REPORT OF THE 2023 HEALTH & SAFETY TASK FORCE TO THE RRT 10/NORTHWEST AREA COMMITTEE

February 14, 2024

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TABLE OF CONTENTS

ACRONYMS

ACP	Area Contingency Plan or Area C-Plan
ATSDR	Agency for Toxic Substances and Disease Registry
BELO	Back End Litigation Order (in multi-district litigation 2179, BP DWH)
BMP	Best Management Practice
BP	British Petroleum
BREESI	Brief Environmental Exposure Survey & Inventory
CAL OSPR	California Dept. of Fish & Wildlife, Office of Oil Spill Prevention & Response
CAM	Community Air Monitoring
CERTs	Community Emergency Response Teams
EMT	Emergency Medical Technician
ERHMS	Emergency Responder Health Monitoring and Surveillance
ESF	Essential Support Function
EU	Environmental Unit
FEMA	Federal Emergency Management Agency
HAZWOPER	Hazardous Waste Operations and Emergency Response
HHE	Health Hazard Evaluation
HIPAA	Health Insurance Portability and Accountability Act
H&S Task Force	Health & Safety Task Force
IC, ICS	Incident Command, Incident Command System
IDLH	Immediately Dangerous to Life or Health
JIC	Joint Incident Command
LEPC	Local Emergency Preparedness Committee
NIEHS	National Institute of Environmental Health Sciences
NIMS	National Incident Management System
NIOSH	National Institute of Occupational Safety and Health
NRT	National Response Team
NWAC	Northwest Area Committees
NWRCP	Northwest Regional Contingency Plan
OELs	Occupational Exposure Limits
OEM	Occupational & Environmental Medicine
OSHA	Occupational Safety and Health Administration
OSLTF	Oil Spill Liability Trust Fund
OSPR	Oil Spill Prevention and Response
PAHs	Polycyclic Aromatic Hydrocarbons
PELs	Permissible Exposure Limits
PHA	Public Health Assessment
PHO	Public Health Office
PIO	Public Information Officer
PM2.5	Particulate Matter, fine
PSRO	Primary Spill Response Organization

QEESI	Quick Environmental Exposure Survey & Inventory
RRT	Regional Response Team
SME	Subject Matter Experts
TAD	Technical Assistance Document
THCs	Total Hydrocarbons
TILT	Toxic Induced Loss of Tolerance
UC	Unified Command
VOCs	Volatile Organic Carbons
VOO	Vessels of Opportunity
WAC	Washington Code

EXECUTIVE SUMMARY

The Health and Safety (H&S) Task Force of the Regional Response Team 10/Northwest Area Committees (RRT 10/NWAC) was one of eight task forces chartered by the RRT 10 Executive Committee on February 3, 2023. The H&S Task Force was assigned four tasks:

1. Review the Northwest Regional Contingency Plan (NWRCP) health and safety sections to identify the need (and how) to incorporate the National Response Team's (NRT) Emergency Responder Health Monitoring and Surveillance (ERHMS) System into the plan;
2. Create health and safety messaging for responders and public regarding oil-chemical exposures;
3. Create a list of health subject matter experts to be called upon during a spill response; and
4. Evaluate the need for development/use of Public Health Assessment (PHA) Units in responses under the NWRCP.

In chartering the H&S Task Force, the RRT 10/NWAC recognized the potential for oil spill exposures to cause long-term harm in workers and the public even when exposed to low concentrations of contaminants (below action levels in some cases). Because the implications of this are profound, a synopsis of the current science on long-term harm to human health from oil spill exposures and implications for health risk assessments is provided in Appendix A. Further, the two main parts of this report, Protecting Worker Health (Task 1) and Protecting Public Health (Task 4), are each introduced with a background to lay a foundation for our reviews and evaluations.

I. Protecting Worker Health

The NRT ERHMS system was first reviewed to understand the perceived gaps and deficiencies in protecting responder health, and the NRT's remedies—the critical elements and pathways to address the concerns. The approach to integrate an ERHMS Unit into the Incident Command System (ICS) structure was also reviewed. New terms such as "uncertain exposures" and "complex chemical mixtures" were given working definitions for this report, based on descriptions in the ERHMS guidance. The NRT ERHMS guide for key decision makers is an excellent concise summary and is provided in Appendix B.

Since the signs and symptoms of potential overexposure are key to assessing health risk from uncertain exposures and presence of complex chemical mixtures, studies describing the mechanism for hypersensitivity, and the corresponding validated surveys for assessing environmental exposure sensitivities, were examined closely. Recommended environmental exposure screening tools for chemical sensitivity are provided in Appendix C.

Next, after considering several reasons to justify establishing a separate ERHMS Unit and where to site it within the ICS structure, the NWRCP was reviewed to determine if it supported key elements of the ERHMS system to conduct and track worker health monitoring from pre- through post-deployment and to track population trends with medical surveillance for early intervention in real-time during illness outbreaks. Review results show where an ERHMS Unit could be integrated into the NWRCP and are summarized in Table 1 in Appendix D. A sample ERHMS decision matrix was also developed to aid in implementation (Appendix E).

And finally, relevant state and federal Occupational Safety and Health Administration (OSHA) Hazardous Waste Operations and Emergency Response (HAZWOPER) laws were reviewed to determine what changes, if any, may be needed to support an ERHMS Unit. Seven areas of persistent gaps and deficiencies in federal and Washington state OSHA HAZWOPER standards were identified in provisions for definitions, elements of an emergency response plan, skilled support personnel, training, a medical monitoring and surveillance program, recordkeeping, and post-emergency response workers. Results of this regulatory gap analysis are presented in summary form (Table 2) with suggested language for federal (and Idaho and Oregon) standards in Appendix F and for Washington standards in Appendix G.

While the RRT 10/NWAC could integrate an ERHMS Unit into responses conducted under the NWRCP without any law changes, some changes would be necessary to create a duty in federal and state laws for employers to initiate and conduct health monitoring and surveillance of employees. Even in the absence of regulatory changes to state and federal occupational safety regulations, a clear policy on the use of available tools within incident command responses would provide clear support for the protection of responder health.

Recommendations for Protecting Worker Health

In general, support for using the updated ERHMS system in the Northwest Region should be increased. To make this actionable, the H&S Task Force recommends that the RRT 10/NWAC develop a stated preference for long-term health monitoring and surveillance of response workers and community health assessments of the exposed public as part of emergency response and a streamlined process with procedures and tools to integrate an updated ERHMS system into responses in the Northwest Region. Further, the RRT 10/NWAC should request the NRT to support and promote use of an updated ERHMS system among RRTs and federal regulators.

Specific recommendations are as follows:

1. To mark a foundational change in the approach of protecting worker and public health, a clear statement is needed in the NWRCP, repeated in all Area Contingency Plans (ACPs or Area C-plans), that recognizes the potential for oil spill exposures to cause long-term harm to workers and the public even when exposed to contaminants at low action levels and that further states a preference for long-term health monitoring and surveillance of people who work in an on-site field capacity during oil spills and for community health monitoring and surveillance during oil spills.
2. Create an Incident Command System (ICS) position under the Safety Officer dedicated to creating an ERHMS Unit.
3. Add a determination of whether chemical mixtures are, or are likely to be, present as part of initial hazard assessment in the 96-hour tool kit for major incidents (9220).
4. Add the ERHMS decision matrix to the 96-hour tool kit (9220) for Day 1 as part of the initial hazard assessment and site-specific safety plan.
5. Update the ERHMS system by incorporating screening tools for chemical sensitivities and/or intolerances, using BREESI (a Brief Environmental Exposure Survey and Inventory) and QEESI (a Quick Environmental Exposure Survey and Inventory) as a Best Management Practice in the NWRCP.
6. Update the H&S Job Aid to include the use of ERHMS system.
7. Utilize and maintain a secure online, cloud-based, government-owned, HIPAA-approved information management system for the updated ERHMS medical monitoring and surveillance data.
8. Request that the NRT urge OSHA to update the HAZWOPER standard to create a mandatory duty for employers to initiate and conduct health monitoring and surveillance of employees during oil-chemical responses using the updated ERHMS system and the suggested language in Appendix F.
9. Request the NRT to actively promote the ERHMS system among the RRTs and update the tools for the modern workforce.
10. Request that the Washington Dept. of Labor and Industries, Division of Occupational Safety and Health, update the WAC standards to create a mandatory duty for employers to initiate and conduct health monitoring and surveillance of employees during oil-chemical responses using the updated ERHMS system and provide the suggested language in Appendix G.

II. Protecting Public Health

Four key reasons are provided to justify establishing a Public Health Assessment (PHA) Unit, as it would:

1. Consolidate all aspects of public health into one place;
2. Retain local authority over public health;
3. Create quality information (by tracking and recording signs and symptoms of potential over exposure) to make evidence-based decisions about health risk and actions in real-time; and
4. Alleviate some of the public's mental health stress associated with the disaster by interfacing regularly with the public to address concerns and explain sample results for sediment, soil, water, and air, and how they are screened.

In the section on integrating the PHA Unit, consideration was given to siting the PHA Unit in various places within the ICS framework, but ultimately the decision was to align with the California OSPR approach of creating two positions for its new PHA Unit, i.e., a PHA Unit leader (EPA or public health agency) familiar with the ICS and a PHA Unit Coordinator for the state and local public health entities.

There is a lot of overlap with Liaison and the PHA Unit. Part of the work to develop a PHA Unit should include evaluating how to integrate the PHA Unit and Liaison to delineate how they would work together. For example, should Liaison be interacting with the public and communicating concerns back to PHA Unit, and then PHA Unit answering concerns and using Liaison as the messenger?

Also considered were ways to scale a PHA Unit and how to trigger an effort with a PHA Unit decision matrix (Appendix E), ways for public health entities to get informed of a health threat, the need for a centralized database to track long-term harm until no longer deemed necessary, and the need to communicate health risk and health and safety messaging in real-time broadly and also specifically to oil-impacted property owners. Last, possible funding sources were discussed.

<u>Recommendations for Protection of Public Health</u>

1. Create a PHA Unit and recommend where to site it within the ICS structure based on the scale of the incident; the preference is to create two positions—a PHA Unit leader (EPA or local or state government agency) familiar with the Incident Command System and a PHA Unit Coordinator for the state and local public health entities.

2. Create a committee to develop criteria for a PHA Unit, including use of environmental exposure surveys for chemical sensitivities, such as BREESI and QEESI.
3. Create or update public health educational materials about oil spill exposures for risk communication in general and specific messaging for oil-impacted property owners.
4. Create an online, cloud-based data storage system for PHA Unit data.
5. Purchase or create a PHA app for mobile phones to collect data.

III. Health and Safety Messaging

The implications of documenting and tracking exposures to hazardous substances and health hazards, based on signs and symptoms of exposure and underlying chemical sensitivities, make it necessary to do a systemic overhaul of all health and safety messaging for oil-chemical responses. The success of a symptom-based health monitoring and surveillance program hinges on whether people are adequately trained or informed to recognize the evidence: the signs and symptoms of potential exposure. Without such information, people are unlikely to report symptoms that can be mistaken for common maladies such as colds or flu, headaches, vertigo, or skin rashes.

Coincidentally, EPA's final action on Subpart J rules governing use of dispersants and other products, effective as of December 11, 2023 (88 FR 38280), also requires an overhaul of messaging related to dispersant use. Much of this information is misleading, inaccurate, incorrect, outdated, and incomplete, in terms of known health impacts of dispersants on humans—including messaging in worker safety training manuals. Under the current standards, such information can be used as grounds for product removal [40 CFR §300.970(a)(1) and (4)].

The H&S Task Force recommends that this work be done by this task force in 2024, along with development of an ERHMS Annex and a PHA Annex within the NWRCP.

List of Health Subject Matter Experts

The listing of Health Subject Matter Experts to be called upon during a spill response exists within the NWRCP within Section 7120, which presents response partners in public health protection for federal and state agencies within the region. As with every NWRCP update cycle, the contacts for the Health Subject Matter Experts should be reviewed per the normal plan update cycle.

Recommendations For Future Work

The understanding of the ERHMS system for protection of responder health and the newly developed methods for incorporation of public health protection into a PHA Unit required considerable time and work on the part of the small task force. Further, developing expertise in the tools available to support responder and public health were accomplished late in the process (September 2023). Accordingly, the task force did not have time to complete some of the tasks to the degree necessary to elevate their use in the Northwest Region. Some needed changes require work in concert with the NRT, or even NRT-led initiatives to move forward in the improved outcomes of protecting worker and public health from exposures at hazardous materials response incidents.

It is therefore proposed that the Health & Safety Task Force be reconvened or rechartered to:

1. Develop new Annexes to NWRCP for the ERHMS Unit and PHA Unit and include or incorporate by reference (as for other annexes) a list of Subject Matter Experts in each annex.
2. Complete a rewrite of health and safety messaging for responders and the general public during oil-chemical responses. (This task requires a different combination of subject matter expertise that does not exist with current task force members. If moving forward, this task should draw from public health and communications experts in the Northwest and nationally.)
3. Review available health monitoring and surveillance tools; find/develop phone apps to facilitate health monitoring and surveillance intake of workers and public health assessments.
4. Request the NRT to promote development of any needed tools/databases to support wider surveillance and longer-term monitoring of responders and the public exposed during incidents.

TASK FORCE OPERATIONS

A total of 4 people originally signed up for the H&S Task Force, and a total of twenty-two calls were convened between March and August 2023 to accomplish the work. In addition, one special session was held June 8 with the California Dept. of Fish and Wildlife OSPR and RRT 9 Public Health Assessment Unit (PHA Unit) working group (participants listed below) to coordinate and discuss parallel efforts to address potential public health exposures during oil spills by RRT Regions 9 and 10. The H&S Task Force facilitator briefed the group's progress to the NWAC and the RRT 10 steering committee on 29 May, 27 July, 27 September, and 6 December, 2023.

MEMBERS & AFFILIATIONS

Name	Affiliation	Email
Co-leaders		
Laura Hayes	WA Dept. of Ecology	LHAY461@ecy.wa.gov
Don Pettit	OR Dept. of Environmental Quality	don.pettit@deq.oregon.gov
Riki Ott	ALERT Project	riki@alertproject.org
Persons who attended at least one monthly meeting		
Conner Barnes	US Ecology (industry sector)	Conner.Barnes@usecology.com
Natalie Lowell	Makah Tribe	nclowell@uw.edu

PERSONS WHO PROVIDED ADDITIONAL INFORMATION RELEVANT TO THIS REPORT

Name	Affiliation	Email
Matt Bissell	WA Ecology	mabi461@ecy.wa.gov
Jase Brooks	WA Ecology	jasb461@ecy.wa.gov
Tammy Kendall	WA Ecology	THOW461@ecy.wa.gov
Sonja Larson	WA Ecology	SLAR461@ecy.wa.gov
Brian MacDonald	WA Ecology	macb461@ecy.wa.gov
Shawn Zaniewski	WA Ecology	SZAN461@ecy.wa.gov
Participants in the June 8, 2023, special session with California OSPR & RRT 9		
Rachel Fabian	CA Dept. Fish & Wildlife	Rachel.Fabian@wildlife.ca.gov
Kathleen Jennings	CA Dept. Fish & Wildlife	kathleen.Jennings@wildlife.ca.gov
Bill Jones	EPA	jones.bill@epa.gov
Benjamin Perry-Thistle	U.S. Coast Guard	Benjamin.Perry-Thistle@uscg.mil
Ben Castellana	EPA	castellana.ben@epa.gov

Karen Riveles	CA Office of Environmental Health Hazard Assessment	Karen.Riveles@oehha.ca.gov
Trisha Johnson	Contra Costa Health	Trisha.Johnson@cchealth.org
Harry Allen	EPA	Allen.HarryL@epa.gov
Jason Musante	EPA	musante.jason@epa.gov
Julie Yamamoto	CA Dept. Fish & Wildlife	Julie.Yamamoto@wildlife.ca.gov

INTRODUCTION

With respect to protection of responder health, the most recent oil spill of national significance—the 2010 BP Deepwater Horizon disaster—repeated what had occurred in previous emergency events since the 1989 *Exxon Valdez* oil spill[1] and, later, the 2001 World Trade Center tragedy.[2] Once again, response workers, cleanup workers, and the public across the impacted coastal Gulf region in four states became sick below exposure levels thought to be safe, and the initial exposures have led to still ongoing rare and debilitating long-term illnesses, premature deaths, and cancers.[3] (See Appendix A for science synopsis of current literature.)

In 2012, the National Response Team (NRT) published a comprehensive Emergency Responder Health Monitoring and Surveillance framework (ERHMS) to resolve persistent gaps and deficiencies in the capacity of the NRT to protect emergency response workers, public health personnel, and cleanup, repair, and restoration workers ("on-site field workers").[4]

The ERHMS system introduces uncertain exposures as an outcome of an exposure assessment for complex or mixed exposures when individual exposure constituents may not exceed Occupational Exposure Limits (OELs) but the complex mixture may still pose a threat, and for health hazards and other hazards when safe limits for exposure have not been established or when the toxicity of the hazard is unknown.[5] The NRT states that for uncertain exposures, "additional exposure

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[1] Murphy K. 2001. Exxon oil spill's cleanup crews share years of illness. *Los Angeles Times* 5/11/2001. https://www.latimes.com/archives/la-xpm-2001-nov-05-mn-372-story.html

[2] Prezant DJ, 2007. World Trade Center Cough Syndrome and its treatment. *Lung*. 2008;186 Suppl 1:S94-102. doi: 10.1007/s00408-007-9051-9. Epub 2007 Nov 20. https://pubmed.ncbi.nlm.nih.gov/18027025/

[3] Sneath S, Laughland O, 2023. "They cleaned up BP's massive spill. Now they're sick – and want justice," *The Guardian* 4/20/2023. https://www.theguardian.com/environment/2023/apr/20/bp-oil-spill-deepwater-horizon-health-lawsuits

[4] NRT, 2012. Emergency Responder Health Monitoring and Surveillance (ERHMS) Technical Assistance Document (TAD). 1/26/2012. https://www.nrt.org/sites/2/files/ERHMS_Final_060512.pdf

[5] OSHA recognizes certain chemicals, and mixtures that include these chemicals, as health hazards that induce carcinogenicity, germ cell mutagenicity, and reproductive toxicity, i.e., that induce or increase the incidence of cancers, genetic mutation in reproductive cells of unborn babies, and adverse effects on sexual function and fertility in adults and developmental toxicity in offspring, respectively. Such hazards and chemical mixtures containing such hazards are exceptions to dose-response relationships that underlie toxicological principles on which the OELs are based. Crude oil is a mixture that contains these health hazards.
OSHA, 2012. 1910 Subpart Z. Toxic and Hazardous Substances. 1910.1200 Appendix A – Health Hazard Criteria (Mandatory), at A.0.4.2. https://www.osha.gov/laws-regs/regulations/standardnumber/1910/1910.1200AppA

monitoring, health, or biological monitoring is warranted before a determination about the exposure can be made."[6]

The ERHMS system relies on evidence-based health monitoring using signs and symptoms of exposure described in the 2012 OSHA HAZWOPER Health Hazard Criteria (Mandatory).[7] The success of a symptom-based health monitoring and surveillance program for workers hinges on whether people are adequately trained to recognize the evidence: the signs and symptoms of potential exposure. Without such information, workers are unlikely to report symptoms that can be mistaken for common maladies such as colds or flu, headaches, vertigo, or skin rashes.[8] Without reporting, there can be no surveillance and no triggering mechanism for intervention measures. With no mitigation measures, illness outbreaks occur—and the initiators for long-term harm are in place.[9]

The ERHMS system is based on lessons learned from several disaster responses, including Hurricanes Katrina (2005) and Sandy (2012), the World Trade Center tragedy, BP Deepwater Horizon, and others. The ERHMS system includes procedures to provide real time data and recommendations on health and safety issues, guidance on how to implement the ERHMS system, which is designed to be fully compatible with the National Incident Management System (NIMS), and steps that the Incident Command should take to facilitate the functioning of an ERHMS Unit during a disaster response.[10]

Since the ERHMS system was introduced in 2012, the mechanism for the two-phase process for chemical sensitization, described in the 2012 OSHA health hazard criteria, is now understood as cell-mediated immunology, which operates within cells.[11] As noted by OSHA, the process involves cellular memory, a function that can amplify response with subsequent triggering events even at

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[6] See note 4, NRT, 2012, ERHMS TAD, at 39.

