assessment following the deepwater horizon oil spill: Polycyclic aromatic hydrocarbon exposure in Vietnamese-American shrimp consumers	N/A	Shrimp analyzed for cancer risks through consumption of eating shrimp harvested from the Gulf	- found that there were no adverse health implications or additional risks of cancer from eating the analyzed shrimp, even for those who ate shrimp frequently

Interpretation of the Results

Of the 12 reports reviewed, 75% were related to potential health implications from occupational exposure, while the remaining 25% were related to PPE regulations. Of those

reports related to potential health implications, 50% of the studies concluded that there was a direct correlation between adverse health impacts and occupational exposure. Additionally, almost half of those reports confirmed that there were significant adverse health risks, such as increased risks of cancer or DNA damage, from occupational exposure to petroleum products. It was further found in the literature that benzene exposure increases risks of leukemia at much lower benzene exposure limits than previously thought. Evidence also shows that due to lack of proper instructions, policy indifference, as well as fit and comfort issues, that PPE is not always as effective as it could be. It was also found that in 50% of the studies reviewed that first responders were exposed to toxic substances from petroleum products either during oil spills or pollution clean-up efforts, in addition to increased occupational exposure risks for those who work in the petroleum industry.

CASE STUDY SUMMARY

At approximately 10:00 am on Sunday morning, March 17th, the ITC Deer Park facility outside of Houston, TX, began responding to reports that a storage tank full of Naphtha (a component of gasoline) had caught fire (Deerpark Emergency Services, 2019). The facility, which is comprised of 242 above-ground storage tanks, has a storage capacity of approximately 13.1 million barrels of hazardous products and chemicals. The initial fire that erupted on the 17th was contained to a single grouping of 15 tanks containing stored products including Naphtha, Toluene, Xylene, Benzene, Pyrolysis Gasoline and Gasoline Blend stocks. Multiple local officials and “Industrial Mutual Aid” first responders joined the firefighting efforts as the fire continued to spread, subsequently impacting seven tanks within the first 24 hours (Deerpark Emergency Services, 2019). First responders continued to attack the fire utilizing a water and firefighting foam mixture throughout the first few days, with as many as eight of the tanks

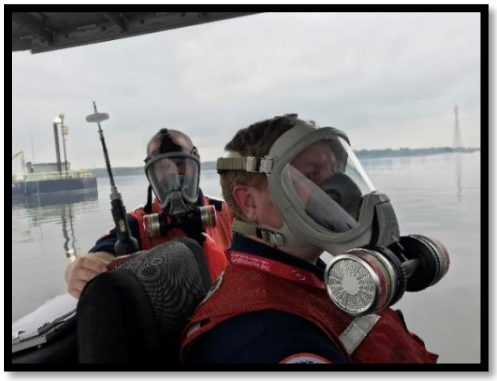
simultaneously burning by Tuesday, March 19th, eventually resulting in the collapse of two additional tanks (Deerpark Emergency Services, 2019).

Supplemental state and local resources, including neighboring state firefighting teams, descended on Deer Park to assist. The initial fire was extinguished by March 20th, with crews continuing to spray firefighting foam to prevent re-ignition, along with vapor suppression efforts, throughout the week. Despite their best efforts to keep the fire suppressed, there were several re-flashes throughout the week that required additional firefighting efforts, which also increased the dynamics of the overall response. By March 21st, a temporary "Shelter-in-Place" for residents near the ITC Deer Park site was issued due to elevated levels of benzene readings that had been identified during environmental air monitoring activities (Deerpark Emergency Services, 2019). By the 21st, the Unified Command grew to include the Responsible Party (ITC), EPA Region VI, City of Deer Park, Texas Commission on Environmental Quality (TCEQ), and the USCG (Deerpark Emergency Services, 2019). Approximately 3,000 feet of containment and sorbent boom were deployed at critical points in the Tucker and Buffalo Bayous and the Houston Ship Channel, in addition to the exclusionary boom placed around the Battleship Texas and the entrance to Santa Ana Bayou (Deerpark Emergency Services, 2019).

Unfortunately, the situation took a turn for the worse by the end of the week when a dike wall containing the combined products released from the tanks, as well as the firefighting foam and water mixtures, resulting in the hazmat release into the adjacent tributaries and waterways. Extended firefighting efforts resulted in volumes of water and foam exceeding the design capacity of the tank farm's containment systems, which enabled the hazardous chemicals and mixture products to reach the Houston shipping lanes in Deer Park. An additional shelter in place order was issued due to the air quality while the vital waterway was shut down to commercial

traffic. On-water benzene detection levels exceeded 20 ppm during the initial phases of the response near the facility while many areas within five miles exceeded the OSHA PEL of 1 ppm for benzene exposures. In addition to the breach, multiple tanks at ITC also re-ignited but firefighting efforts were able to quickly extinguish the fire in the afternoon of March 22nd. By March 24th, over 27,000 feet of boom was deployed resulting in the bulk of the released products being successfully contained within the Tucker Bayou area. There were also at least 34 vessels and 15 skimmers on scene conducting clean-up operations in the area, including two of the NSF 26' response small boats (Deerpark Emergency Services, 2019).

On March 26th, the Houston Ship Channel remained closed; however, coordinated vessel movements were able to resume due to visual inspection teams that verified no residual product remained on the vessels, as well as ensuring contaminants were not being transported to unaffected areas. That same day, approximately 1.4 million gallons of hazardous materials had been removed from the ITC facility, as well as approximately 541,000 gallons of pollution that had been removed from the waterways (Deerpark Emergency Services, 2019). Between March 17th and March 27th, more than 1,100 federal, state, and local emergency responders, partners, agencies, and contractors descended to the scene to assist in all clean-up and mitigation efforts. By the 27th, the Houston Ship Channel was partially reopened, with 106 vessels successfully transiting through the channel and only a few requiring decontamination that utilized hot water and elevated pressure washing devices (Deerpark Emergency Services, 2019).



MST1 Brett Chmiel & MK1 Tal Hipps in APRs conducting air monitoring. Photo taken by BMC Travis Rogers.

Incident Complexities

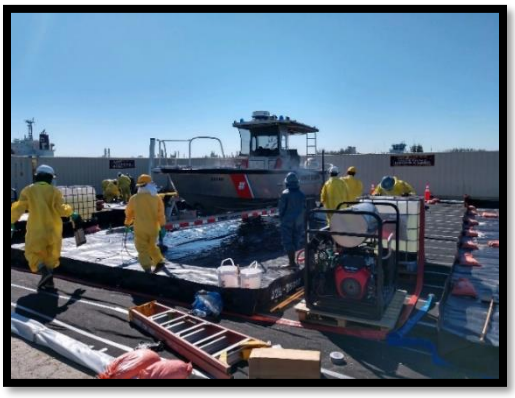
The 2nd 80s Fire incident initiated a response that led to the activation of approximately 5,000 personnel across 322 organizations throughout the duration of the response. Benzene remained the primary chemical hazard to response crews. An interagency agreement was developed between the EPA and USCG to assist in response activates which included containing, collecting, recovering and disposing of the released materials from the shoreline and the surface water. NSF deployed 52 personnel comprised from each of the three Strike Teams (AST, GST, & PST), as well as from the CG- IMAT and PIAT. On-water response efforts were critical once the federal waterways were impacted. However, these efforts were severely hampered due to on-water benzene levels exceeding 20 ppm in the vicinity of ITC. Many areas requiring on-water response operations also exceeded the OHSA PEL for benzene.

Multiple response personnel formed an integrated response structure aligning with ICS standards. The tank farm's containment failure resulted in the release of an estimated 80,000 barrels, or 3.36 million gallons, of petroleum and chemical products, mixed with firefighting foam and contaminated water into Tucker's Bayou and subsequently into the Houston Ship Channel. Countermeasures to this significant catastrophe required the coordinated application of over a million gallons of firefighting foam and the deployment of hundreds of regional firefighting organizations. Additionally, to contain and recover the massive release of mixed petrochemical products, the Unified Command employed several OSROs, resulting in the deployment of hundreds of response vessels, skimmers, vacuum trucks, and thousands feet of deployed boom throughout the Houston Ship Channel. It is noteworthy to point out is that all work areas and tasking were accompanied with an air monitoring representative. A contractor who specialized in air monitoring and hazardous atmosphere detection was hired to fill all air