[7] See note 5, OSHA HAZWOPER Appendix A, at A.2.1.1. for skin symptoms, A.8.2.2.1. for respiratory symptoms, and A.8.2.2.2. for neurological symptoms.

[8] The respiratory and neurologic symptoms described in note 7 mimic cold- and flu-like symptoms and are considered characteristic of oil spill exposures. Aguilera F, Méndez J, Pásaro E, Laffon B, 2010. Review on the effects of exposure to spilled oils on human health. *J Applied Tox* 30(4):291–301.

[9] For example, chronic specified physical conditions in the BP Deepwater Horizon medical benefits class action settlement include sequela from direct chemical splash to eyes, chronic rhinosinusitis, reactive airways dysfunction syndrome, and chronic contact dermatitis, in Exhibit 8, at 14–15. Plaisance, et al. 2012. [BP] Deepwater Horizon Medical Benefits Class Action Settlement, as amended on May 1, 2012. On behalf of the Medical Benefits Settlement Class v. BP Exploration & Production. Case 2:10-md-02179-CJB-SS, Doc. 6427-1, 05/03/12, No. 12-CV-968. https://www.laed.uscourts.gov/sites/default/files/OilSpill/6.pdf

[10] NRT, 2012. Emergency Responder Health Monitoring and Surveillance (ERHMS): A Guide for Key Decision Makers. 1/26/2012. https://www.nrt.org/sites/2/files/ERHMS_Decisionmakers_060512.pdf

[11] Masri S, et al., 2021. Toxicant-induced loss of tolerance for chemicals, foods, and drugs: Assessing patterns of exposure behind a global phenomenon. *Environ Sci Eur* 33:65. https://doi.org/10.1186/s12302-021-00504-z

low levels of chemicals that were previously tolerated—and can lead to chemical intolerance. Updating the ERHMS system to include basic screening for environmental exposure, using validated and available tools, would help identify and better protect workers with chemical sensitivity or chemical intolerance.

Further updates are needed to the ERHMS toolkit and to modernize the platforms for it to become a truly useful and efficient tool to track responder health throughout their response careers to better protect their health and to inform future responses. In addition, the OSHA HAZWOPER standard needs to be updated to support symptom-based health monitoring as a critical requirement to achieve its goal of protecting worker health and safety.

Gaps and deficiencies also exist in the capacity of the NRT and states to protect public health during an oil spill emergency. While states delegate public health authority to local jurisdictions, the public health assessments (and the state authority to conduct them) are not well integrated into responses. To fill this gap, the California Fish and Wildlife Office of Oil Spill Prevention and Response (CAL OSPR) and Regional Response Team (RRT) 9 created a Public Health Assessment (PHA, pronounced "P-HA") Unit after the 2015 Refugio oil spill in California[12] and integrated it into the Incident Command System during response while retaining state authority. This was successfully deployed during a 2021 offshore pipeline oil spill in California.[13]

The success of a symptom-based a health risk assessment for the public hinges on whether people are adequately informed to recognize the evidence: the signs and symptoms of potential exposure. Without such information, people are likely to self-medicate and doctors are likely to misdiagnose the cause of the common symptoms. Accurate medical diagnoses and treatment are key to mitigate long-term harm from oil spill exposures.

In light of these developments and the large amount of scientific research, including two (still ongoing) epidemiology studies from the BP Deepwater Horizon disaster, RRT 10 and the Northwest Area Committee (RRT 10/NWAC) chartered a task force in 2023 to review the existing health and safety policies specified by the Northwest Regional Contingency Plan (NWRCP) to determine if there are needs to incorporate an ERHMS Unit and PHA Unit into the NWRCP and to update the plan's health and safety messaging.

The two main sections of this report, Protecting Worker Health and Protecting Public Health are introduced with a background to lay a foundation for our reviews and evaluations.

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[12] California Dept. of Fish and Wildlife, Office of Spill Prevention and Response ("CAL OSPR"), Natural Resource Damage Assessment (NRDA) and Restoration, 2015. Refugio. https://wildlife.ca.gov/OSPR/NRDA/Refugio

[13] CAL OSPR, 2021. Pipeline P00547. https://wildlife.ca.gov/OSPR/NRDA/Pipeline-P00547

PROTECTING WORKER HEALTH

"Valdez Crud" (*Exxon Valdez* oil spill, 1989)[14]
"World Trade Center Cough Syndrome" (2001)[15]
"BP Syndrome" (BP Deepwater Horizon oil spill, 2010)[16]

BACKGROUND: GETTING TO ERHMS

Initial symptoms of chemical exposure have been dubbed different names by response workers during different disasters. It was well-known within the oil industry medical community prior to the *Exxon Valdez* oil spill that initial symptoms of exposure were early warnings of potential long-term harm.[17] Just before the BP Deepwater Horizon oil disaster, the scientific community arrived at the same understanding based on the first review of human health effects from large maritime oil spills, including epidemiology studies after the 2002 *Prestige* oil spill in Spain and the 2007 *Hebei Spirit* oil spill in South Korea. The review identified a suite of acute symptoms now considered characteristic of oil spill exposures.[18]

In June 2010, the Institute of Medicine sponsored a workshop in New Orleans to assess effects of the BP Deepwater Horizon oil disaster on human health, inform monitoring efforts for anticipated

[14] See note 1, Murphy, 2001. *Exxon Valdez* oil spill's cleanup crews.
[15] See note 2, Prezant, 2007. World Trade Center Cough Syndrome.
[16] See note 3, Sneath & Laughland, 2023. They cleaned up BP's massive spill.
[17] Six weeks after the *Exxon Valdez* oil spill in 1989, Dr. Robert Rigg, a former medical director for Standard Alaska (BP), warned the Alaska fishermen response workers: "It is a known fact that neurologic changes (brain damage), skin disorders (including cancer), liver and kidney damage, cancer of other organ systems, and medical complications... can and will occur to workers exposed to crude oil and other petrochemical by-products. While short-term complaints, i.e., skin irritation, nausea, dizziness, pulmonary symptoms, etc., may be the initial signs of exposure and toxicity, the more serious long-term effects must be prevented."
Rigg R, MD, Letter to Cordova District Fishermen United, May 13, 1989, Cordova, AK. Cordova Fact Sheet 1989 1[29], City of Cordova, Alaska.
[18] See note 8, Aguilera, et al., 2010. Review.

adverse health effects, and communicate the health risk from oil spill exposure to the public.[19] Prior to the workshop, neither the regulatory agencies nor BP had paid any attention to worker biomonitoring.[20] During the workshop, the scientist who presented the review also presented the on-going genotoxicity studies from the *Prestige* oil spill.[21] The workshop panel recommended immediate implementation of biomonitoring protocol at any time during an oil spill. After the workshop, exposure experts from the Institute of Medicine and three agencies—the National Institute of Occupational Safety and Health (NIOSH), the National Institute of Environmental Health Sciences (NIEHS), and the Nuclear Regulatory Commission—each prepared worker biomonitoring protocols and sent them to BP.[22]

At time of the workshop, citizen responders working on-site on the waters and adjacent coastal land were already reporting symptoms characteristic of oil spill exposures. Unlike the professional responders, the ad hoc citizen responders had no screening for pre-existing conditions, no or minimal HAZWOPER training, and were not part of a health monitoring program.[23]

Instead of initiating a biomonitoring program for its workers, BP voluntarily initiated an air quality monitoring protocol, which was not about exposure assessment. Instead, it was about perceptions, as internal BP documents reveal: "Although we are documenting zero exposures in most monitoring efforts, the monitoring itself adds value in the eyes of public perception, and zeros add value in defending potential future litigation."[24] BP's occupational medicine lead, Dr. Flower, supported biomonitoring to "confirm (or otherwise) the lack of exposure as indicated by air sampling…"[25] Flower recommended biomonitoring as an appropriate "backstop" to confirm

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[19] NAS Institute of Medicine, McCoy MA, Salerno JA, rapporteurs, 2010. Assessing the Effects of the Gulf of Mexico Oil Spill on Human Health: A Summary of the June 2010 Workshop (National Academies Press: Washington, DC). ISBN 978-0-309-38538. Free download: http:/nap.edu/12949

[20] In: BP Deepwater Horizon BELO cases, Case 3:19-cv-00963-MCR-HTC, F Northern District of Florida, Pensacola Division. Document 547, 10/28/22. Plaintiffs' Motion for Admission of Plaintiffs' Expert Opinions Because of BP Defendants' Spoilage of Evidence of Plaintiffs' Exposures, at 8.

[21] Laffon B, Aguilera F, Rios-Vazquez J, et al. 2014. Follow-up study of genotoxic effects in individuals exposed to oil from the tanker Prestige, 7 years after the accident. *Mutat Res.*, 760:10–16. doi: 10.1016/j.mrgentox.2013.09.013

[22] See note 20, Deepwater Horizon BELO cases, 2022, Document 547, at 12.

[23] "Response workers generally must be trained pursuant to the HAZWOPER regulation administered by the OSHA. 29 C.F.R. § 1910.120. This regulation requires specific training and medical surveillance and monitoring for workers dealing with hazardous materials. While this regulation presumably applied to formal response contractors after the Deepwater Horizon spill, it was not applied consistently to citizen responders who also require its protections," at 277 and endnote 25 (at 353).

National Commission on the BP Deepwater Horizon and Offshore Drilling. 2011. *Deep Water: The Gulf Oil Disaster and the Future of Offshore Drilling. A Report to the President.* https://nrt.org/sites/2/files/GPO-OILCOMMISSION.pdf

[24] See note 20, BELO cases, at 19 and 29, citing Doc. 547 Exhibit 14, BP John Fink email, 7/31/2010 at 1.

[25] Ibid., at 15–16.

whether workers were getting acute toxic exposures during the spill response. He would later stand by his statements in court.[26]

The NIOSH director at the time, John Howard, also found BP's air quality monitoring program was insufficient to assess worker exposure, since it did not reflect total exposure or high episodic exposures that get diluted out, and it was affected by winds such that measurements of aerosols, in particular, were underestimated.[27] Total exposure, Director Howard maintained, is more associated with longer term health effects, and to assess total exposure, a biomonitoring program was critical. Director Howard warned that continuing to monitor worker health without the addition of a biomonitoring program "leaves us scientifically incomplete" and unable to explain "that harmful exposures are occurring despite negative air sampling results." Further, it "impairs our ability to conduct long-term health studies…"[28]

BP chose not to implement any biomonitoring program. This was the proverbial last straw for the federal agencies involved in the BP Deepwater Horizon disaster response. In a remarkable act of transparency, OSHA posted a public disclaimer on it PELs Annotated Tables website:

> "OSHA recognizes that many of its permissible exposure limits (PELs) are outdated and inadequate for ensuring protection of worker health. Most of OSHA's PELs were issued shortly after adoption of the Occupational Safety and Health (OSH) Act in 1970 and have not been updated since that time…
>
> "Industrial experience, new developments in technology, and scientific data clearly indicate that in many instances these adopted limits are not sufficiently protective of worker health…
>
> "OSHA recommends that employers consider using the alternative occupational exposure limits because the Agency believes that exposures above some of these alternative occupational exposure limits may be hazardous to workers, even when the exposure levels are in compliance with the relevant PELs."[29]

In March 2012, OSHA revised its health hazard communication standard (1910.1200 Appendix A) to create a work-around to the outdated PELs.[30] The new criteria for classification of health and physical hazards and chemical mixtures describe exceptions to the PEL-based acute toxicity

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[26] Ibid., at 16.
[27] Ibid., at 13–14, citing Doc. 547 Exhibit 6, Greg Lotz (CDC/NIOSH/DART) email, 6/24/2010 at 1.
[28] Ibid., at 14–15, citing Doc. 547 Exhibit 8, John Howard (NIOSH) email, 6/27/2010 at 1.
[29] OSHA Permissible Exposure Limits – Annotated Tables. https://www.osha.gov/annotated-pels
[30] See note 5, OSHA, 2012, 1910.1200 Appendix A.

testing for health hazard classes of Carcinogenicity, Germ Cell Mutagenicity, and Reproductive Toxicity, and chemical mixtures that include these health hazards.

The symptoms of exposure described in the standards include: skin rashes or ulcers, bleeding, or alopecia (hair loss) in A.2; respiratory symptoms such as coughing, difficulty breathing, or shortness of breath in A.8.2.2.1; and neurological symptoms such as severe headaches or migraines, nausea or vomiting, dizziness or vertigo, irritability, fatigue, deficits in perception and coordination, reaction time, or sleepiness, and impaired memory function (A.8.2.2.2). Many of these symptoms are identical to those described as characteristic of oil spill exposures.[31]

In practice this means that OSHA recognizes these symptoms as evidence of exposure in situations where health hazards and/or complex mixtures of hazardous chemicals are present—like during oil spills. Oil spill exposures are not simply from a single chemical in a defined setting, but rather from complex, multi-phase mixtures of oil-chemical hazards in constantly variable physical and environmental settings.

But even more significantly, OSHA also acknowledged that sensitization symptoms could be amplified with subsequent lower chemical exposures. Although the mechanism for this was not described until 10 years later, the OSHA health hazard criteria standard in 2012 described respiratory and skin sensitization as a two-phase process, involving "induction of specialized immunological memory in an individual by exposure to an allergen…", in which the immune system learns to react, followed by "elicitation, i.e., production of a cell-mediated or antibody-mediated allergic response by exposure of a sensitized individual to an allergen." OSHA continued describing that clinical symptoms arise when the subsequent exposure is sufficient to elicit a visible reaction but notes, "Usually, for both skin and respiratory sensitization, lower levels are necessary for elicitation than are required for induction" (A.4.1.4). This means hypersensitivity is not dose dependent (dose being understood as a numerical concentration and a duration).

In 2012, the NRT published a comprehensive (non-mandatory) ERHMS system to resolve persistent and significant gaps and deficiencies in the capacity of the NRT to protect emergency response workers, public health personnel, and cleanup, repair, and restoration workers. In the intervening decade-plus since the BP Deepwater Horizon disaster, the science is in—and it

[31] Aguilera et al., 2010, Review of human health impacts.
Laffon B, Pasaro E, Valdiglesias V. 2016. Effects of exposure to oil spills on human health: Updated review. *J Toxicol Environ Health.* Part B, 19:3-4, 105-128. doi: 10.1080/10937404.2016.1168730
Levy B, Nassetta, W. 2011. "The Adverse Health Effects of Oil Spills: A Review of the Literature and a Framework for Medically Evaluating Exposed Individuals," *Int J Occup Environ Health*; 17:121–167. doi: 10.1179/107735211799031004

supports the symptom-based monitoring recommended by the NRT and adopted into the OSHA HAZWOPER health hazard communication standards. These are the topics of the next section.

The NRT ERHMS System & The Need For Updates

The NRT described the need for a comprehensive health monitoring system to document exposures to hazardous substances by explaining why such exposures often go unnoticed and undocumented. The precedent was set for small-scale incidents. It needs to be updated based on practical experience, current science and advances in technology:

> "Not all exposure assessments require collection of quantitative data, but most assessments include some element of environmental monitoring. In many small-scale incidents involving local fire or emergency medical services (EMS), monitoring of hazardous exposures is often not performed in a systematic fashion, and it may be initiated only when affected individuals begin to exhibit signs or symptoms of illness. Minor or traumatic injuries are typically documented, because of both the obvious cause and location of those injuries as well as the OSHA injury reporting requirement. However, worker exposures to hazardous substances may often go undocumented and unreported. Documenting and assessing exposures are crucial in any efforts to ensure and promote responders' safety and health. This information can be utilized both in real-time during the response, as well as post-event as the exposure data are analyzed for evidence of hazardous exposures."[32]

The ERHMS system is well described in the NRT guide for decision makers (2012) and provided in Appendix B. The ERHMS system provides all the expected elements of a comprehensive health monitoring and surveillance program. Highlights include:

> *During Pre-Deployment*: A centralized database (personal computer based, standalone database) to roster and track all responders; medical screening for physical and mental health; and, for responders who are fully certified to perform duty-specific tasks, site-specific training to recognize anticipated hazards and signs and symptoms of potential overexposure and to mitigate them.
>
> *During Deployment*: Health monitoring of individual responders for signs and symptoms of potential exposures during deployment in real time; medical surveillance of the response population as a whole to track illness and injury trends in real time to identify adverse health consequences and intervene early to maximize recovery and minimize

[32] See note 4, NRT, 2012, ERHMS TAD, at 35–36.

> further exposures for workers remaining on-scene; obtaining sufficient, accurate, and useful worker exposure data to make evidence-based decisions regarding PPE or work practice controls to protect the health and safety of responders in real time; and communication of exposure and health monitoring and surveillance data broadly to workers, within and between organizations, inside and outside of the ICS structure.
>
> *During Post-Deployment*: Out-processing health assessments completed before departure of individuals or shortly after demobilization; tracking of health and function of similar exposure histories and those who reported similar adverse health effects; and an after-action report to evaluate the ERHMS system to better protect responder safety and health and to improve the safety environment during the next emergency.

The NRT guide also recommends assigning the ERHMS Unit to the Safety command within the ICS structure[33] and taking steps to facilitate the unit's functioning by ensuring the following:

- Pre-deployment activities are completed.
- Data sharing and collaboration occur between the ERHMS Unit and other key sections of the ICS command such as Safety, Planning, and Logistics.
- Injury and illness data are acquired and analyzed from a variety of sources, including safety records, on-site medical facilities, state and local emergency departments and clinics, and federal medical resources assigned to the event.
- Responder activities and environmental monitoring occur and are documented.
- The communication plan is developed early in a response and can accommodate the recommendations from the ERHMS Unit.
- All responders participate in the out-processing assessment.
- An organization is assigned to implement post-event health tracking recommended by the ERHMS Unit.