monitoring activities in support of the Unified Command. Each on water venue (i.e. booming and decontamination operations), and land based work groups within the exclusion zone had at least one air monitoring representative assigned to quantify the work site environments to help determine product concentrations and environmental conditions. Initial zone delineation resulted in CG federal oversight concentrating on all on-water activities or areas closest to the water, while EPA oversight was concentrated on land-side activities, to include the impacted tank farm and the nearby Deer Park community. Furthermore, the prominent smoke plume visible above the facility caused the City of Deer Park to issue intermittent shelter-in-place notifications for the facility and eventually the entire city of Deer Park. TCEQ, Harris County HAZMAT, EPA, NSF and the Center for Toxicology & Environmental Health carried out air monitoring for benzene, VOCs, and semi-volatile organic compounds (SVOCs). Indicative of the size of the plume and subsequent shelter-in-place notifications, media attention spread from the local audience to national level news within the first operational period.

The concentrated efforts of on-scene responders coupled with the coordinated development and execution of tactics by the Unified Command, resulted in the successful deployment of over 400 agency and industry pollution mitigation assets. Two hundred vessels were visually inspected and decontaminated by mobile teams consisting of USCG, EPA, contracted third-party response management personnel, and oil spill response organizations (OSRO) as necessary to facilitate continuous operations in the area. Coordinated decontamination operations continued thereafter to allow ships directed by Vessel Traffic Service to transit through the affected area. As overall pollution mitigation efforts continued and the hazardous materials were removed from the environment, the air quality improved, resulting in the lifting of shelter-in-place constraints and the re-opening of commerce.

NSF Response Posture & Incident Contributions



GST's 26' TAN-B smallboat going through decon procedures. Photo taken by MK1 Chaz Smith.

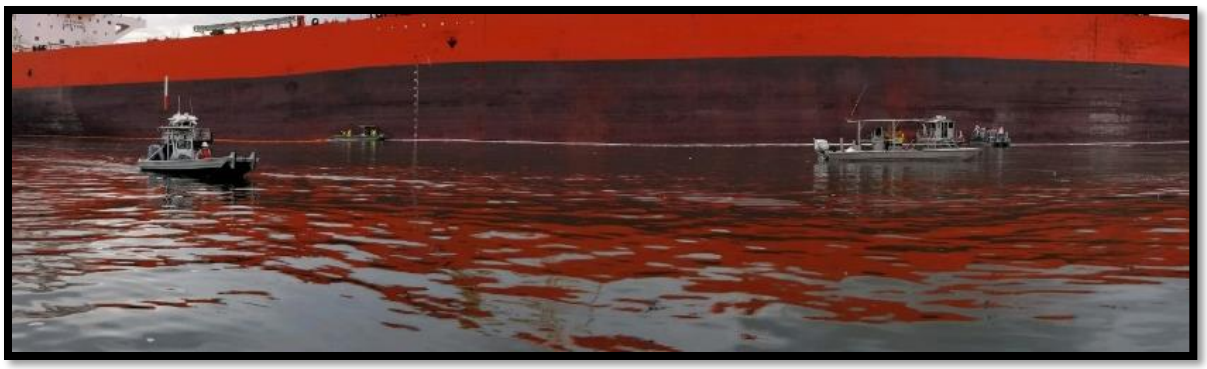
During the first week of the initial ITC Deer Park facility tank farm fire event, the EPA Region VI Incident Commander and OSC requested NSF availability to support, should a request be made. The call for NSF support followed the tank farm's containment wall failure. The NSF assisted with air monitoring, site safety and OSRO contractor oversight. The GST immediately deployed six members, with actual boots on the ground and fully operational the following morning. Within the first two weeks, the NSF would have a combined presence of 52 personnel deployed to Deer Park and supporting the response effort. On water operational assignments included conducting air monitoring, oversight of contractor clean-up operations, site safety assistance, and decontamination oversight. Shore side assignments included filling critical ICS Command and General Staff roles, both within the Incident Command Post, along with various staging and support venues.