The ERHMS guidance describes health monitoring and surveillance as "two different but complementary methods to protect the health and safety of incident responders during an emergency operation" (at v), as follows:

> "*Monitoring* refers to the ongoing and systematic collection, analysis, interpretation, and dissemination of data related to an individual incident responder's injury and illness status. This allows for the evaluation of the occurrence of an exposure, determination of the level of exposure an individual responder might experience

[33] Ibid., at 2.

during duties, and assessment of how that exposure is affecting the individual responder.

"*Surveillance* refers to the ongoing and systematic collection, analysis, interpretation, and dissemination of illness and injury data related to an event's emergency responder population as a whole. This allows for the tracking of emergency responder health (illness and injury) trends within the defined population during response. A mechanism to allow tracking should be an integral part of the response to any event."[34]

Uncertain Exposures & The Need For Environmental Exposure Surveys

The ERHMS system introduces a third outcome of an exposure assessment—and the need for health monitoring.

The core of the ERHMS system is an exposure assessment involving three conclusions: acceptable exposures, described as those below a pre-determined occupational exposure limit (OEL) as determined by quantitative or qualitative methods; unacceptable exposures, as those that exceed or will exceed pre-determined OELs; and uncertain exposures, which are described as follows:

"Uncertainty surrounding the exposure assessment occurs when not enough information is available to make a judgment about health risk. Often, complex or mixed exposures fall into this category. Although individual exposure constituents may not exceed OELs, the complex mixture may pose a threat. Exposure assessments deemed uncertain may also result when the toxicity of the hazard is unknown or when safe limits for exposure have not been established. This determination does not mean that there is no existing or future hazard, but rather it means that additional information gathering, including additional exposure monitoring, health, or biological monitoring, is warranted before a determination about the exposure can be made. Where uncertainty exists in exposure assessment, it is wise to utilize an approach known as the "precautionary principle" when making safety and health decisions. Under this principle, it is best to err on the side of safety when any decision concerning human health and safety is in the balance.

"There may be opportunities to perform dose reconstruction based on limited field quantitative data. This effort requires a more in-depth analysis involving the kinds of techniques used in designing exposure reconstruction models.

[34] Ibid., at v.

> "A holistic approach to investigating and understanding the impact of exposures on responder health should be adopted—one that does not rely on environmental results alone to determine risk. Information must be gathered from a variety of sources, discussed in other sections of this document, to determine if exposures occurred, who may have been exposed, and who needs medical treatment."[35]

By including uncertain exposures, the ERHMS system recognizes that harm can occur and is occurring at levels below those presumed to be protective and, further, that environmental monitoring alone is unreliable to assess health risk for chemical mixtures of health hazards.[36] It is for these reasons that epidemiologists use a semi-quantitative (presence or absence descriptive) approach to determine acute and long-term harm from low action levels and uncertain exposures such as oil spills. Scientists have found these approaches to be more accurate in detecting and understanding human health effects from uncertain exposures than a quantitative (numerical concentration-based) approach with traditional methods, such as environmental monitoring based on a single or a similar set of chemicals. The latter creates a low-biased impression of the true scale and nature of an oil spill's harmful consequences.

Accounting for uncertain exposures, health hazards, and chemical sensitivities means past practices need to be reconsidered. For example, the work zones (aka safety zones) established at hazardous substance release sites, including oil spills, identify the types of operations and degree of hazard at different areas within the release site. The designation then influences the amount of training for workers, among other things. However, the work zone concept assumes that higher levels of contamination equate to greater potential for risk and that exposures below PELs are protective. But these assumptions are invalid in any zone when the release involves chemical mixtures and other health hazards. While the exclusion (hot) zone has the highest potential for acute exposure to high levels of hazardous substances, the warm zone of reduced contamination still has a high potential for exposure to lower levels of hazardous substances in chemical mixtures, for which PELs are not reliable indicators of health risk, but symptom-based health monitoring is.

The practical application of this means that *all* on-site field workers involved in response or cleanup of chemical mixtures involving health hazards, especially during an uncontrolled release lasting weeks or months, must have training to recognize the characteristic symptoms of potential chemical overexposure—and there must be a systematic way to record and report such symptoms to support and evaluate medical surveillance data for trends to minimize harm and protect worker health in real-time.

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[35] Ibid., at 39.

[36] See note 28, Exhibit 8, 2010, Howard, at 1.

There is a need to update the ERHMS system based on the new understanding of chemical sensitivities. Since the ERHMS system was introduced in 2012, the mechanism for the two-phase process for chemical sensitization, described in the mandatory OSHA health hazard criteria, is now understood as cell-mediated immunology, which operates within cells.[37] Cell-mediated immunology is a mechanism for a class of diseases that are *not* true allergic responses, as it does *not* involve antibody (i.e., immunoglobin E) reactions and often manifests at very low levels of exposure. Cell-mediated immunology involves a different branch of the immune system than an antibody-mediated true allergic response, which operates outside cells.[38] The cell-mediated response is rapid, as mast cells are paired directly with nerve cells, and it involves cellular memory, a function that can amplify response with subsequent triggering events even at low levels of chemicals that were previously tolerated. This can lead to chemical intolerance, which qualifies for coverage under the Americans with Disabilities Act.[39]

The main categories of chemicals that initiate a cell-mediated response are chemicals derived from fossil fuels (coal, oil, and natural gas) or synthetic organic chemicals, and their combustion products. Another category is biological toxicants, often due to particles and vapors from toxic molds or algae (Miller et al., 2023).[40]

Diagnostic and validated screening tools now widely used in over two dozen countries for chemical, food, and drug sensitizers include "BREESI" and "QEESI" for Brief and Quick Environmental Exposure Survey and Inventory, respectively,[41] developed through the Hoffman TILT (Toxicant Induced Loss of Tolerance) Program at University of Texas, Austin.[42] BREESI is a screening tool that rapidly assesses a person's sensitivity to common chemicals, pharmaceutical drugs, and foods and beverages and can be used to determine job placement to minimize health risk. QEESI is used by clinicians and researchers to better understand chemical sensitivity/intolerance that underlie a growing number of chronic conditions,[43] including

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[37] See note 11, Masri et al., 2021, Chemical intolerance.

[38] Miller CS, Palmer RF, Dempsey TT, *et al.* 2021. Mast cell activation may explain many cases of chemical intolerance. *Environ Sci Eur.* 33, 129. https://doi.org/10.1186/s12302-021-00570-3

[39] Findlaw online. Is Multiple Chemical Sensitivity a Disability under ADA [Americans with Disabilities Act] https://www.findlaw.com/employment/employment-discrimination/chemical-sensitivities-discrimination.html

[40] Miller CS, Palmer RF, Kattari D, Masri S, Ashford NA, Rincon R, Perales RB, Grimes C, Sundblad DR. 2023. What initiates chemical intolerance? Findings from a large population-based survey of U.S. adults**.** *Environ Sci Europe*. 35 (1) DOI: 10.1186/s12302-023-00772-x

[41] Hoffman TILT Program, 2023. Univ. of Texas, San Antonio. Chemical intolerance self assessment. https://tiltresearch.org/self-assessment/

[42] Ibid. https://tiltresearch.org/

[43] Molderings GJ, Afrin LB. 2023. A survey of the currently known mast cell mediators with potential relevance for therapy of mast cell mediators with potential relevance for therapy of mast cell-induced symptoms. Review. *Naunyn Schmiedebergs Arch Pharmacol*. May 27. doi: 10.1007/s00210-023-02545-y.

autoimmune diseases in children of mothers with chemical intolerance.[44] QEESI can also be used as an indicator of chemical exposure and to track the emergence of chemical intolerance after major exposure events.[45] (Surveys are in Appendix C.)

There are two immediate practical applications of this advanced understanding of immunology. First, the ERHMS system should be updated to include baseline environmental exposure screening for chemical sensitivity with BREESI and QEESI, as part of the physical and mental health pre-deployment examinations for all on-site public and private field workers, as part of exit surveys, and as part of any long-term monitoring effort. This would help identify workers who may have already been impacted by low levels of chemicals or other sensitizers in their environment, such as from living in communities near oil-chemical industries or from past military exposures, and who are, therefore, more likely to be triggered by and hypersensitive to oil-chemical exposures.[46] In these cases, job assignments should have minimal risk of chemical exposure, and there should be consistent health monitoring during deployment with immediate work intervention, if symptoms arise, and tracking after deployment to mitigate or prevent long-term harm.

Second, the program needs to be conducted by qualified Occupational and Environmental Medicine (OEM) doctors who have been trained to recognize the difference between the characteristic signs and symptoms of potential chemical exposure and cold- and flu-like symptoms or heat stress that can mimic the former. Common cold and flu and heat stress are relatively short-term events, while chemical exposures, especially without early intervention and treatment, can lead to a lifetime of debilitating illnesses, cancers, and premature deaths.

Incorporating an updated ERHMS system, i.e., one that includes environmental exposure screening for chemical sensitivity, into the NWRCP is discussed next.

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[44] Heilbrun LP et al. +5, 2015. Maternal chemical and drug intolerances: Potential risk factors for autism and Attention Deficit Hyperactivity Disorder (ADHD). *J Am Board Fam Med* Jul-Aug;28(4):461-70. doi: 10.3122/jabfm.2015.04.140192

[45] See note 38, Miller et al., 2021, Chemical intolerance.

[46] Lowe SR, McGrath JA, Young MN, Kwok RK, Engel LS, Galea S, Sandler DP. 2019. Cumulative disaster exposure and mental and physical health symptoms among a large sample of U.S. Gulf Coast residents. *J Traumatic Stress*; 32:196-205. doi.org/10.1002/jts.22392.

Review of the NWRCP to Support Incorporation of an Updated ERHMS System

Before we reviewed the entire NWRCP, we first looked at three areas of practical concern where we knew there were gaps and deficiencies in worker protection. These concerns encompass:

- the need for symptom-based health monitoring and surveillance;
- the need for HAZWOPER-certified training for temporary citizen responders; and
- the need to modernize data collection and recordkeeping.

First, we acknowledged that PELs are inadequate, especially for chemical mixtures. The over reliance on PELs to assess health risk has led to underreporting (if any) of actual signs and symptoms of exposure for several reasons. PEL calculations use sentinel chemicals or groups of oil components like THCs (Total Hydrocarbons), VOCs (Volatile Organic Compounds), PAHs (Polycyclic Aromatic Hydrocarbons), etc., as a surrogate for oil spill exposure. Measurements that rely on sentinel chemicals do not detect all the oil components. For example, only 1.3-4% of the PAHs in fresh oil are captured by traditional methods.[47] The complex formulations made for time-weighted average limits are often made without adequate information about the nature of the mixtures (OSHA 1900.1000) and are invalid for any chemical mixtures involving health hazards.

Also, traditional methods do not account for the size of oil-contaminated droplets. For example, dispersants make oil spill-related air emissions even more toxic by increasing the ratio of nano-to-micro-size oil droplets without altering the concentration of particle-bound polycyclic aromatic hydrocarbons (PAHs).[48] One study found that inhalation of dispersant-mediated particulate emissions increased the total mass burden of nano particles inhaled and deposited in upper respiratory tract and trachea bronchial region of humans about 10 times, compared to slicks of crude oil without dispersants.[49] Traditional monitoring for air quality would not account for the increased health risk from the *size* of the droplet instead of the concentration.

Other limitations of PELs include the assumption of 8-h work shifts in a 40-h work week, which is not applicable for extended shifts and 24/7 exposures often encountered during oil spill

[47] Payne JR, Driskell WB. 2018. Macondo oil in northern Gulf of Mexico waters – Part 1: Assessments and forensic methods for Deepwater Horizon offshore water samples. *Mar Poll Bull* 129:399–411. doi.org/10.1016/j.marpolbul.2018.02.055

[48] Afshar-Mohajer N, et al. 2018. A laboratory study of particulate and gaseous emissions from crude oil and crude oil-dispersant contaminated seawater due to breaking waves. *Atmospheric Environ.* 179:177-186. https://doi.org/10.1016/j.atmosenv.2018.02.017

[49] Afshar-Mohajer, N., Fox, MA, Koehler, K. 2019. The human health risk estimation of inhaled oil spill emissions with and without adding dispersant, *Science of the Total Environ.* 654:924-932. doi: 10.1016/j.scitotenv.2018.11.110

responses. PELs do not account for synergistic interactions, mixtures that act on multiple target organs, and individual chemical sensitivities. Even OSHA admits that "many of its permissible exposure limits are outdated and inadequate for ensuring protection of worker health."[50]

The classic example, well known among industry and government regulators, is that tank lining workers work themselves out of their jobs after about five years. The toxicology lens, based on PELs and quantifying concentrations of sentinel chemicals, fails to protect these workers. Switching to a sensitivity lens, based on cell-mediated immunology, we understand that the workers gradually develop an intolerance to the chemicals in the products sprayed on the tank surfaces until the workers become physically unable to do this work. These illnesses, like those from oil spill exposures, are preventable.

A new approach is needed to secure and support symptom-based health monitoring. Knowing that PELs are no longer deemed reliable for protection of human health, the NRT developed an evidence-based approach using key symptoms of exposure to assess health. Unfortunately, current regulatory standards do not require recordkeeping to support symptom-based health monitoring. OSHA used to require recording and reporting of cold/flu-like symptoms but that requirement was dropped in 2001.[51] Also, modern intake platforms or a centralized database have not been developed to facilitate monitoring and surveillance. Requiring employers to record and report such symptom-based health criteria would provide the data needed to support establishment of an ERHMS system within responses.

Second, health monitoring starts with basic awareness training. Yet not all responders and other on-site field workers are properly HAZWOPER-trained to recognize signs and symptoms of potential exposure. Untrained workers will lack the awareness to realize and report a potentially dangerous situation. The classic example of lack of awareness training occurred during the BP Deepwater Horizon oil disaster when seven Louisiana fishermen operating as in situ burn crews were Medevacked off their boats and treated at a local hospital for acute respiratory failure in late May 2010. None had any HAZWOPER training—nor any respirator use training, but all were very

[50] See note 29, PELs—Annotated Tables.

[51] OSHA exemption 29 USC § 1904.5(b)(2)(viii): Occupational Injury and Illness Recording and Reporting Requirements, Final rule. 66 Fed. Reg. 5916 Jan. 19, 2001. 66 FR 5916

ALERT and allies petitioned OSHA in 2023 to reinstate this standard. ALERT and allies. 2023. Petition to OSHA to change a key rule that would provide greater protection to oil spill response workers. Feb. 13, 2023. https://alertproject.org/wp-content/uploads/2023/02/EII-ALERT-OSHA-Petition-FINAL-021323.pdf. https://alertproject.org/wp-content/uploads/2023/02/EII-ALERT-OSHA-Petition-FINAL-021323.pdf

clearly doing HAZMAT work. All subsequently are experiencing long-term respiratory harm and other illnesses, as evidenced from court records.[52]

While the rules for hazardous waste operations clearly state that only trained, qualified employees are permitted to participate in or supervise field activities [1910.120(e)], there is no such rule in the emergency response regs (q). The only workers who are NOT required to have minimum, employer-certified, HAZWOPER-training are skilled support personnel who are needed temporarily to perform immediate emergency support work. This is ripe for exploitation of these workers.

During the BP Deepwater Horizon oil disaster response, for example, ad hoc citizen responders were assigned to designated response work like the Vessel of Opportunity Program or shoreline "cleanup"—without adequate training to understand the signs and symptoms of potential chemical overexposures. The problem even reached the president's desk when the National Commission on the BP Deepwater Horizon oil disaster reported in 2011:

> "Response workers generally must be trained pursuant to the HAZWOPER regulation administered by the OSHA. 29 C.F.R. § 1910.120. This regulation requires specific training and medical surveillance and monitoring for workers dealing with hazardous materials. While this regulation presumably applied to formal response contractors after the Deepwater Horizon spill, it was not applied consistently to citizen responders who also require its protections."[53]

Mandatory respiratory protection programs require medical evaluation, training, and monitoring. Further, employers are required to provide respirators for employees in IDLH (Immediately Dangerous to Life or Health) atmospheres [OSHA, Subpart I, 1910.134(d)(2)(i)], and, where the employer cannot identify or reasonably estimate the employee exposure, the employer must consider the atmosphere to be IDLH [OSHA 1910.134(d)(1)(iii)]. Under the ERHMS system, uncertain exposures have the potential to present IDLH conditions until proven otherwise. However, the ERHMS system does not yet carry the weight of law.

By not recognizing uncertain exposures as presenting potentially IDLH conditions has resulted in unhealthy levels of exposure for certain response workers such as occurred during the BP Deepwater Horizon oil spill response—and will occur again until regulatory remedies provide the necessary training.

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[52] *Wunstell et al v BP*. 2023. Case 2:10-cv-02543-JTM-KWR, document 152, filed 5/5/2023. Order and Reasons. https://www.docketbird.com/court-documents/Wunstell-et-al-v-BP-PLC-et-al/-Order-and-Reasons-submitted-on-5-5-2023/laed-2:2010-cv-02543-00152

[53] See note 23, National Commission, 2011, *Deep Water*, at 277 and 353 (in endnote 25).

Third, for an ERHMS Unit to become a dedicated program for response, the data collection and recordkeeping need to be modernized. The ERHMS system needs to include a centralized secure HIPAA-approved repository for data collected to support data analysis for health monitoring of individuals and health trends for surveillance, and communication in real-time. COVID may have paved the way for this upgrade, in terms of establishing a process as an Essential Support Function (ESF)-8 of the Dept. of Health.[54]

Modern data intake tools are also needed to accomplish the intake at each data collection point. The ERHMS Info Manager is way too complicated for data collection (NIOSH, 2023).[55] An intake app for a phone could really simplify things for responders and the public. For example, the system needs to be adapted to deploy on devices commonly in use today such as cell phones, tablets, web-apps, etc., to increase its efficiency and utility. Data intake should also include 24-h exposure data for extended response and data on temporary housing and proximity to the contaminated area.

Finally, the ERHMS system at present is not suited to the modern workforce that needs to accommodate multiple employers and follow a responder the full length of their career.

The Agency for Toxic Substances and Disease Registry (ATSDR) provides a rapid response registry as a tool for local and state public health and disaster response agencies to support health assessments over time (ATSDR, 2023).[56] The agency also provides a decision support tool when considering whether to establish a registry (ATSDR, 2023).[57]

The use of the ERHMS system is supported by a 4-day course on disaster related exposure assessment and monitoring, offered through FEMA Center for Domestic Preparedness (FEMA, 2023). One of us (Hayes) took the FEMA ERHMS course/training in September 2023 and is now a valuable resource to help set up an updated ERHMS Unit in the RCP.