Significant response challenges had to be overcome throughout the response. Take a moment to consider what the on-water conditions were like; a CERCLA release event along with the significant threat of pollution in a U.S. navigable waterway that warranted the closure of the Houston Ship Channel, coupled with consistently elevated hazardous levels of benzene being detected in the days following the containment wall breach. The EPA Region VI and USCG Sector Houston-Galveston OSCs were responsible to ensure that all mitigation efforts were being brought to bear and implemented in accordance with the NCP. Additionally, there was immense pressure to ensure unity of effort between federal, state, local, and contracted personnel to ensure

the pollution was contained, mitigated, and elevated benzene levels were reduced before the shipping lanes could reopen to commercial traffic, all while conducting clean-up operations inside the hazardous environments.

Federal oversight was limited to only NSF personnel to perform these tasks as a result of benzene levels exceeding the PEL and TLV, thus requiring use of the APR devices with the attached MSA, P100 filters. The maximum use concentration (MUC) limits for APR usage in benzene hazards was set to not exceed 25 ppm. This was determined by multiplying the APR assigned protection factor (APF) of 50 times the TWA of 0.5ppm resulting in a MUC of 25ppm for NSF response personnel to operate in hazardous environments. Environments that exceeded the MUC required supplied air respirators in the form of SCBA's or Cascade systems with air hose systems. Throughout the response, APR devices were sufficient for conditions experienced. CG policy requiresd our responders to use the most conservative value known, which is ACGIH's TLV of 0.5 ppm for exposure. CG personnel would then be limited to 25 ppm max concentrations, however, contractors would be limited to 50 ppm max concentrations. Additionally, elevated concentrations were sustained at the loading dock where the Tucker Bayou met the Houston Ship Channel. After boom was deployed, the benzene values exceeded the 50 ppm values and required supplied air respirators. The elevated detection values were also problematic under docks and combing. As the docks served as natural collection areas and prevented the sun from elevating the temperatures and assist in the "burning off" of these volatile organic products. Additionally, these areas were considered as confining spaces and thus presented additional concerns during response operations. Lastly, product shifting with the wind

was evident and difficult to track at times, which resulted in suspended operations to reduce responder's exposure potential.



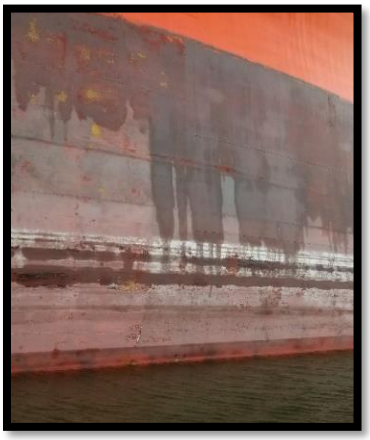
A roving decontamination team in action. Photo taken by MST2 Weldon James.

The NSF led "On-Water Recovery Branch" was charged with managing all on-water divisions, including site safety and contractor oversight. Two NSF members embedded with on-scene OSROs that were charged with pollution mitigation efforts utilizing marco skimmers, boom placement and tending, and product recovery. NSF air monitoring equipment for on-water air monitoring included a 5-gas meter and a benzene specific direct reading instrument. The 5-gas meter is a device that is used for oxygen, lower explosive levels, volatile organic compounds, and carbon mon-oxide detection, as well as having an additional chemical specific sensor inserted. The benzene specific direct reading instrument is a single source detector that employs a separation tube and provides real time measurements for airborne benzene levels. This equipment is absolutely vital for ensuring responders and workers on scene are protected from exposure to VOCs, especially benzene, and other hazardous atmospheric conditions.

A primary responsibility was assisting USCG Sector Houston-Galveston in moving commercial traffic through the impacted zone, and helping with the re-opening of the channel. To prevent the spread of product from the impacted zones to the non-impacted zones, a series of booming systems were put in place. These cleaning and decontamination activities fell to the

Decontamination Branch Director, led by an NSF member who's role was to determine and verify that vessels were checked, monitored, and decontaminated prior to being released from the impacted zone along with all vessel transits out-bound from the port. Vessels were visually inspected by decontamination teams, and if needed, were then decontaminated.