NWRCP Review & Summary Table

A review of the entire NWRCP plan[58] identified areas where the updated ERHMS system, as defined above, and a Public Health Assessment Unit (described Part II) are already covered, should be added, or more detailed guidance should be incorporated into the plan to streamline

[54] US Dept. of Health and Human Services, 2008. Emergency Support Function #8 – Public Health and Medical Services Annex. ESF #8-1. https://www.fema.gov/pdf/emergency/nrf/nrf-esf-08.pdf

[55] 2023. ERHMS Info Manager. https://www.cdc.gov/niosh/erhms/erhms-info-manager.html#print

[56] ATSDR online, 2023. Rapid response registry. https://www.atsdr.cdc.gov/rapidresponse/index.html

[57] ATSDR online, 2023. Rapid response registry tools. https://www.atsdr.cdc.gov/rapidresponse/#tools

[58] RRT 10/NWAC, 2020. Northwest Regional Contingency Plan. Online. https://www.rrt10nwac.com/nwacp/

their use during responses. The review identifies sections/annexes to the NWRCP and describes how each element could be covered by revising or adding new language to better protect all on-site field workers—professionals and non-professionals alike.

In general, there are numerous areas where the existing sections in 2000, 3000 and 4000 should be updated to incorporate the updated ERHMS system with the environmental exposure surveys (BREESI and QEESI) into planning and responses. The results of the review are presented in a table in Appendix D. An ERHMS decision matrix should be included in the 96-h toolkit in the NWAC (9220.1) to determine if the unit should be activated (see Appendix E).

We agreed with the NRT's recommendation to place the ERHMS Unit in Unified Command as a Safety Officer function—perhaps as a separate function or as a revision of 2234 and 2235 to encompass both environmental and health monitoring. The Health and Safety Job Aid (9203) should have new sections developed to cover the incorporation of the updated ERHMS system into response health and safety planning.

We note that incorporating an updated ERHMS system at the national level will make the current NIOSH approach to Health Hazard Evaluations obsolete. Instead, these evaluations could become part of the post-deployment monitoring and tracking phase with mandatory reviews at 1-year, 3-year, and 5-year intervals to generate more accurate, relevant, and timely quality information for decision-makers.

Developing the two new annexes to the NWRCP are needed elements to provide clear direction for their implementation. This would be the work of the Health & Safety Task Force in 2024.

Finally, we explored what incorporating an ERHMS Unit might look like in practice, drawing from a 1994 deposition of Daniel Teitelbaum, MD, a board-certified in environmental medicine, occupational medicine, and medical toxicology, with experience organizing medical programs during disaster response (doximity profile).[59]

According to Dr. Teitelbaum, functional and effective health monitoring means worker safety programs should have an occupational and environmental medicine structure with one lead Occupational and Environmental Medicine (OEM) doctor, not an Emergency Room doctor. For oil spill responses involving 10,000+ people, there should be one OEM physician for every 2,500 workers with two nurses and an industrial hygienist assigned to each team and safety personnel so

[59] Teitelbaum DT, MD, 1994. Deposition. October 12. In: *Garry Stubblefield and Melissa Stubblefield v. Exxon Shipping Company, Exxon Corporation, VECO, Inc., and Norcon, Inc.* 3AN–91–6261 CV (HBS), AK Superior Court, Third Judicial District at Anchorage (1994). Doximity profile: https://www.doximity.com/pub/daniel-teitelbaum-md-58ae50c4

that, for each task force and each shift, there would be either an EMT or a certified safety person who could provide first aid. These ERHMS teams would report to the lead OEM doctor who participates in and reports to Unified Command.

In summary, the revisions to the NWRCP and associated job aids should accomplish the following:

Pre-deployment

- Rostering and tracking of all on-site field responders and workers through a centralized database
- Baseline physical examinations and environmental exposure surveys for chemical sensitivities
- Baseline mental examinations
- A record of the level of HAZWOPER-training and certification for duty-specific tasks

During deployment

- Workplace assessments for health hazards including chemical mixtures and signs/symptoms of exposure
- Health monitoring and surveillance in real-time
- Symptom-based triggers for intervention measures
- Communication of health risk and health monitoring/surveillance in real-time
- Exit survey

Post-deployment

- Sharing medical records with employees
- Recordkeeping and reporting to OSHA
- Long-term tracking
- Mandatory health hazard evaluations due 1 year, 3 years, and 5 years intervals post-event, as part of the health survey program
- Recordkeeping and reporting to OSHA/NIOSH
- After Action Reports

OSHA HAZWOPER Analysis & The Need For Updates To Support An ERHMS Unit

> "Because oil spills have historically been viewed as environmental disasters, affecting nature, the Oil Pollution Act of 1990 and related policies offer fewer tools for addressing the human dimensions of such accidents... An unfortunate lesson of the [BP Deepwater Horizon] oil spill is that the nation was not well prepared for the possibility of widespread, adverse effects on human health and mental well-being, especially among a particularly vulnerable citizenry."
>
> National Commission (2011)[60]

This section presents an analysis of the changes needed in the OSHA HAZWOPER standards to support and/or require the establishment and use of an ERHMS Unit for spill responses in the Pacific Northwest, specifically, and United States in general.

Even though the RRT 10/NWAC could integrate an ERHMS Unit into the NWRCP without any law changes, changes in federal and state laws to support an ERHMS system would create a duty for employers to initiate and conduct health monitoring and surveillance of employees. Since it may be desirable to understand what this would entail, we identified seven areas of persistent gaps and deficiencies in federal and state HAZWOPER standards to determine what regulations or laws may be needed to support an ERHMS Unit as part of the NWRCP (Table 2) and nationally. The seven areas include:

1. Definitions;
2. Elements of an emergency response plan;
3. Skilled support personnel;
4. First responder awareness level training;
5. Health monitoring and surveillance;
6. Recordkeeping; and
7. Post-emergency response workers.

[60] See note 23, National Commission, 2011, *Deep Water*, at 191–2.

Of the three states in the NWRCP, Idaho is covered by the federal standards and the Oregon standards use the same numbering system. Thus, any changes noted for the federal regs would also apply to Idaho and Oregon. Washington has its own HAZWOPER regulation, and it has revised some of the federal regs, so it is listed separately. The suggested language is provided in Appendix F (OSHA HAZWOPER) and Appendix G (Washington HAZWOPER). Language for definitions is also presented in full in this section along with rationale for all suggested revisions.

Table 2. Areas of concern in relevant federal & Washington state HAZWOPER laws

Areas of Concern	OSHA HAZWOPER Law	WA HAZWOPER Law
1. Definitions	1910.120(a)(3)	WAC 296-824-009
2. Elements of an emergency response plan	1910.120(q)(2)	WAC 296-824-20005(1)
3. Skilled support personnel	1910.120(q)(4)	WAC 296-824-20005(2) WAC 296-824-50015
4. First responder awareness level training	1910.120(q)(6)(i)	WAC 296-824-30005
5. Health monitoring and surveillance	1910.120(q)(9)	WAC 296-824-40005
6. Recordkeeping	1910.120(f)(8)	WAC 296-824-40010
7. Post-emergency response workers	1910.120(q)(11)	WAC 296-824-70005

1. Definitions

The following definitions are from OSHA 1910.120(a)(3) and Washington Code (WAC) 296-824-099. Oregon and Idaho utilize federal OSHA definitions. The inset text following each definition presents the proposed language to incorporate the new scientific understanding of uncertain chemical exposures and the health risks of such exposures.

Health hazard

Both standards have identical definitions, and both cite the mandatory OSHA Health Hazard Criteria (1910.1200 Appendix A), although neither include complex chemical mixtures nor provide descriptions for the signs and symptoms of overexposure. Instead, they provide general descriptions of hazardous effects as categories. The H&S Task Force suggests a revised working definition (new language underlined):

> *Health hazard* means a chemical or a complex chemical mixture that is classified in accordance with the Hazard Communication Standard, 29 CFR 1910.1200, as posing one or more of the following acute or chronic health effects: Acute toxicity (any route of exposure); skin corrosion or irritation; serious eye damage or eye irritation; respiratory or skin sensitization; germ cell mutagenicity; carcinogenicity; reproductive toxicity; specific target organ toxicity (single or repeated exposure); aspiration toxicity or simple asphyxiant. (See Appendix A to § 1910.1200 – Health Hazard Criteria (Mandatory) for the criteria to determine whether a chemical or a chemical mixture is classified as a health hazard.)

Complex chemical mixtures

Neither standard provides a definition. The H&S Task Force suggests a new working definition:

> *Complex chemical mixture* means a material made up of one or more hazardous substances and/or health hazards with similar, dissimilar, or unknown toxicological endpoints, any of which are or may be in multiple phases as solids, liquids, dissolved states, colloids, suspensions, aerosols, and/or vapors simultaneously. Complex chemical mixtures are presumed to be health hazards until proven otherwise.

Signs or symptoms

Neither standard provides a definition. The H&S Task Force suggests a new working definition, using the characteristic symptoms of chemical overexposure (from oil spills) and the descriptions in 1910.1200 Appendix A for health hazards from skin corrosive/irritants A.2, respiratory irritants A.8.2.2.1, and narcotic effects A.8.2.2.2:

> *Signs or symptoms of exposure* to health hazards, as described in the Health Hazard Communication Standard, 29 CFR 1910.1200 Appendix A, include skin rashes or ulcers, bleeding, bloody scabs, alopecia (hair loss) or scars from skin corrosive/ irritants (A.2); cold- and flu-like symptoms such as wheezing, coughing, difficulty breathing or shortness of breath, chest tightness, watery eyes, runny nose from

> respiratory irritants (A.8.2.2.1); and severe headaches or migraines, nausea or vomiting, dizziness or vertigo, irritability, fatigue, impaired memory function, deficits in perception and coordination, reaction time, or sleepiness from central nervous system effects (A.8.2.2.2).

Uncertain exposures

Neither standard provides a definition. The H&S Task Force suggests a new working definition, adopted from the ERHMS TAD (2012):

> *Uncertain exposures* often involve complex chemical mixtures and occur when the toxicity of the hazard is unknown or when safe limits for exposure have not been established or when health monitoring indicates the presence of signs or symptoms of potential chemical overexposure. Uncertain exposures may also involve individual hazardous substances or health hazards when health monitoring indicates the presence of signs or symptoms of potential chemical overexposure below a pre-determined occupational exposure limit.

These changes in definitions signal systemic overhauls are needed of federal HAZWOPER standards and standards of states with OSHA-approved plans to support the updated ERHMS system recommended by the NRT. For example, "hazardous substance" and "health hazard" describe different materials, yet the standards often refer to only hazardous substances. This is beyond the scope of the H&S Task Force.

2. Elements of an Emergency Response Plan

The OSHA 1910.120(q)(2) and WAC 296-824-20005(1) regulations define the elements of an Emergency Response Plan. These standards require medical surveillance, as discussed (q)(9) below, but unless it is part of a comprehensive system of awareness training for and health monitoring of all on-site field workers, supported by recordkeeping and real-time analysis, the medical surveillance will not provide the quality information needed by decision-makers to minimize or prevent harm to response workers—as it consistently has not in past disasters.

To close this gap and to support an updated ERHMS system, we suggest requiring an additional element, after emergency medical treatment and first aid, for "health monitoring and surveillance" in both federal and Washington state laws (see Appendices F and G, respectively). Medical professionals proficient in emergency medicine have different skills and training than occupational and environmental medicine (OEM) professionals who are trained to recognize initial signs and symptoms of potential oil-chemical overexposures and discern the difference between chemical exposures and heat stress or common colds and flu.

3. Skilled Support Personnel

> "The National Contingency Plan overlooks the need to respond to widespread concerns about human health impacts. For smaller oil spills, the response effort is generally carried out by trained oil spill response technicians but, given the scale of the response to the Deepwater Horizon spill and the need to enlist thousands of previously untrained individuals to clean the waters and coastline, many response workers were not screened for pre-existing conditions. This lack of basic medical information, which could have been collected if a short medical questionnaire had been distributed, limits the ability to draw accurate conclusions regarding long-term physical health impacts."
>
> National Commission (2011)[61]

Read the lead sentence again and take "overlook" literally, as in "fails to notice." This is because "oil spills have historically been viewed as environmental disasters, affecting nature…"[62] When a major oil spill occurs close to a populated region, where people love and actively interact with the coastal, nearshore, and ocean environments, thousands of people, especially those with boats, will want to DO something to "help" clean up the mess. Thousands… or more.

In South Korea, some 1.8 million people arrived from around the Pacific rim and island nations to volunteer after the *Hebei Spirit* oil spill in late 2007. Their names are engraved in the walls of the museum that opened on the 10th memorial to honor the volunteers. Many volunteered again for the long-term health studies after they became sick, this time to help the scientists understand what had happened and how to mitigate or prevent such harm in the future. To honor the volunteers, Korean researchers called their collective work of health effect research on the oil spill, the HEROS program.[63]

The OSHA HAZWOPER standard section (q) is directed towards the private sector.[64] Paragraph [1910.120(q)(4)] addresses the need to contract temporary skilled support workers in large numbers, if necessary, for a major oil spill. These workers are often unfamiliar with hazardous waste operations. However, under this standard, they can be assigned to active emergency

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[61] See note 23, National Commission, 2011, *Deep Water*, at 277.

[62] Ibid., at 191.

[63] Park MS, Choi K-H, Lee S-H, Hur J-I, Noh SR, Jeong W-C, Cheong H-K, Ha M. 2019. Health effect research on *Hebei Spirit* Oil Spill (HEROS) in Korea: A cohort profile. *BMJ Open* 9:e026740. doi:10.1136/ bmjopen-2018-026740

[64] OSHA, 2015. Training Requirements in OSHA Standards, OSHA 2254-09R 2015, at 42. https://www.osha.gov/sites/default/files/publications/osha2254.pdf

response work, such as beach cleanup, decontamination, Vessels of Opportunity (VOO) crews, or oil spotters, where they may be exposed to reduced levels of contamination for weeks or months. These temporary designated response workers may have only a health and safety briefing about job site hazards or, at most, a first responder awareness level training (OSHA 2015)[65] that does not include a minimum number of hours of HAZWOPER training, as discussed in the next section.

The ERHMS system is designed to afford all workers who unexpectedly participate in response activities the same benefits of health monitoring and surveillance, especially in events that have a high probability of post-incident after-effects. In the ERHMS system, pre-screening and health questionnaires before deployment kick off a comprehensive health monitoring and surveillance program during and after the incident. However, the federal OSHA regs do not do this.

Federal regulations

OSHA HAZWOPER standard 1910.120(q)(4) states: "Personnel, not necessarily an employer's own employees, who are skilled in the operation of certain equipment, such as mechanized earth moving or digging equipment or crane and hoisting equipment, and who are needed temporarily to perform immediate emergency support work that cannot reasonably be performed in a timely fashion by an employer's own employees, and who will be or may be exposed to the hazards at an emergency response scene, are not required to meet the training required in this paragraph for the employers' regular employees…"

In contrast, regular employees who work as emergency or post-emergency responders[66] have a minimum of 8 to 40 hours of HAZWOPER training.[67] While some states have VOO programs that require HAZWOPER training,[68] others do not. Skilled support personnel who may spend weeks or months on-site in the field are not even required to have the minimum 8-hours of HAZWOPER training required for off- or on-site first receivers who spend minimal time on-site in the field when receiving incident victims who have not been thoroughly decontaminated.[69] Clearly, this

[65] Ibid., at 20–21.

[66] OSHA, 1990. Standard interpretation: Full time contract personnel at plant facility considered "workplace employees." Involving standards 1910.120(q)(11). 10/23/1990. https://www.osha.gov/laws-regs/standardinterpretations/1990-10-23

[67] OSHA, 2012. Standard interpretation: Applicability of HAZWOPER to the clearing and rerailing of train cars after derailment situations. Involving standards 1910.120 (a)(2)(iv), (q)(4), (q)(6), and (q)(11). 3/14/2012. https://www.osha.gov/laws-regs/standardinterpretations/2012-03-14

[68] Lamor, 2019. Vessels of Opportunity Integration and Equipment. February. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=165979

[69] OSHA, 2017. Standard interpretation: Training requirements for emergency response medical service. Involving standards 1910.120(q)(6) and (q)(6)(i). 3/31/2017. https://www.osha.gov/laws-regs/standardinterpretations/2017-03-31

standard puts skilled support personnel who become temporary designated responders at a health risk from oil spill exposures and at a health risk from long-term harm from their work-related initial exposures.

The National Commission also noted that the VOO program used untrained temporary workers for active response duty:

> "[Through the VOO program,] BP employed private vessels to conduct response efforts such as skimming, booming, and transporting supplies... the State of Louisiana began its own program, as did [several local governments]. The Unified Command struggled to coordinate this floating militia of independent vessels and to give them useful response tasks. Having hundreds of vessels look for oil did not contribute significantly to the response, because aircraft were more effective at spotting oil. Placing boom requires skill and training, and responders differed in their judgments of how much the vessels contributed."[70]

From this, we determined that there is a gap in the federal OSHA HAZWOPER standard 1910.120(q)(4) that allows temporary skilled "support" personnel to be contracted for designated response work (both emergency and post emergency). While the hazardous waste operations regulations clearly state that only HAZWOPER-trained, qualified employees are permitted to participate in or supervise field activities [1910.120(e)(1)], there is no such statement in the emergency response regulations (q) for temporary designated response workers.

To address this gap and to support an updated ERHMS system, particularly in states without OSHA-approved state plans, the H&S Task Force suggests adding new language to OSHA 1910.120(q)(4) to distinguish between skilled support workers who are needed temporarily to perform immediate emergency support work [(q)(4)(i)], and "temporary designated responders" (such as VOO teams) who are needed temporarily to perform designated response work [(q)(4)(ii)], such as a designated task force during an oil spill response, based on language found in the definition for "emergency response" in [(q)(a)(3)]. The proposed language requires minimum training for temporary designated responders and additional training for specific duties and function to be performed, with all the training certified by employers.

Washington regulations

Washington (and perhaps other states with OSHA-approved state plans) have taken steps to ensure that only HAZWOPER-trained certified workers are involved in active oil spill response work.

[70] See note 23, National Commission, 2011, *Deep Water*, at 140–141.

For example, Washington created a VOO Program in 2011 (after the BP Deepwater Horizon disaster) that requires all individuals involved to be HAZWOPER-trained and certified. State law requires facility plan holders and covered vessel plan holders (and owners and operators) to have a plan to obtain "nondedicated" work boats and operators that will be available for oil spill response work (WAC 173-182-315 and -317). In practice, the plan involves contracting primary spill response organizations (PSROs), which subcontract with the nondedicated VOO work boats and operators. VOOs are organized by regions and into two tiers. Tier I VOOs may contract with one or more PSROs, are pre-trained, and have HAZWOPER training "appropriate to the tactics the vessel may be assigned" with no more than 50% of the vessels pretrained exclusively for logistical support, i.e., with no or minimal HAZWOPER training (WAC 173-182-317). Tier II vessels are registered but not under contract to a plan holder's dedicated PSRO and may be rapidly trained and contracted for at least logistical support during large spills. Washington law also preregisters volunteers for the VOO program and a general volunteer.[71] The general volunteer program does not require HAZWOPER training, but it provides administrative work to keep volunteers from being exposed. Only persons from these pre-populated lists can assist during oil spill response.

Further, Washington law requires employers to give the same health and safety precautions given to employees to skilled support personnel (WAC 296-824-50015) and to provide the same industrial safety and health care for temporary workers as for their own employees (WAC 296-801),[72] meaning that temporary employees should be covered under the worksite employer's safety program. Washington law also requires staffing agencies to provide training to the employee for general awareness safety training for recognized industry hazards the employee may encounter at the worksite (WAC 296-801).

However, there is still a need for skilled support personnel during an oil spill response, and there is still a danger that these personnel may experience uncertain exposures and exhibit signs and symptoms of potential overexposure. To further close this gap in worker protection, we suggest revising WAC 296-824-20005(2) and WAC 296-824-50015 to better prepare these personnel to recognize signs and symptoms of exposure and to distinguish between skilled support workers and temporary designated responders to better protect all workers.

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[71] Washington Dept of Ecology. Vessel of Opportunity Program and Volunteer Program. 2011. https://www.oilspills101.wa.gov/vessel-of-opportunity-program/

——. Spill Prevention, Preparedness, & Response Program. 2014. Vessels of Opportunity: Supporting Oil Spill Response Activities. June. https://apps.ecology.wa.gov/publications/documents/1108006.pdf

[72] Reck T. 2021. Work injury for temporary workers: New law and historic legislation. Blog. https://tarareck.com/work-injury-temporary-worker/

4. First Responder Awareness Level Training

Under federal OSHA HAZWOPER regs for emergency response, the only people who are NOT required to have a minimum number of hours of employer-certified HAZWOPER-training are individuals who are trained at the first responder awareness level 1910.120(q)(6)(i). Washington regs are identical to OSHA regs in this paragraph. Further, currently first responder awareness level training does not include training to recognize signs and symptoms of potential overexposure to health hazards including complex chemical mixtures.

These standards are inadequate to support the ERHMS system because, as mentioned previously, the success of a health monitoring and surveillance program for workers hinges on whether people are adequately trained to recognize signs and symptoms of potential exposure. Without such information, people are unlikely to report symptoms that can be mistaken for common maladies such as colds or flu, headaches, vertigo, or skin rashes. Without reporting, there can be no intervention measures. This can lead to illness outbreaks and long-term harm to health.

This standard allows individuals who have not been adequately trained to recognize oil and chemical hazards to be at an emergency response scene where they may or are likely to be exposed to these hazards.

To address this gap, we suggest revising OSHA 1910.120(q)(6)(i) to support an updated ERHMS system by requiring that first responders at the awareness level receive at least eight hours of HAZWOPER training or have sufficient experience to objectively demonstrate competency in the stated areas, certified by the employer. We also suggest revising the areas of competency to include an understanding of hazardous substances, health hazards, and complex chemical mixtures and the ability to recognize signs and symptoms of potential overexposure to these hazards and take appropriate actions to mitigate harm. Further, we suggest similar revisions to WAC 296-824-30005 in Table 2 and Table 3.

5. Health Monitoring & Surveillance

OSHA HAZWOPER 1910.120(q)(9) and WAC 296-824-40005 do not support an ERHMS system. Neither standard provides comprehensive health monitoring and surveillance for all on-site field workers involved in oil spill response.

OSHA standard 1910.120(q)(9)(i) only provides limited health monitoring for two types of technicians and the monitoring is not incident-specific: “Only members of an organized and dedicated HAZMAT team and hazardous material specialists receive baseline physical examinations and are provided with medical surveillance as required in paragraph (f), which is not part of emergency responses.” This presumes that only workers who are likely to encounter and/or

be exposed to high levels of hazardous materials are the ones most at risk and in need of health monitoring. These presumptions are invalid for health hazards and complex chemical mixtures.

OSHA standard 1910.120(q)(9)(ii) denies emergency responders incident-specific health monitoring: "Any emergency response employees who exhibit signs or symptoms of potential overexposure to hazardous substances must be provided with medical consultation as required in paragraph HAZWOPER paragraph 1910.120(f)(3)(ii)." The latter provides standard medical surveillance and recordkeeping instead of incident-specific coverage. Critical information may not be conveyed to the physician as the standard covers employees who may have been exposed to hazardous substances but not health hazards as in 1910.120(f)(3)(i). Further, to support the initial consultations, the employer must provide a description of the employee's exposure levels or anticipated exposure levels as required in 1910.120(f)(6)(iii), but not a description of any uncertain exposures.

In contrast, the ERHMS system recognizes that exposure to any level of a health hazard or complex chemical mixture presents a potential health risk, that some persons will be more at risk than others to the same levels of contaminants, and that incident-specific health monitoring and surveillance is needed for all on-site field workers to minimize the risk of exposure and mitigate long-term harm.

The existing OSHA standards prevent the type of data collection needed to protect all on-site field workers and to support a comprehensive ERHMS system. To address these deficiencies, we suggest replacing OSHA section 1910.120(q)(9) in its entirety with new language that establishes a duty for employers to conduct health monitoring and surveillance of all on-site field workers, using an updated ERHMS system, and doing the same in Washington standards.

6. Recordkeeping

OSHA HAZWOPER 1910.120(f)(8) and WAC 296-824-40010 do not support an ERHMS system. Neither standard provides for a centralized recordkeeping database for incident-specific health monitoring and surveillance data for all on-site field workers—public and private, contractors and subcontractors—involved in oil spill response.

To address this gap in the OSHA HAZWOPER standards, we suggest adding new section 1910.120(q)(9)(v) for data collection and recordkeeping of all on-site field workers, using an updated ERHMS system, and doing the same in Washington standards.

7. Post-Emergency Response Operations

OSHA HAZWOPER 1910.120(q)(11) and WAC 296-824-7005 do not support an ERHMS system. Neither standard provides for consistent incident-specific monitoring of either temporary

designated emergency responders or regular employees who were involved during emergency response operations or post-emergency response operations. The current OSHA standard does not consider post-emergency response work to be part of the incident.

For example, any temporary designated responder would be provided medical treatment under OSHA standards 1900.120 (b) through (o). This means that long-term health surveillance for the incident would be compromised, as well as the primary function of the updated ERHMS Unit, which is to mitigate or prevent long-term harm from the incident.

The updated ERHMS system relies on long-term tracking of incident-specific health monitoring and surveillance to recognize and mitigate long-term harm. This is radically different than the NIOSH Health Hazard Evaluations (HHEs) that restrict their research to data collected during deployment. For example, the HHEs for both the *Exxon Valdez* oil spill and the BP Deepwater Horizon oil disaster concluded that the ubiquitous cold- and flu-like symptoms were exactly that, or symptoms of heat stress (in the case of the BP disaster) and did not require long-term health monitoring.[73] These conclusions have proved to be naïve, inaccurate, and untrue, based on follow up surveys[74] and clinical, laboratory, and epidemiology studies (see Appendix A). Further, the HHEs have wrongly informed policy- and decision-makers for decades, leading to laws that do not adequately protect worker health.

To address this gap in the OSHA HAZWOPER standards, we recommend adding a new section 1910.120(q)(9)(v) for data collection and recordkeeping to support an updated ERHMS system and doing the same in Washington standards. The new section provides all on-site field workers who were involved in an incident with an opportunity for long-term post-deployment health monitoring and surveillance, if needed.

Further, we recommend revamping the NIOSH Health Hazard Evaluations into the long-term health monitoring and surveillance support needed for the updated ERHMS system to provide quality information for policy- and decision-makers. Instead of one report, there could be a 3-part series, issued 1, 3 and 5 years after the incident—long enough to assess the true cause of harm and whether mitigation measures, if any, were successful.

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[73] NIOSH, 1991. Health Hazard Evaluation Report: HETA-89-200-2111 and HETA-89-273-2111, May. *Health Hazard Evaluation of the Exxon/Valdez* Alaska oil spill. Prepared by Gorman RW, Berardinelli SP, Bender TR. https://www.cdc.gov/niosh/nioshtic-2/00200313.html

NIOSH, 2011. *Health Hazard Evaluation of the Deepwater Horizon Response Workers,* Health Hazard Evaluation Report, HETA 2010-0115 and 2010-0129-3138. Aug. Prepared by King BS, Gibbons JD. https://www.cdc.gov/niosh/hhe/reports/pdfs/2010-0115-0129-3138.pdf

[74] O'Neill A. 2003. Self-Reported Exposures and Health Status Among Workers from the *Exxon Valdez* Oil Spill Cleanup. MSc Thesis for the Degree of Master of Public Health, Yale University, Dept. of Epidemiology and Public Health. https://rikiott.com/wp-content/uploads/2016/05/oneill_thesis.pdf

Summary of Needed Regulatory Changes

In summary, persistent gaps and deficiencies were identified in state and federal HAZWOPER regulations that undermine or obstruct the goal of protecting worker health and safety during emergency response and mitigating or preventing long-term harm. The seven areas of concern are each addressed by a remedy, as follows.

1. Add new definitions for complex chemical mixtures, signs and symptoms of exposure, and uncertain exposures, and revise the definition for health hazard, based on the 2012 OSHA HAZWOPER Appendix A Health Hazard Criteria (mandatory).
2. Add health monitoring and surveillance to the required elements of a response plan.
3. Differentiate skilled support personnel between those who are needed temporarily to provide immediate emergency support work and those who are needed temporarily to perform designated response work.
4. Upgrade first responder awareness level training to ensure all on-site field workers, including temporarily designated responders, are HAZWOPER-trained and certified.
5. Codify an updated ERHMS system for comprehensive health monitoring and surveillance that can be applied consistently to all on-site field workers (e.g., professional emergency and temporary designated responders, public health personnel, and cleanup, repair, and restoration workers).
6. Codify an updated ERHMS system for centralized recordkeeping.
7. Require consistent incident-specific health monitoring and surveillance for all post-emergency response workers who were involved during emergency response.

The recommendations in this section were presented in the Executive Summary but are repeated here in the context of, and following, our discussion.

Recommendations For Protecting Worker Health

Recommendations for Protecting Worker Health

In general, support for using the updated ERHMS system in the Northwest Region should be increased. To make this actionable, the H&S Task Force recommends that the RRT 10/NWAC develop a stated preference for long-term health monitoring and surveillance of response workers and community health assessments of the exposed public as part of emergency response and a streamlined process with procedures and tools to integrate an updated ERHMS system into responses in the Northwest Region. Further, the RRT 10/NWAC should request the NRT to support and promote use of an updated ERHMS system among RRTs and federal regulators.

Specific recommendations are as follows:

1. To mark a foundational change in the approach of protecting worker and public health, a clear statement is needed in the NWRCP, repeated in all Area Contingency Plans (ACPs or Area C-plans), that recognizes the potential for oil spill exposures to cause long-term harm to workers and the public even when exposed to contaminants at low action levels and that further states a preference for long-term health monitoring and surveillance of people who work in an on-site field capacity during oil spills and for community health monitoring and surveillance during oil spills.
2. Create an Incident Command System (ICS) position under the Safety Officer dedicated to creating an ERHMS Unit.
3. Add a determination of whether chemical mixtures are, or are likely to be, present as part of initial hazard assessment in the 96-hour tool kit for major incidents (9220).
4. Add the ERHMS decision matrix to the 96-hour tool kit (9220) for Day 1 as part of the initial hazard assessment and site-specific safety plan.
5. Update the ERHMS system by incorporating screening tools for chemical sensitivities and/or intolerances, using BREESI (a Brief Environmental Exposure Survey and Inventory) and QEESI (a Quick Environmental Exposure Survey and Inventory) as a Best Management Practice in the NWRCP.
6. Update the H&S Job Aid to include the use of ERHMS system.
7. Utilize and maintain a secure online, cloud-based, government-owned, HIPAA-approved information management system for the updated ERHMS medical monitoring and surveillance data.
8. Request that the NRT urge OSHA to update the HAZWOPER standard to create a mandatory duty for employers to initiate and conduct health monitoring and surveillance of employees during oil-chemical responses using the updated ERHMS system and the suggested language in Appendix F.
9. Request the NRT to actively promote the ERHMS system among the RRTs and update the tools for the modern workforce.
10. Request that the Washington Dept. of Labor and Industries, Division of Occupational Safety and Health, update the WAC standards to create a mandatory duty for employers to initiate and conduct health monitoring and surveillance of employees during oil-chemical responses using the updated ERHMS system and provide the suggested language in Appendix G.

PROTECTING PUBLIC HEALTH

> "Everybody I knew or loved or cared about was going to the doctor for headaches or chest pains or stomach pains—and it was stomach cancer, liver cancer, kidney cancer, colon cancer, pancreatic cancer, breast cancer, lymph node cancer, brain cancer. I went to 23 funerals in 18 months, then I stopped counting. People in the community have had to learn to live ill."
>
> Kindra Arnesen, Venice, Louisiana, 2020[75]

BACKGROUND

It was common knowledge across the Gulf Coast during the BP disaster that ordinary folks—residents and visitors—were also getting "oil sick" (Gulf coast vernacular) with the same signs and symptoms expressed by workers. Even the limited number of studies conducted on public health connected spill exposures with increased health risk.

For example, the Southeast Louisiana air quality study found that the 5-month (May through September 2010) average ambient air levels for benzene and PM2.5 exceeded pre-spill background levels and protective standards for public health in regional (rural) and coastal areas—and, further, the data carried an aerosol signature associated with the oil spill.[76] In contrast, the air quality in the urban areas was relatively normal compared to previous years and the levels did not exceed public health standards. Many think this study set a "floor" for oil exposure levels for residents and workers, at least in southeast Louisiana, because it is difficult to imagine that on-site land workers could have experienced lower exposure levels than residents when these workers were also exposed 24/7, and they did not usually wear protective gear.[77]

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[75] Natural Resources Defense Council, 2020. The mother who became a voice for the Gulf. https://www.nrdc.org/stories/mother-who-became-voice-gulf

[76] Nance E, King D, Wright B, Bullard RD. 2016. Ambient air concentrations exceeded health-based standards for fine particulate matter and benzene during the BP Deepwater Horizon oil spill. *J Air Waste Manag Assoc.* Jan, 66(2):224-36. doi: 10.1080/10962247.2015.1114044

[77] GAP (Government Accountability Project), 2013. Deadly dispersants in the Gulf: Are public health and environmental tragedies the new norm for oil spill cleanups? Devine S, Devine T. www.whistleblower.org

This "floor" for oil exposure levels likely extended to other coastal communities across the oil-impacted Gulf coast because hydrology controlled the movements of the air masses. Airborne oil contaminants were just hitch-hikers along for the ride. Studies confirmed that oil spill pollutants were transported both within and above the marine boundary layer to land. Secondary organic aerosols that formed within the marine boundary layer[78] were predicted to reach coastal communities downwind of the spill upwelling source and over 80 miles inland.[79]

The oil mists and aerosols carried within this layer were observed by coastal residents and others, as it coated seaward-facing windows of homes and vehicles and collected in folds of beach umbrellas left outside for the night (witnessed by author). Soot and other pollutants from smoke plumes that lofted above the marine boundary layer[80] were blown overland and returned to the earth's surface as the "oil rain" observed by coastal residents. Pollutant transport within and above the marine boundary layer were commonly seen as gray haze, which one Venice (Louisiana) resident described as "everywhere" during the early days of the disaster.[81]

Increased concentrations of PM2.5 and secondary organic aerosols in affected coastal counties was linked with increased incidence of low birth weight (<2500 g) and premature born infants (<37 weeks of gestation), with more pronounced adverse infant health outcomes for black, Hispanic, less educated, unmarried, and younger mothers.[82] Also, unusually high levels of oil were

———, 2015. Addendum Report to Deadly dispersants in the Gulf: Are public health and environmental tragedies the new norm for oil spill cleanups? Devine S, Devine T. https://whistleblower.org/wp-content/uploads/2018/11/GAPAddendumReportFinal.pdf

———, 2020. Ten Years After [BP] Deepwater Horizon: Whistleblowers continue to suffer an unending medical nightmare triggered by Corexit. Apr 2020. Devine T, Arnold A. https://whistleblower.org/wp-content/uploads/2020/04/Ten-Years-After-Deepwater-Horizon.pdf

———, 2024. DEEP IMPACT: Ongoing vulnerability in oil spills from the deadly dispersant Corexit. Pacey L, Devine T.

[78] de Gouw JA, Middlebrook AM, Warnecke C, + 24, Watts LA. 2011. Organic aerosol formation downwind from the [BP] Deepwater Horizon oil spill. *Mar Science* 331:1295–99. 10.1126/science.1200320

[79] Middlebrook AM, Murphy DM, Ahmadov R, +25, and Ravishankara AR. 2012. Air quality implications of the Deepwater Horizon oil spill, at Table 8. *Proc Nat Acad Sci. Phys Sci*; 109: 20280–5. doi:10.1073/pnas.1110052108

[80] Ibid., Middlebrook et al., 2012.

Perring AE, + 13, Fahey DW. 2011. Characteristics of black carbon aerosol from a surface oil burn during the Deepwater Horizon oil spill. *Geophys Res Lett*; 38: 1–5. doi: 10.1029/2011GL048356

Ryerson TB, + 26. Atmospheric emissions from the Deepwater Horizon spill constrain air-water partitioning, hydrocarbon fate, and leak rate. 2012 *Geophys Res Lett* 38, L07803.

[81] Conception Media, 2020. The Cost of Silence. Investigative documentary film. Santa Barbara, CA. https://www.conceptionmedia.net/the-cost-of-silence-details

[82] Beland L-P, Oloomi S, 2019. Environmental disaster, pollution, and infant health: Evidence from the [BP] Deepwater Horizon oil spill. *J Environ Econ Mgmt.* Nov 98:102265. doi.org/10.1016/j.jeem.2019.102265

found in the blood of exposed residents, including children and oil spill workers during the 2010 oil spill response.[83] Although the levels had dropped to near background levels three years later,[84] the initial high levels were predictive of end-organ damage, which after a latency period, began manifesting as severely compromised health, premature deaths, and a dramatic increase of clusters of rare diseases and cancers, associated with oil exposures, in children and adults in oil-impacted coastal communities.[85]

Advancements in medical research, technology, and managing big data have led to an understanding that long-term harm from acute high-level exposures to pollutants is consistent with the long-term harm from chronic low-level exposures to the same pollutants.

For example, a meta-analysis of petroleum-exposed workers and residents living near petroleum facilities found petroleum industry work was generally associated with an increased risk of multiple myeloma (with non-significant elevated risk for acute myeloid leukemia, chronic lymphocytic leukemia, and leukemia), and cancers of the prostate and urinary bladder, and, in offshore workers, an increased risk of lung cancer. Further, residential proximity to petroleum was associated with childhood leukemia.[86]

Volatile organic compounds like benzene and other solvents are known to induce blood cancers including acute myeloid leukemia, multiple myeloma, chronic lymphatic leukemia, and other blood- and hepatic-related disorders.[87] Further, exposure to a range of levels of PM2.5 of the size range generated during oil spills as secondary organic aerosols or chemically dispersed oil was

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[83] Summarco PW, Kolian SR, Warby RA, et al. 2016. Concentrations in human blood of petroleum hydrocarbons associated with the BP/Deepwater Horizon oil spill, Gulf of Mexico. *Arch Toxicol*. 2016 Apr;90(4):829-37. doi: 10.1007/s00204-015-1526-5. https://pubmed.ncbi.nlm.nih.gov/25998020/

[84] Doherty BT, Kwok RK, Curry M, et al. 2017. Associations between blood BTEXS concentrations and hematological parameters among adult residents of the U.S. Gulf states, Table 2. *Environ Res.* Apr 26;156:579-587. doi:10.1016/j.envres.2017.03.048

Werder EJ, Engel LS, Blair A, et al. 2019. Blood BTEX levels and neurologic symptoms in Gulf states residents. *Environ Res*. 175:100-107. doi: 10.1016/j.envres.2019.05.004.