Throughout the initial few weeks of the response, there were as many as six decon teams in charge of decontaminating commercial vessels that needed to transit the Houston Ship Channel, which included a roving decon team that would decontaminate priority vessels. Priority was given to vessels contaminated that were in port when the release happened. Hot water pressure washers were the main means of decontamination. Local Houston Fire Department boats with high pressure water hoses were also utilized for vessels than transited into product with cargo on board, but then were offloaded were significantly higher, leaving a contamination film in hard to reach/higher freeboard. Additionally, there was a dedicated decon team that could decontaminate a vessel while in-transit through the Houston Ship Channel, during which wash-off could be contained with sweeping boom behind the vessel. All teams and the Branch Director initially had their APR on-person, but after benzene levels decreased following the initial emergency response, the need for APRs also decreased.



Evidence of contamination on a ship that recently had cargo offloaded. Photo taken by MST2

CONCLUSION

In accordance with the NCP, the NSF is available to assist OSCs in their response duties, just as they did by assisting Region VI and USCG Sector Houston-Galveston during the ITC Deer Park response. There are segments scattered throughout the NCP that reference what resources the NSF can provide. To reference just a few, the NCP refers to the NSF as a vital

resource during any worst case discharge event, the ability for the NSFCC to coordinate use of private and public personnel and equipment, including Strike Teams, to mitigate worst case discharges. Also, the NSF is vital component of the National Response System – the mechanism for coordinating response actions by all levels of government in support of FOSCs.

In a best case scenario during a significant oil spill or chemical release, Facility and Vessel Response plans would always be sufficient in the aftermath of something going wrong. But as history has proven, bad days don't always follow preferred paths or happen in vacuums. When disasters are born and situations destabilize, the ability for federal, state, local, private, industry, and even tribal representatives to come together, and work as a team is vital. This was absolutely showcased in the ITC Deer Park response; representatives and workers from many organizations, and from all over the country came together obtain common goals of protecting the public, mitigating environmental concerns, and reopening the Houston Ship Channel.

NSF's support to the EPA Region VI and USCG Sector Houston-Galveston FOSCs is just one case study that highlights how NSF can help during critical responses – especially when it comes to cases involving hazardous atmospheric concerns, such as elevated levels of benzene. Research has found that occupational exposure, especially to VOCs like benzene, can lead to years being shaved off of responders and workers' lives. Ensuring proper PPE regulations are followed, and requesting the right people with the right equipment (both in government and industry roles) are embedded in the right places, can also ensure that our best resource – our people – live longer. While significant CERCLA or large scale hazardous material responses don't happen often, the NSF continually trains to be ready to respond if the request for assistance is received.

CONTRIBUTORS: ***CAPT Mark Shepard, CDR Carolyn Moberley, CDR Jarod Toczko, Mr. Mike Drieu, Mr. Matthew Tilimon, DC1 Christopher Bemis***

REFERENCES

Carugno, M., Pesatori, A., Dioni, L., Hoxha, M., Bollati, V., Albetti, B.,…Barrarelli, A. (2012). Increased mitochondiral DNA copy number in occupations associated with low-dose benzene exposure. *Environmental Health Perspectives, 120,* 210-215. Retrieved from https://dash.harvard.edu/bitstream/handle/1/8564479/3279451.pdf?sequence=1

Deerpark Emergency Services. 2019. ITC Fire Updates. https://www.deerparktx.gov/1778/ITC-Fire

EPA. 2019. National Oil and Hazardous Substances Pollution Contingency Plan (NCP) Overview. https://www.epa.gov/emergency-response/national-oil-and-hazardous-substances-pollution-contingency-plan-ncp-overview

Eykelbosh, A. (2014a). *Health effects of oil spills and implications for public health planning and research* (Report prepared for the National Collaborating Centre for Environmental Health, Vancouver Coastal Health). Retrieved from http://www.ncceh.ca/sites/default/files/Health_Effects_Oil_Spills_Nov_2014.pdf