Werder EJ, Gam KB, Engel LS, et al. 2018. Predictors of blood volatile organic compound levels in Gulf coast residents. *J Expo Sci Environ Epidemiol*. June;28(4):358-370 doi: 10.1038/s41370-017-0010-0.

[85] See note 81, Conception Media, 2020.

Eastern Shore Community Health Project. 2021 (updated). Based on National Cancer Institute statistics for 2013–2017. http://easternshorechp.org/cluster-maps/

See note 77, GAP, 2013-2024, BP Deepwater Horizon Public Record.

[86] Onyije FM, et al. 2021. Cancer incidence and mortality among petroleum industry workers and residents living in oil producing communities: A systematic review and meta-analysis. *Int'l J Environ Research Pub Health* Mar 18,4343. doi.org/10.3390/ijerph18084343

[87] Constantini AS, et al., 2008. Risk of leukemia and multiple myeloma associated with exposure to benzene and other organic solvents: Evidence from the Italian-Multicenter Case control study. *Am J Ind Med* 51(11):803–11. doi: 10/1002/ajim.20592

associated with respiratory tract diseases like asthma/wheezing, lower respiratory track illness, bronchitis, and lung cancer, with children more susceptible than adults.[88]

Better understanding of the initial symptoms, mechanisms, pathways, and disease outcomes has led to calls from clinicians, academics, and federal agencies for better policies and practices to minimize harm from occupational and environmental exposures and manage chronic illnesses.[89]

From this background, we determined that better policies and integrated practices were needed to minimize the public health risk from exposure to complex mixtures of oil-chemicals during emergency releases and ensuing harm (see also Appendix A).

Integrating a PHA Unit Into the NWRCP

We discussed four key reasons to justify establishing a Public Health Assessment (PHA) Unit. First, there is a need to consolidate all aspects of public health in one place. There is always an aspect of public health in all oil spill response activities, yet it lacks integration into the NCP. Instead, what the public sees is that the environment and wildlife have a position/function in the Incident Command System and Unified Command, but there is no parallel position/function for public health and safety. A PHA Unit would put everything in one unit. It could be scaled up, depending on the size and complexity of the oil spill.

Second, it doesn't matter if it's COVID, a natural disaster, or an oil-chemical release. Protecting public health falls to local public health jurisdictions to host, collect, share, and simplify results. If anything, the knowledge that well-defined signs and symptoms of exposure can lead to long-term illnesses and cancers that could have been mitigated with proper and early intervention makes it an imperative to act upon, not ignore, the outbreak of cold- and flu-like symptoms that follow oil-chemical emergency releases. A PHA Unit would make good intentions actionable, while retaining local authority over public health and integrating this authority into the ICS structure.

Third, having a well-planned PHA Unit, based on the latest science and technology and ready to implement, could provide quality information to responders and increase the odds of "minimum-regret" decisions during emergency responses, a more conservative option than "maximum-win" decisions, and one that is used when resource stakes are high[90]—such as when there is a need to mitigate or prevent long-term harm to worker and public health during an oil spill. For example,

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[88] Liu Q, Xu C, Ji G, et al., 2017. Effect of exposure to ambient PM2.5 pollution on the risk of respiratory tract diseases: a meta-analysis of cohort studies. *J Biomed Res*. Jan 19;31(2):130-142. doi: 10.7555/JBR.31.20160071. PMID: 28808195; PMCID: PMC5445216.

[89] Bijlsma N, Cohen MM. 2016. Environmental chemical assessment in clinical practice: Unveiling the elephant in the room. *Int J Environ Res Public Health* 13(2):181. doi:10.3390/ijerph13020181

[90] See note 58, RRT 10/NWAC, 2020, Review dispersants and health.

there is still a heavy reliance on air monitoring to assess health risk, a maximum-win decision. However, currently, exposure monitoring is the more conservative minimum-regret decision. The PHA Unit would report both air quality exceedances and signs and symptoms of exposure. It could be substituted for the Community Air Monitoring (CAM) (NWAC 9418) since it would encompass both air quality monitoring and health monitoring.

Fourth, a PHA Unit could help alleviate some of the mental health stress associated with the disaster by providing local people a voice and a process to express concerns, share ideas, and provide feedback and providing the agencies an opportunity to explain sample results for sediment, soil, water, and air, and how they are screened. The messaging would come from a local public health jurisdiction that has eyes/ears on the ground and interfaces regularly with the public to hear concerns as they evolve during a response. Perhaps this is why the idea of better communicating health risk to the public during oil-chemical spills/releases is catching on—especially after the train derailment in East Palestine, Ohio. For example, Local Emergency Planning Committee (LEPC) Kennewick and Tacoma Pierce County want to be involved in creating better messaging for the public and a PHA Unit. It would be good to build on this momentum.

Relevant Lessons Learned from RRT 9/CAL OSPR Working Group

During the Refugio oil spill in California, the state Dept. of Fish and Wildlife, Office of Oil Spill Prevention and Response ("CAL OSPR") and RRT 9 found public health assessments—and authority—were not well integrated into response (CAL OSPR, 2015).[91] They created a working group to remedy this gap by establishing a PHA Unit. The CAL PHA Unit integrates public health within the ICS structure during response while retaining state authority by creating two positions: a PHA Unit leader (EPA) familiar with the Incident Command System and a PHA Unit Coordinator for the state and local public health entities. This PHA Unit was successfully deployed during a 2021 offshore pipeline oil spill in California.[92] However, up to this point, the CAL OSPR PHA Unit relies on air monitoring and does not include assessments for sign, symptoms, and sensitivities of potential overexposure. Its members want to collaborate with the H&S Task Force to develop a public health monitoring and surveillance monitoring program and integrate it into the response plans in 2024.

Siting the PHA Unit Within the ICS Structure

We discussed siting of the PHA Unit in various places within the ICS framework, but ultimately aligned with the CAL OSPR position. Some of our reasoning follows.

[91] See note 12, CAL OSPR, 2015, Refugio.
[92] See note 13, CAL OSPR, 2021. Pipeline P00547.

Option: Command → Liaison Officer → NEW Public Health Officer (PHO)

Coordinators are under Liaison. The Incident Command–Joint Information Center–Public Information Officer (IC-JIC-PIO) all coordinate on messaging but maintaining state and local authority over public health—and messaging—is paramount to maintaining credibility.

Command → Safety Officer (SFO)

We felt that PHA Unit responsibilities should not fall under Command → Safety Officer to minimize scope creep and to keep responder health and safety separate from community health and safety. It would also prevent resources from being pulled from one area to another. There is precedent for preventing scope creep under community air monitoring.

Planning → Environmental Unit (EU)

Air, water, and soil are natural resources, monitoring of which is considered "environmental monitoring." Collecting and digesting data are also EU roles. External communications about the EU findings are a Liaison role. Similarly, a Liaison role could be connected to the PHA Unit like with the Environmental Unit. Community air quality and health monitoring could be sited in an EU, but we felt that the EU has other responsibilities—it's about the environment. There is a span of control issue if the response gets too large or complex (see "Scaling the PHAU effort" below).

Command - - - - - - - - > Public Health

Instead of coming from Unified Command, the messaging would come from a local public source. IC-JIC-PIO can all help share the messaging, but Public Health needs eyes/ears on the ground to identify concerns from subject matter experts and the public. However, if the PHA Unit is entirely outside of the Unified Command (UC), then funding would be a problem, as well as access to resources and messaging. Operating within the ICS structure is about a unified response.

The California working group seems to have arrived at a working solution, i.e., integrating the PHA Unit within the ICS structure by creating two new positions, a PHA Unit leader (EPA, in their case) to coordinate with the IC-JIC-PIO to share messaging and a PHA Unit Coordinator for the state and local public health entities to coordinate collecting and digesting the data.

Clarification: This means the public, NOT LEPCs, which only respond to Extremely Hazardous Substances (EHS) chemical releases from facilities or trains from natural disasters. Even though the Oil Pollution Act mandated that LEPCs plan for oil spills, this was an unfunded mandate, and it didn't really get implemented. However, during an oil spill, the Local On-Scene Coordinator

(LOSC) is usually a member of the LEPC, and they are a good source of local knowledge, experience, and resources. Pipeline and Hazardous Materials Safety Administration (PHMSA) funds LEPCs through Hazardous Materials Emergency Preparedness (HMEP) grants.

Scaling The PHA Unit & Deciding When To Activate It

Another idea was to scale the PHA Unit depending on the size and/or complexity of the oil spill like this as a possible example:

SMALL SCALE: Planning → Environmental Unit (EU)
MEDIUM SCALE: Independent Unit under Planning → PHA Unit
LARGE SCALE: As for medium scale but with both leader and coordinator roles filled.

A Public Health Assessment decision matrix has been developed by the RRT 9/CAL OSPR working group (see Appendix E). Adding guidance for health was suggested. The Public Health Department of each state or local government would use the decision matrix and keep the Unified Command (UC) informed. The complexity of the spill or where it occurs does not matter for public health. A barometer of health risk could be whether the UC has initiated the ERHMS Unit, not where the spill has occurred.

Public health departments should be proactive to get informed of a health threat, relying on public education and local Community Emergency Response Teams (CERTs) to report outbreaks. While people have been "trained" by COVID to report health symptoms to public health officials, public health educational materials about what to expect for oil spill emergencies would be helpful and are part of Task 2 recommendations.

Emergency room records could be reviewed but most people self-treat for symptoms that appear as a common cold or flu. Since people do self-treat, pharmacy records of inventory and sales could be used as indicative of an illness outbreak in the populace. For example, during the BP Deepwater Horizon disaster, Gulf Coast pharmacies reported unusually high "flu season" level sales during the summer off season.

Further, since oil spill exposures can cause long-term harm to health, there is a need for public health assessment to continue for at least 5 years post-spill. This also has implications for public health educational materials, long-term coordination with treating health care providers in the impacted region, and responsibility to maintain public records of data. Recommendations were added to create an online, cloud-based data storage system for PHA Unit data and to modernize data collection with mobile phones, although it was acknowledged that a diversity of methods would be needed to collect data from impacted people without cell phones.

Tools—available and/or needed

Other tools for a PHA Unit, besides the decision matrix, include the environmental exposure surveys, BREESI and QEESI, discussed earlier under Protecting Worker Health and in Appendix C. This would help identify neighborhoods or areas of a community where residents may have already been initiated by low levels of chemicals or other sensitizers in their environment[93] (Lowe et al., 2019) or where the spilled oil may create a higher exposure risk.

For example, after the largest tar sand-derived oil spill in Kalamazoo, Michigan (2010), residents near the Ceresco dam suffered health problems as submerged tar sands oil pooled and collected in the upstream sediments and oil on the river surface created mists and aerosols as the contaminated water spilled over the dam.[94] Enbridge's home buyout program did not include rental properties such as Baker Estates Trailer Park, located 200–300 feet from the oiled river in Battle Creek. The low-income residents living there suffered characteristic symptoms of oil exposure and, within five years of the spill, 18 residents had died, many believe from spill-related health issues. In these cases, environmental exposure surveys would have warned of a problem and actions could have been taken to mitigate or prevent long-term harm.

Also, tools should be able to access potential sources for data mining, such as purchasing and production records such as from local pharmacies where people get over-the-counter medication for self-treatment of common cold- and flu-like symptoms.

Possible Funding Sources for a PHA Unit

The PHA Units could be set up by states with matching funds from the Oil Spill Liability Trust Fund (OSLTF) to assist states in preparing for oil spill response. For expenses incurred during response, the impacted state or lead federal agency could submit a claim to the OSLTF to request reimbursement. Or, if a state makes a disaster declaration, then other funding sources would become available under Emergency Support Function #8 (ESF-8)– Public Health and Medical Services Annex 4 and, in Washington state for example, ESF-8 Appendix 2 – Medical

[93] Lowe SR, McGrath JA, Young MN, et al., 2019. Cumulative disaster exposure and mental and physical health symptoms among a large sample of U.S. Gulf Coast residents. *J Traumatic Stress*; 32:196-205. doi.org/10.1002/jts.22392.

[94] CBS News (AP), 2011. Study: No long-term health effects of Kalamazoo River spill. 8/18/2011. https://www.cbsnews.com/detroit/news/study-no-long-term-health-effects-of-kalamazoo-river-spill/ The report only assessed the health risk from submerged oil. The Michigan Dept. of Community Health noted in a written statement, "It does not evaluate breathing in chemicals from the remaining oil or any public safety concerns posed by the ongoing cleanup of oil in the river." Residents who lived in Baker Estates Trailer Park along the river reported open sores and worsening respiratory problems over five years.

Surge Response. If there is responsible party, then the funds would be pulled out of existing budgets and reimbursed.

Recommendations For Protecting Public Health

1. Create a PHA Unit and recommend where to site it within the ICS structure based on the scale of the incident; the preference is to create two positions—a PHA Unit leader (EPA or public health agency) familiar with the Incident Command System and a PHA Unit Coordinator for the state and local public health entities.
2. Create a committee to develop criteria for a PHA Unit, including use of environmental exposure surveys for chemical sensitivities such as BREESI and QEESI.
3. Create or update Public Health educational materials about oil spill exposures for risk communication in general and specific messaging for oil-impacted property owners.
4. Create an online, cloud-based data storage system for PHA Unit data.
5. Purchase or create an app for mobile phones to collect data.

HEALTH & SAFETY MESSAGING

A quick review of the "Key Messages for Oil Spills" in the USCG's PIO Job Aid,[95] and similar documents being used by Region 10 members, found the guidance (and their constituent messaging) in need of updates based on newer findings of long-term harm from oil spill exposures. The messaging is heavy on use of air monitoring to assess health risk to hazardous substances. Health hazards are rarely mentioned, complex chemical mixtures are not mentioned at all, and signs and symptoms of exposure are not used to assess health risk. Air monitoring is now known to be insufficient without health monitoring and surveillance. The implications of documenting and tracking exposures to hazardous substances and health hazards—based on signs and symptoms of exposure and underlying chemical sensitivities—make it necessary to do a systemic overhaul of all health and safety messaging for oil-chemical responses.

This could be part of the mandatory reviews of all contingency plans (Area C-Plans, preauthorization plans as part of Area C-Plans, and RCPs) that was triggered by EPA's final action on Subpart J governing use of dispersants and other products now in effect.[96] Current standards require:

- mandatory reviews based on the latest science, technology, law, and lessons learned from other spills [§ 300.910(a)(3)];
- consideration of product limitation and use parameters [§ 300.910(a)(1)]; and
- participation of state members as part of Area Committees in plan review and approval [§ 300.910(a)(1)].

Current standards also require, as part of the information for product submittal, product limitations and use parameters and known environmental fate and effects [§ 300.915(a)(9)–(11)]. These rules, combined with the current standards for truth-in-reporting [§ 300.970(a)(1)], including new or relevant information about impacts or potential impacts to human health or the environment [§ 300.970(a)(4)], will provide accurate, complete, and relevant ("quality") to make informed choices about product use—and informed messaging. For example, failure to comply with the truth-in-reporting rules, can be used as grounds for removal of a product from the Schedule. At a minimum, these standards necessitate the rewriting most of the messaging on dispersant effects and how to reduce exposures.

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[95] US Dept. Homeland Security, US Coast Guard, 2014. Public Information Officer, PIO, Job Aid. https://homeport.uscg.mil/Lists/Content/Attachments/2916/PIO_Job_Aid-May2014.pdf

[96] 88 FR 38280.

CONCLUSION & NEXT STEPS

The Health & Safety Task Force of the RRT 10/NWAC was one of eight task forces chartered by the RRT Executive Committee in February 2023. The purpose of the H&S Task Force was to examine the need for updates to the NWRCP to protect responder and public health during emergency responses to hazardous materials releases, especially ones that involve health hazards and chemical mixtures such as oil spills.

The National Response Team helped develop and has promoted the use of the Emergency Responder Health Monitoring and Surveillance (ERHMS) system to mitigate health impacts in situations where PELs are an unreliable indicator of health risk, such as from exposure to low levels of health hazards and chemical mixtures. However, the implementation of this potentially game-changing approach to protecting worker health during emergency responses has lagged. In addition, since it was developed over a decade ago, the ERHMS toolkit lacks some features that would allow it to become a truly useful and efficient tool to track responder health throughout their response careers.

The ERHMS system and other tools are needed to account for and track on-site field worker health, including emergency response workers, public health personnel, and cleanup, repair, and restoration workers. Prescreening tools should include environmental exposure surveys for chemical sensitivities and health monitoring during and following emergency responses to better identify the effects on individuals and mitigate long-term harm and to inform future responses. Data intake tools should be updated to allow for use on modern platforms (cellphone/tablet apps) and should feed a secured database that can store an individual's data throughout their careers.

To mark a foundational change in the approach of protecting worker and public health, the Health & Safety Task Force recommends a clear statement is added in the NWRCP, and repeated in all Area Contingency Plans, that recognizes the potential for oil spill exposures to cause long-term harm to workers and the public even when exposed to contaminants at low action levels, and further, that states a preference for long-term health monitoring and surveillance of people who work in an on-site field capacity during oil spills and for community health monitoring and surveillance during oil spills.

The Health & Safety Task Force recommends that an updated ERHMS Unit with environmental exposure surveys and a centralized on-line database be established within the ICS structure and be stood up for appropriate incidents, and further, that the tools created for the purposes of protecting on-site field worker health be incorporated into all incident responses that could

possibly jeopardize such workers' health—especially where health hazards and chemical mixtures are or are likely to be present.

The Health & Safety Task Force also recommends that a policy be established within the NWRCP to stand up and support the use of a Public Health Assessment (PHA) Unit with technical assistance, equipment, and other resources and, further, that a PHA Unit be stood up and implemented during responses where the public may be at risk of exposure to contaminants from releases of hazardous substances in the Pacific Northwest.

The shift to a symptom-based health monitoring approach to assess worker and public health risk from oil spills, and other disasters involving health hazards and chemical mixtures, marks a foundational change in hazardous materials response. As with any foundational change, policies need to be updated, based on the science and evidence of harm, to better protect humans during response efforts and to mitigate long-term harm.

And, finally, the Health & Safety Task Force recommends that it be continued in 2024 for the following tasks:

1. Develop the statement marking the foundational change to symptom-based health monitoring in the NWRCP.
2. Develop a new Annex to the NWRCP for a ERHMS Unit, including a list of Subject Matter Experts, and revise other sections as needed to support such a unit (based on detailed recommendations in Section I. Protecting Worker Health).
3. Develop a new Annex to the NWRCP for a PHA Unit, including a list of Subject Matter Experts, and revise other sections as needed to support such a unit (based on detailed recommendations in Section II. Protecting Public Health).
4. Initiate/complete a rewrite of health and safety messaging for responders, other on-site field workers, and the public during oil-chemical responses; Develop health and safety messaging, as needed, to support both new annexes.