Eykelbosh, A. (2014b). *Short- and long- term health impacts of marine and terrestrial oil spills* (Literature review prepared for the Regional Health Protection Program, Office of Chief Medical Health Officer, Vancouver Coastal Health). Retrieved from http://www.vch.ca/media/VCH-health-impacts-oil-spill.pdf

Farfel, M., DiGrande, L., Brackbill, R., Prann, A., Cone, J., Friedman, S.,…Thorpe, L. (2008). An overview of 9/11 experiences and respiratory and mental health conditions among World Trade Center health registry enrollees. *Journal of Urban Health, 85* (6), 880-090. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2587652/

Farooqui, R., Panthi, K., Azhar, S. (n.d.). *Addressing the issue of compliance with personal protective equipment on construction worksites: A workers' perspective*. Retrieved from http://ascpro0.ascweb.org/archives/cd/2009/paper/CPRT176002009.pdf

Glass, D., Gray, C., Jolley, D., Gibbons, C., Sim, M., Fritschi, L.,…Manuell, R. (2003). Leukemia risk associated with low-level benzene exposure. *Epidemiology, 14,* 569-577. Retrieved from http://journals.lww.com/epidem/Fulltext/2003/09000/Leukemia_Risk_Associated_With_Low_Level_Benzene.11.aspx

Jackson, B., Baker, J., Ridgely, S., Bartis, J., & Linn, H. (2004). *Protecting emergency responders, volume 3* (Report prepared for RAND Corporation). Retrieved from http://www.rand.org/pubs/monographs/MG170.html

Jacobsen, K. (2012). *Introduction to health research methods: A practical guide.* Sudbury, MA: Jones & Bartlett Learning.

King, B., and Gibbins, J. (2011). Health hazard evaluation of deepwater horizon response workers. *Health Hazard Evaluation Report HETA 2010-0115 & 2010-0129-3138.* Retrieved from https://www.cdc.gov/niosh/hhe/reports/pdfs/2010-0115-0129-3138.pdf

Krstev, S., Stewart, P., Rusiecki, J., & Blair, A. (2007). Mortality among shipyard coast guard workers: A retrospective cohort study. *Occupational and Environmental Medicine, 64,* 651-658. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2078389/

Michaels, D., and Howard, J. (2012). Review of the OSHA-NIOSH response to the deepwater horizon oil spill: Protecting the health and safety of cleanup workers. *Public Library of Science Currents, 4.* Retrieved from http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3957409/

Rusiecki, J., Thomas, D., Blair, A. (2009). Mortality among United States Coast Guard marine inspectors: A follow up. *Military Medicine, 174,* 843-851. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2790328/

Solomon, G., & Janssen, S. (2010). Health effects of the Gulf oil spill. *Journal of the American Medical Association,* E1-E2. Retrieved from https://www.researchgate.net/publication/45659858_Health_Effects_of_the_Gulf_Oil_Spill

Vaughan, Adam. 2017. Torrey Canyon disaster – the UK's worst-ever oil spill 50 years on. In: The Guardian. https://www.theguardian.com/environment/2017/mar/18/torrey-canyon-disaster-uk-worst-ever-oil-spill-50tha-anniversary

Wells, Peter G. 2016. The iconic Torrey Canyon oil spill of 1967 – Making its legacy. *Marine Pollution Bulletin, MPB-08232.* Retrieved from http://dx.doi.org/10.1016/j.marpolbul.2016.12.013

Weinhold, B. (2010). Emergency responder health: What have we learned from past disasters? *Environmental Health Perspectives, 118,* 348-350. Retrieved from http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2920106/pdf/ehp-118-a346.pdf

Wilson, M., Frickel, S., Nguyen, D., Bui, T., Echsner, S., Simon, B.,…Wickliffe, J. (2015). A targeted health risk assessment following the deepwater horizon oil spill: Polycyclic aromatic hydrocarbon exposure in Vietnamese-American shrimp consumers. *Environmental Health Perspectives, 123* (2), 152-159. Retrieved from http://ehp.niehs.nih.gov/wp-content/uploads/123/2/ehp.1408684.alt.pdf