AUTHOR BIOS

LAURA HAYES

BSc Environmental Science, Pacific University (2015), MSc in Industrial Hygiene, Montana Technological University (2020)

OSHA Emergency Safety Specialist Certificate (2018)

16 years of experience in oil spill and hazardous materials response

DON PETTIT

BSc Geology and Interdisciplinary Studies, Southern Oregon State University (1986), MSc in Geology, Portland State University (1990) hydrogeology, sedimentology emphasis)

35 years of experience in cartography/GIS, geologic and environmental investigations, fate and transport of environmental contaminants, site remediation, environmental protection, and planning/responding to emergency phase hazardous materials releases

RIKI OTT

MSc, Univ South Carolina (1980) and PhD, Univ of WA (1985) in marine toxicology

Subject matter expert: Oil spill effects on human health and cold-water marine ecosystems

Matriarch of high standing: Solidarity Clan ("British Columbia") recognized in 144 First Nations

37 years of experience in dealing with socio-economic-environmental consequences of major oil spills including *Exxon Valdez* (1989), *Aagean Sea* (1992, Coruna, Spain), *Sea Prince* (10-y memorial in 2005, Yosu, South Korea), *Prestige* (2002, Galicia, Spain), *Hebei Spirit* (2007, Taean, South Korea), BP Deepwater Horizon (2010), Enbridge PL-5 (2010, Kalamazoo, MI), Exxon Pegasus PL (2013, Little Rock, AR), BP Whiting refinery (2014, Lake Michigan), *Marathassa* (2015, English Bay, Vancouver, BC), *Wakashio* (2020, Mauritius, western Indian Ocean)

Author: *Alaska's Copper River Delta* (Univ WA Press, 1998)

Sound Truth and Corporate Myths (Dragonfly Sisters Press, 2004) on long-term impacts to people and wildlife from *Exxon Valdez* oil spill

Not One Drop (Chelsea Green Publishing, 2008) on long-term socio-economic and psychosocial harm to people and communities from the *Exxon Valdez* oil spill

Documentary films (as cast):

Black Wave: The Legacy of the Exxon Valdez Oil Spill (Macumaba International/ Bullfrog Films, 2008)

Dirty Energy. The Deepwater Horizon Disaster: First-Hand Stories from the Louisiana Bayou (B Hopkins/ Cinema Libre Studio, 2013)

The Cost of Silence (Conception Media, 2020), an investigation of the health consequences of the BP Deepwater Horizon oil disaster

Director: A Locally Empowered Response Team (ALERT) (www.alertproject.org), a project of Earth Island Institute

APPENDIX A.

> "When you have sick workers and sick animals, and they are sick because of the same chemical, then you have the strongest evidence possible that the chemical is causing the problem."[1]
>
> Dr. William Rea, MD
> Cardio-thoracic surgeon
> Founder, Environmental Health Clinic–Dallas
> Mentor & friend

Science Synopsis:

Human Health Impacts of Oil Spill Exposures

by Dr. Riki Ott
Subject Matter Expert
The ALERT Project

This synopsis is meant to support the recommendations and next steps in the Health & Safety (H&S) Task Force Report, specifically, the need for and development of the Annexes and Job Aids for the EHRMS Unit and PHA Unit and updating the health and safety messaging. Originally conceived as a brief overview, it was expanded to include a more detailed review digest to better serve its multi-purpose function. It was largely excerpted, with some modifications and updates, from a 2023 ALERT and allies petition to OSHA to reinstate the pre-2001 recordkeeping requirements for cold- and flu-like symptoms,[2] and from an amicus curiae letter (pro se) in support of retaining expert witness testimony (epidemiology studies) that was granted by the 11th Circuit Court of Appeals.[3]

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[1] Ott R, 2008. *Not One Drop: Betrayal, and Courage in the Wake of the* Exxon Valdez *Oil Spill* (Chelsea Green Publishing: White River Junction, VT), at 219–220.

[2] ALERT and allies, 2023. Petition to OSHA to change a key rule that would provide greater protection to oil spill response workers. Feb. 13, 2023. https://alertproject.org/wp-content/uploads/2023/02/EII-ALERT-OSHA-Petition-FINAL-021323.pdf

[3] Ott F, 2023. BP Deepwater Horizon BELO Cases v. Lester Jenkins et al., USCA11 Case: 23-11535, Document 42-1, filed 10/23/2023. Mot. for leave to file an amicus curiae letter in support of plaintiffs-appellants and reversal. https://alertproject.org/wp-content/uploads/2024/01/23-11535_DocketEntry_11-28-2023_44-Amicus-Brief.pdf

OVERVIEW

Human health effects of exposures during oil spills have been studied following only eight of the thirty-nine supertanker oil spills since the 1960s, counting the BP *Deepwater Horizon* oil disaster. From these eight studies emerged a suite of acute symptoms now considered characteristic of oil spill exposures.[4] Many of these acute respiratory, neurological, and cardiovascular symptoms—such as cough, wheezing, difficulty breathing, runny nose, burning/itchy eyes, headache, dizziness, nausea, tightness of chest, and tiredness/fatigue—mimic common cold/flu-like symptoms. Other common acute symptoms are skin rashes and lesions.

Of these eight studies, only three initiated long-term studies to examine chronic health effects after the initial exposures. From these three oil spills, including the *Prestige* (Spain, 2002), the *Hebei Spirit* (South Korea, 2007), and the BP *Deepwater Horizon* (U.S., 2010), have emerged consistent findings of adverse chronic health harm among exposed residents and workers.[5] The epidemiology studies are supported by findings from clinical and lab studies.

Causal relationships are now widely recognized between initial acute symptoms of oil spill exposure and long-term respiratory, cardiovascular, and neurological harm, including cancers, in workers and among residents of oil-producing communities.

Significantly, the findings of short- and long-term harm to humans from oil exposures:

- occur at initial levels of petroleum hydrocarbons that are at the lower end of OELs and the upper end of public health standards;
- are more reliably characterized by initial symptoms of exposure than concentration levels (symptoms described in literature and existing regulations);
- increase with exposure to oil dispersants and oil combined;
- increase in medically-underserved communities;
- may decrease with proper use of Personal Protective Equipment (PPE); and
- are supported by lab and field studies on animals.

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[4] Aguilera F, Méndez J, Pásaro E, Laffon B, 2010. Review on the effects of exposure to spilled oils on human health. *J Applied Tox* 30(4):291–301.

Levy B, Nassetta, W. 2011. "The Adverse Health Effects of Oil Spills: A Review of the Literature and a Framework for Medically Evaluating Exposed Individuals," *Int J Occup Environ Health*, 17:121–167. doi: 10.1179/107735211799031004

[5] Park MS, et al. 2019. Health effect research on Hebei Spirit Oil Spill (HEROS) in Korea: A cohort profile. *BMJ Open* 9:e026740. doi:10.1136/ bmjopen-2018-026740

Laffon B, Pasaro E, Valdiglesias V. 2016. Effects of exposure to oil spills on human health: Updated review. *J Toxicol Environ Health.* Part B, 19:3-4, 105-128. doi: 10.1080/10937404.2016.1168730

The findings of long-term harm to human health are well supported by advances in understanding the fate of oil and chemically dispersed oil, in particular: the rapid formation of noxic secondary organic aerosols via photooxidation of oil at the sea surface; the rapid transformation of oil mist into oil aerosols with aerial application of dispersants; the dispersal of these aerosols and other oil components over long distances both within and above the marine boundary layer; and, in coastal and rural regions of southeast Louisiana (where the study was based), the average exceedances of protective standards for public health for benzene and fine particulate matter (as oil particles) in air samples, carrying an oil spill-derived aerosol signature, over the five months of peak emissions following the BP *Deepwater Horizon* oil disaster.[6]

Collectively, the studies on oil spill fate imply that air monitoring alone is unreliable for assessing health risk to workers from chemical mixtures that contain health hazards, especially during 24/7 exposures over long durations (months), and that public health standards may be more suitable than occupational exposure limits (OELs).

REVIEW DIGEST

The current science on fate and effects of oil spill exposures, including chemically-dispersed oil, to humans and wildlife is extensive. The review is presented in three sections: oil spill fate first to determine presence and form of health hazards and to provide context for the effects studies, which are organized as respiratory impacts and other impacts to humans and animal studies and lastly, third, the implications for human health risk assessments.

Current studies on oil spill fate from the BP Deepwater Horizon disaster

This section focuses on the fate of surface oil, which poses a health risk to humans through inhalation and skin contact from air-borne contaminants. The great bulk of oil released from the damaged BP Deepwater Horizon wellhead rose from the seafloor through nearly a mile (over 5,000 feet) of water column to the sea surface.[7] Subsea dispersant injection (SSDI) was

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[6] Nance E, King D, Wright B, Bullard RD. 2016. Ambient air concentrations exceeded health-based standards for fine particulate matter and benzene during the BP DHOS. *J Air Waste Manag Assoc*. Jan, 66(2):224-36. doi: 10.1080/10962247.2015.1114044

[7] "Almost all the methane released from the wellhead entered this subsurface intrusion layer along with significant fractions of other dissolved compounds and some tiny (order 100 microns) oil droplets (Lehr et al., 2010). The oil remaining in larger droplets rose to the sea surface, forming slicks." Lehr et al., 2010. Deepwater Horizon oil budget calculator: A report to the national incident command. Federal Interagency Solutions Group, Oil Budget Calculator Science and Engineering Team: National Incident Command. In: National Academy of Sciences (NAS), 2022, *Oil in the Sea IV*, at 19 (Box 1-1).

NAS, 2022. *Oil in the Sea IV: Inputs, Fates, and Effects* (Washington, DC: The National Academies Press). https://doi.org/10.17226/26410

ineffective at dispersing oil at depth—the well blowout dynamics did that very effectively, shredding the pressurized oil into droplets of all sizes.[8] SSDI was also ineffective at trapping the oil droplets at depth,[9] beyond the 5% or less of the liquid oil that was trapped in the deep intrusion layer with or without dispersant use.[10] Further, SSDI was ineffective at moving gaseous components, e.g., methane and hazardous VOCs (Volatile Organic Compounds), into the water column beyond the significant amount that was forced to entrain (become part of the liquid water column) by the crushing pressure and frigid ocean temperatures.[11]

Once on the sea surface, the oil was subjected to rapid weathering via photochemical oxidation,[12] which proved to be a dominant fate of surface oil[13] and one that rapidly reduces effectiveness of dispersants sprayed onto the sea surface[14] to disperse the oil into the water column (under the sea surface). However, aerial spraying of dispersants makes oil spill-related air emissions even more toxic by increasing the ratio of nano-to-micro-size oil droplets *without altering the concentration* of particle-bound polycyclic aromatic hydrocarbons (PAHs).[15] This particular fraction of crude oil is

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[8] Fingas M, 2014. A review of literature related to oil dispersants, 2011–2014, for the Prince William Sound Regional Citizens' Advisory Council, Anchorage, Alaska, Section 4.6 at 24–25. https://www.pwsrcac.org/wp-content/uploads/A-Review-of-Literature-Related-to-Oil-Spill-Dispersants-2011-2014.pdf

[9] Evidence preceding the onset of SSDI is similarly consistent with low percentages of liquid oil in the deep intrusion layers. "[O]nly a small fraction of liquid oil was trapped in the layers with and without SSDI." NAS, 2020. *The Use of Dispersants in Marine Oil Spill Response* (Washington, DC: The National Academies Press), at 46. https://doi.org/10.17226/25161

[10] "Available evidence from BP Deepwater Horizon indicates that deep intrusion layers were preferentially enriched in soluble hydrocarbon components compared to the liquid oil droplets. Gros et al. (2017) and indicates that ~5% or less of the liquid oil was trapped in the deep intrusion layers. Gross et al., 2017. Petroleum dynamics in the sea and influence of subsea dispersant injection during [BP] Deepwater Horizon. *Proc Nat Acad Sci*, 114 (38):10065–10070. doi.org/10.1073/pnas.1612518114.

[11] Paris CB, et al., 2018. BP Gulf Science Data reveals ineffectual subsea dispersant injection for the Macondo blowout. *Front Mar Sci* 5:389. doi.org/10.3389/fmars.2018.00389

[12] Ward CP, Overton EB, 2020. How the 2010 *Deepwater Horizon* spill reshaped our understanding of crude oil photochemical weathering at sea: a past, present, and future perspective. *Environ Sci Process Impacts*. 2020 May. 22(5):1125-1138. doi: 10.1039/d0em00027b;

[13] Ward CP, et al. et al. 2018b. Partial photochemical oxidation was a dominant fate of *Deepwater Horizon* surface oil. *Environ Sci Technol*. 52, 1797–1805. doi: 10.1021/acs.est.7b05948

[14] Ward CP, et al. 2018a. Photochemical oxidation of oil reduced the effectiveness of aerial dispersants applied in response to the [BP] Deepwater Horizon spill. *Environ Sci & Technol Lett* 2018a 5:226-231. doi: 10.1021/acs.estlett.8b00084

[15] Afshar-Mohajer N, et al. 2018. A laboratory study of particulate and gaseous emissions from crude oil and crude oil-dispersant contaminated seawater due to breaking waves. *Atmospheric Environ*. 179:177-186. https://doi.org/10.1016/j.atmosenv.2018.02.017

considered to be very hazardous to human health.[16] By increasing the number of airborne particles across the entire nano-scale range, dispersants can dramatically increase the total mass of aerosolized particles compared to that of crude oil alone.[17] Ultrafine particles can travel longer distances and penetrate more deeply into the alveoli region of the human respiratory system than larger particles[18]—yet the increased health risk, based on *size* of particles rather than concentration, is undetectable using tradition methods of analysis.[19]

Secondary organic aerosols created by photooxidation and aerial spraying of dispersants within the marine boundary layer[20] were predicted to reach coastal communities downwind of the spill and over 80 miles inland.[21] The oil mists and aerosols carried within this layer were observed by coastal residents and others, as it coated seaward-facing windows of homes and vehicles and collected in folds of beach umbrellas left outside for the night. Soot and other pollutants from smoke plumes that lofted above the marine boundary layer[22] were blown overland and returned to the earth's surface as the "oil rain" observed by coastal residents. Pollutant transport within and above the marine boundary layer were seen as haze or smog, respectively.[23]

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[16] World Health Organization, 2010. WHO Guidelines for Indoor Air Quality: Selected Pollutants, Chapter 6, Polycyclic Aromatic Hydrocarbons by (llllll H, Harrison R, Komulainen H, Delgado Saborit JM. https://www.ncbi.nlm.nih.gov/books/NBK138709/

[17] Afshar-Mohajer N, et al., 2020. Impact of dispersant on crude oil content of airborne fine particulate matter emitted from seawater after an oil spill. *Chemosphere* 256; 127063. doi: 10.1016/j.chemosphere.2020.127063

[18] For example, inhalation of dispersant-mediated particulate emissions increased the total mass burden of *nano* particles inhaled and deposited in upper respiratory tract and trachea bronchial region of humans by about 10 times, compared to slicks of crude oil without dispersants. Afshar-Mohajer N, Fox MA, Koehler K. 2019. The human health risk estimation of inhaled oil spill emissions with and without adding dispersant, *Sci of the Total Environ* 654:924-932. doi: 10.1016/j.scitotenv.2018.11.110

[19] Further, traditional methods only capture 1.3–4% of the PAHs in fresh oil, making them unsuited for health risk assessments. Payne JR, Driskell WB, 2018. Macondo oil in northern Gulf of Mexico waters – Part 1: Assessments and forensic methods for Deepwater Horizon offshore water samples. *Mar Poll Bull* 129:399–411. doi.org/10.1016/j.marpolbul.2018.02.055

[20] de Gouw JA, et al., 2011. Organic aerosol formation downwind from the [BP] Deepwater Horizon oil spill. *Mar Science* 331:1295–99. 10.1126/science.1200320

[21] Middlebrook AM, et al., 2012. Air quality implications of the Deepwater Horizon oil spill. *Proc Nat Acad Sci Phys Sci* 109:20280–5, at Figure 8. doi:10.1073/pnas.1110052108

[22] Perring AE, et al., 2011. Characteristics of black carbon aerosol from a surface oil burn during the Deepwater Horizon oil spill. *Geophys Res Lett*, 38: 1–5. doi: 10.1029/2011GL048356

Ryerson TB, + 26. Atmospheric emissions from the Deepwater Horizon spill constrain air-water partitioning, hydrocarbon fate, and leak rate. 2012 *Geophys Res Lett* 38, L07803.

[23] Britannica online, 2022. https://www.britannica.com/science/planetary-boundary-layer

DeLizo J, Fogarty J, 2018. A comparison between the land and marine boundary layers. 7/1/2018 https://www.alabamawx.com/?p=167365

The Southeast Louisiana air quality study provided context and a link between earlier studies and coastal residents lived experiences. The study found that 5-month average ambient air levels for benzene and $PM_{2.5}$ exceeded pre-spill background levels and protective standards for public health in regional (rural) and coastal areas.[24] In contrast, the air quality in the urban areas was relatively normal compared to previous years, levels of benzene and $PM_{2.5}$ were lower than in coastal and regional areas, and the levels did not exceed public health standards. Also notably, the urban data set was statistically different from the coastal and regional data sets: It exhibited far less variance and lower absolute values of $PM_{2.5}$ than the other two datasets, which were both high and highly variable, indicating an oil spill-derived aerosol and particulate signature.

Current studies on respiratory harm from oil spill exposures

A clinical study, initiated shortly after the BP Deepwater Horizon oil disaster with 7-year follow-up visits, assessed pulmonary function (and hematologic and hepatic markers discussed in the next section) in a cohort of south Louisiana response workers who had worked at least 3 months and been exposed to the oil spill and dispersant.[25] Test results were compared to similar assessments of unexposed people who lived at least 100 miles inland. The most reported initial symptoms of exposure were headaches, shortness of breath, skin rash, chronic cough, fatigue, painful joints, and chest pain.[26] Many of these symptoms are described in the mandatory OSHA HAZWOPER health hazard criteria as indicative of exposure to respiratory and dermal irritants and sensitizers often present in chemical mixtures, especially those containing health hazards.[27]

Significantly, the clinic study found that prolonged or worsening illness symptoms were still present 7 years after the initial exposure.[28] Shortness of breath was the most frequently reported symptom among oil exposed subjects at both their initial (75%) and their 7-year (84%) follow-up visits. While none (0%) of the workers experienced severe pulmonary function abnormalities during their initial visit, most of the workers had progressive deterioration of their respiratory system by the 7-year visit—91% developed chronic rhinosinusitis and 45% chronic reactive airways dysfunction syndrome. The clinic study forewarned of the human health tragedy that followed and was documented in the epidemiology studies.

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[24] See note 6, Nance et al., 2016, Southeast Louisiana air quality study.

[25] D'Andrea MA, Reddy GK, 2013. Health consequences among subjects involved in Gulf oil spill clean-up activities. *Amer J Med* 126(11):966–74. doi: 10.1016/j.amjmed.2013.05.014.

[26] Ibid., D'Andrea and Reddy, 2013, Health consequences.

[27] OSHA, 2012. 1910 Subpart Z. Toxic and Hazardous Substances. 1910.1200 Appendix A – Health Hazard Criteria (Mandatory), at A.0.4.2. https://www.osha.gov/laws-regs/regulations/standardnumber/1910/1910.1200AppA

[28] D'Andrea MA, Reddy GK, 2018. The development of long-term adverse health effects in oil spill cleanup workers of the Deepwater Horizon offshore drilling rig disaster, *Frontiers Pub Health* 6:117. doi: 10.3389/fpubh.2018.00117

The three epidemiology studies conducted after the BP Deepwater Horizon oil disaster used very different cohorts yet found very similar results. The U.S. Coast Guard study cohort was comprised largely of uniformly young, fit, white males with pre- and post-spill medical records and archived biological samples available for all participants. Recall bias was minimal, as most participants completed exit surveys shortly after completing oil spill response work.[29] The National Institute of Health (NIH) Gulf Longitudinal Follow-up (GuLF) study cohort was a unique population of culturally, ethnically, and linguistically diverse peoples with some of the highest rates of unemployment and poverty and the lowest rates of access to healthcare in the United States.[30] The Women and Their Children's Health (WaTCH) study cohort was from southeast Louisiana, largely the same region in the southeast Louisiana air quality study. The cohort reflected the diversity of the GuLF study participants, and it included women spill responders and commercial fisher women.[31]

These epidemiology studies found short- and long-term respiratory harm in workers and coastal residents, including children.[32] The symptoms that were used to identify acute respiratory harm in the questionnaires included runny nose, cough, sore throat, asthmatic wheezing, eye irritation, and difficulty breathing. Unlike common cold- or flu-like symptoms that persist for one to two weeks,

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[29] Rusiecki J, et al., 2018. The [BP] Deepwater Horizon oil spill Coast Guard cohort study. *Occup Environ Med* 75(3):165-175. doi.org/10.1093/annweh/wxab113

[30] Kwok RK, Engel LS, Miller AK, et al. 2017. The GuLF STUDY: A prospective study of persons involved in the BP DHOS response and clean-up. *Environ Health Perspect*. Apr;125(4):570-578. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5382003/

Resnik DB, et al., 2015. Ethical issues in environmental health research related to public health emergencies: Reflection on the GuLF Study. *Environ Health Perspect* 123(9): A227-31. doi: 10.1289/ehp.1509889.

Lawrence KG, Werder EJ, Sandler DP, 2021. Association of neighborhood deprivation with pulmonary function measures among participants in the Gulf Long-Term Follow-up Study. *Environ Res* 6:11170

[31] Peters ES, et al., 2017. The women and their children's Health (WaTCH) study: Methods and design of a prospective cohort study in Louisiana to examine the health effects from the BP oil spill. *BMJ Open* 7(7):e014887. doi: 10.1136/bmjopen-2016-014887

[32] Alexander M, et al., 2018. The BP DHOS Coast Guard cohort study: A cross-sectional study of acute respiratory health symptoms. *Environ Res* 162:196-202. doi: 10.1016/j.envres.2017.11.044

Chen D, et al., 2022. Fine particulate matter and lung function among burning-exposed [BP] Deepwater Horizon oil spill workers. *Environ Health Perspect* 130(2):27001. doi: 10.1289/EHP8930

McGowan CJ, et al., 2017. Respiratory, dermal, and eye irritation symptoms associated with Corexit™ EC9527A/EC9500A following the BP DHOS: Findings from the GuLF STUDY. *Environ Health Perspect* 125(9): 097015. doi: 10.1289/EHP1677

Rusiecki J, et al., 2022. Incidence of chronic respiratory conditions among oil spill responders: Five years of follow-up in the Deepwater Horizon oil spill Coast Guard cohort study. *Environ Res* 203:111824. doi: 10.1016/j.envres.2021.111824

Peres LC, et al., 2016. The [BP] Deepwater Horizon oil spill and physical health among adult women in southern Louisiana: The Women and Their Children's Health (WaTCH) Study. *Environ Health Perspect* 124(8):1208–13. doi: 10.1289/ehp.1510348

the symptoms associated with oil spill exposures persisted for up to at least 5 to 7 years in the epidemiology study (the limits of the study, not the symptoms), and there was progressive deterioration of the respiratory system over time, marked by new or worsening chronic respiratory illnesses and decreased lung function.[33] Exposure to dispersant was also linked with a higher risk of developing chronic respiratory disease.[34]

Significant declines in lung function were also found 1–3 years after the oil spill in offshore workers who were exposed to controlled burning of oil and gas.[35] The decline was functionally equivalent to 1 to several years of lung function loss from aging.[36] The soot emissions during the episodic burns likely exceeded the daily fine particulate matter ($PM_{2.5}$) concentration in federal standards associated with adverse health effects for the general population.[37] However, the health risk from fine particulates was understated, as the background levels for the largest source of primary air emissions—secondary organic aerosols—were not accounted for. Health risk assessment based on symptom-based health monitoring is more accurate as it reflects exposure to all contaminants and their phases (aerosols, $PM_{2.5}$, etc.).

Lab studies conducted with human airway epithelial cells treated with BP crude oil and/or one of the two Corexit dispersants (9500 and 9527), which were used during the BP Deepwater Horizon spill response, support findings of persistent long-term harm.[38] For example, oil-dispersant mixtures were found to promote double- and single-stranded DNA breaks and activation of DNA damage response mechanisms, indicating that oil-dispersant mixtures induce genotoxic effects.[39]

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[33] See note 32, Rusiecki et al., 2022, USCG study chronic respiratory conditions.

[34] See note 32, McGowan et al., 2017, Symptoms associated with Corexit dispersants.

See also note See note 17, Afshar-Mohajer et al., 2019, Inhalation, health risk & dispersants.

[35] See note 32, Chen et al., 2022, Fine particulate matter & lung function.

[36] Pratt GC, Stenzel MR, Kwok RK, et al. 2020. Modeled air pollution from the in situ burning and flaring of oil and gas released following the Deepwater Horizon disaster. *Ann Work Exp & Health* 66(Suppl 1):i172i187, at 13. doi: 10.1093/annweh//wxaao84.

[37] Ibid., Pratt et al., 2020, at 11, finding this comparison was necessary, as there "are no occupational standards" for this hazard, and that the federal standards for the general public were sometimes exceeded.

[38] Major D, et al., 2016. Effects of Corexit oil dispersants and the WAF [water-accommodated fraction] of dispersed oil on DNA damage and repair in cultured human bronchial airway cells, BEAS-2B. *Gene Rep* 3:22-30. doi: 10.1016/j.genrep.2015.12.002

Liu YZ, et al., 2016. The impact of oil spill to lung health – Insights from an RNA seq study of human airway epithelial cells. *Gene* 578:38–51. doi: 10.1016/j.gene.2015.12.016

Liu YZ, et al., 2017. Carcinogenic effects of oil dispersants: A KEGG pathway-based RNA-seq study of human airway epithelial cells. *Gene* 602:16-23.

[39] See note 38, Major et al., 2016, DNA damage, lungs, Corexit dispersants.

Such effects are associated with later development of chronic disease, including an increased likelihood of chronic respiratory disease and cancer.[40]

Similarly, a series of RNA-sequence analyses identified a pattern of genotoxic effects caused by oil and oil dispersants.[41] Specifically, the pattern was one of cancer initiation through transcription errors that blocked various receptors for protein processing and signaling. Corexit 9527, with and without oil, elicited the most pronounced effects on DNA damage and proliferation, including, specifically, initiating *eight* cancer pathways, including small cell lung cancer (aka neuroendocrine tumors), prostate cancer, chronic myeloid leukemia, and non-small cell lung cancer, among others.[42] When combined with oil, dispersant Corexit 9527 functionally shifted the cancer pathway to a smaller set of genes that have more cancer pathways. Biological processes triggered by oil dispersants were also consistent with several common lung diseases such as COPD, asthma, and cystic fibrosis.[43] Authors point out that such results are "not surprising,"[44] given that Corexit 9527 contains the toxin 2-butoxyethanol and its toxic effects have been previously established.[45] What

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[40] See note 38, Lui et al., 2016, Impact of oil spill to lung health; Lui et al., 2017, Carcinogenic effects of oil dispersants.

Gilbert, SF. Developmental Biology, Differential Gene Expression, 6th ed., 2000. Differential gene expression refers to differences in the levels at which cells transcribe DNA into mRNA and subsequently synthesize proteins based on the transcribed genetic material. Although cells naturally exhibit different patterns of gene expression, exposure to environmental conditions or toxins may also result in departures from expected expression patterns for a given cell type.

Krupina K, et al., 2021. Causes and consequences of micronuclei. Curr Opin Cell Biol 70:91-99. *https://pubmed.ncbi.nlm.nih.gov/33610905/* Single- and double-stranded breaks are types of genetic damage in which either one or both strands of the DNA molecule are severed, typically by a toxin or by certain forms of radiation. They can increase the likelihood of harmful chromosomal rearrangements that increase the likelihood of developing cancer or other diseases.

Nelson BC, Dizdaroglu M, 2020. Implications of DNA damage and DNA repair on human diseases. Mutagenesis 35(1):1-3. doi: 10.1093/muage/gez048

[41] See note 38, Lui et al., 2016, Impact of oil spill to lung health; Lui et al., 2017, Carcinogenic effects of oil dispersants.

[42] See note 38, Lui et al., 2017, Carcinogenic effects of oil dispersants. Corexit 9500 and oil treatment was characterized by "upregulation" or blocking of receptors that prevent an inflammatory response and promote an immune response in 8 different cancer initiation pathways, while Corexit 9527 treatment "upregulated" or triggered 27 specific cancer initiation pathways, mostly associated with blocking ribosome biogenesis (synthesis of proteins into an amino acid sequence).

Cancer pathways are defined in terms of "KEGG pathways." Kanehisa M, Goto S, 2000. KEEG: Kyoto Encyclopedia for Genes and Genomes. *Nucleic Acids Res* 28(1):27-30. *doi: 10.1093/nar/28.1.27*

[43] See note 38, Lui et al., 2017, Carcinogenic effects of oil dispersants.

[44] Ibid., Lui et al., 2017, at 10.

[45] CDC (Centers for Disease Control), NIOSH Pocket Guide to Chemical Hazards, 2-butoxyethanol, last reviewed Oct. 30, 2019. https://www.cdc.gov/niosh/npg/npgd0070.html

did surprise the authors, however, was that these two dispersants were still used in the United States, despite the known risks to humans.[46]

Supporting evidence from studies after the *Prestige* and *Hebei Spirit* oil spills found increased prevalence of acute respiratory symptoms and decreased lung function associated with oil spill exposures. For example, military personnel who participated in the *Hebei Spirit* oil spill response also experienced cold/flu-like symptoms including respiratory (cough, sore throat, runny nose, sputum), neurological (headache, dizziness, nausea, fatigue, hot flushing), ophthalmic (red, sore, or watery eyes) symptoms in patients who did not have a previous history of such symptoms.[47] Increased risk of symptoms was positively associated with duration of work, proximity to the spill site (Taean County), and inappropriate use of personal protective equipment.[48]

Studies also found persistent chronic human health harm from oil spill exposure. Reduction in lung function persisted for up to five years post-spill in workers and residents living in proximity to oil spills, and there was no improvement among the exposed workers after six years.[49] Children who lived near the oiled coastline in Taean County had significantly higher rates of airway hyperresponsiveness and asthma, a lower forced expiratory volume in one second, and a higher rate of wheezing at 1.5 years after the *Hebei Spirit* accident, compared with those who lived further from the coastline.[50] Further, male sex, family history of asthma, and residence near the spill area were significant risk factors for asthma.[51] Children who lived in the area impacted by the spill and those who participated in response activities had persistent symptoms of allergic rhinitis

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Johanson G, Boman A (National Institute of Occupational Health, Sweden, and Dept. of Occupational Medicine, Univ. Hospital, Sweden) ("OSHA Sweden"), 1991. Percutaneous absorption of 2-butoxyethanol vapour in human subjects. *Brit J Industrial Med*, 48:788–792. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1035455/

[46] See note 38, Lui et al., 2017, Carcinogenic effects of oil dispersants, at 10.

[47] Gwack J, et al., 2012. Acute health effects among military personnel participating in the cleanup of the *Hebei Spirit* oil spill, 2007, in Taean County, Korea. *Osong Public Health Res Perspect* 3(4):206–212. http://dx.doi.org/10.1016/j.phrp.2012.10.001

[48] Ibid., Gwack et al., 2012, Acute health effects among military personnel (*Hebei Spirit*).

[49] Zock JP, et al., 2012. Persistent respiratory symptoms in clean-up workers 5 years after the *Prestige* oil spill. *Occup Environ Med* 69(7):508–13. doi:10.1136/oemed-2011-100614

Zock JP, et al., 2014. Evaluation of the persistence of functional and biological respiratory health effects in clean-up workers 6 years after the *Prestige* oil spill. *Environ Int'l* 62:72–77, finding of no change in respiratory health of exposed workers from the previous 4 years but an unexpected deterioration of respiratory health in non-exposed controls that compromised detection of long-term harm in exposed workers.

[50] Noh SR, et al., 2019. *Hebei Spirit* oil spill and its long-term effect on children's asthma symptoms. *Environ Pollut* 248:286–294, finding persistence of asthma 5 years after spill.

Park MS, et al., 2019. Health effect research on Hebei Spirit oil spill (HEROS) in Korea: A cohort profile. *BMJ Open* 9:e026740. doi:10.1136/ bmjopen-2018-026740

[51] Ibid., Park et al., 2019, HEROS cohort 10-year review.

years after the oil spilled.[52] These findings are consistent with BP Deepwater Horizon oil spill studies.

Current studies on other illnesses & cancers from oil spill exposures

Respiratory symptoms from oil spill exposures are linked with a wide range of other acute and chronic health effects because inhaled petroleum hydrocarbons rapidly enter the bloodstream. During the BP Deepwater Horizon oil spill and response, very high levels of petroleum hydrocarbons were found in the blood of workers, coastal residents, and children during the spring and summer months of peak oil spill emissions,[53] and residual levels were still evident up to 3 years later.[54]

Once oil enters the bloodstream, the oil is metabolized mainly in the liver and the metabolites produce reactive oxygen species that are excreted in the urine. The metabolites cause oxidative stress in the body, affecting DNA, protein, lipids, and cellular membranes, and altering profiles of blood and liver enzymes, and urinary metabolites.[55] Before the BP Deepwater Horizon oil disaster, benzene exposure was already known to be associated with hematological (blood) toxicity and increased cancer risk but the cancers such as leukemia, myeloma, and lymphoma may take years to develop.[56]

The oil spill clinical study noted earlier also assessed hematologic (blood) and hepatic (liver) markers and renal (kidney) function during initial and 7-year follow-up visits. During the initial visits, exposed workers had significantly altered blood profiles with decreased platelet counts and

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[52] Jeon Y-J, et al., 2016. Impact of allergic diseases in elementary school students by the *Hebei Spirit* oil spill. *Korean Public Health Res* 42:57–68. In: Park MS, et al., 2019. Health effect research on *Hebei Spirit* oil spill (HEROS) in Korea: A cohort profile. *BMJ Open* 9:e026740. doi:10.1136/ bmjopen-2018-026740

[53] Summarco PW, et al., 2016. Concentrations in human blood of petroleum hydrocarbons associated with the BP Deepwater Horizon oil spill, Gulf of Mexico. *Arch Toxicol* 90(4):829-37. doi: 10.1007/s00204-015-1526-5

[54] Doherty BT, et al., 2017. Associations between blood BTEXS concentrations and hematological parameters among adult residents of the U.S. Gulf states, Table 2. *Environ Res* 26;156:579-587. doi:10.1016/j.envres.2017.03.048

Werder EJ, et al., 2019. Blood BTEX levels and neurologic symptoms in Gulf states residents. *Environ Res* 175:100-107. doi: 10.1016/j.envres.2019.05.004

Werder EJ, et al., 2018. Predictors of blood volatile organic compound levels in Gulf coast residents. *J Expo Sci Environ Epidemiol* 28(4):358-370 doi: 10.1038/s41370-017-0010-0.

[55] Reardon S, 2011. Gulf oil spill. Ten months after Deepwater Horizon, picking up the remnants of health data. *Science* 331:1252.

[56] Costantini AS, et al, 2008. Risk of leukemia and multiple myeloma associated with exposure to benzene and other organic solvents: Evidence from the Italian Multicenter Case-Control Study. *Am J Ind Med* 51:803-811.

Khalade A, et al., 2010. Exposure to benzene at work and the risk of leukemia: A systematic review and meta-analysis. *Environ Health* 9:31.

increased hematocrit levels and white blood cell counts, compared to the unexposed group.[57] Exposed workers also had significant amounts of phenol in their urine (than the unexposed group), indicating that workers were exposed to the carcinogen benzene in their work-related oil spill response activities. Exposed workers also had higher levels of three liver enzymes that are specific markers of hepatic dysfunction and damage.[58]

Significantly, biomarkers of blood and liver damage varied among individuals, indicating that oil spill exposures did not uniformly affect those exposed[59]—and that PELs and air concentrations are not reliable predictors of harm for oil spill exposures. During the follow-up visits, there was no improvement in the altered hematological and hepatic functions, indicating initial exposures and symptoms were linked with prolonged and persistent harm.[60]

Acute and persistent cardiac function abnormalities were found in clinic studies[61] and epidemiology studies in exposed workers. A US Coast Guard study found an increased prevalence of chest pain, and a trend of increased prevalence of sudden heartbeat changes, were associated with increased self-reported exposures to crude oil and to combined crude oil and dispersants via inhalation and direct skin contact.[62] Analysis of associated medical data revealed an elevated hazard risk of essential hypertension diagnosis (mostly benign) during 2010–2012 and, during 2013–2015, elevated hazard risk for mitral valve disorders and heart palpitations that are major risk factors for developing coronary heart disease (CHD).[63] The cardiovascular symptoms and conditions were generally stronger among workers reporting exposure to both crude oil and oil dispersants than those reporting neither. Because the study cohort was young and healthy (mean age 30 years), the investigators "did not expect to observe severe heart disease such as [myocardial infarctions, i.e., heart attacks] or CHD after only five and a half years of follow-up."[64]

In comparison, the GuLF study with an older, less fit, and more diverse cohort found in its 5-year follow-up that increased risk of heart attacks and fatal CHD were associated with longer duration of response work, living in proximity of the spill, and higher estimated exposure to "total

[57] See note 25, D'Andrea & Reddy, 2013, Acute health symptoms.

[58] Ibid., D'Andrea & Reddy, 2013.

[59] Ibid., D'Andrea & Reddy, 2013.

[60] See note 28, D'Andrea & Reddy, 2018, Chronic health harm.

[61] Ibid., D'Andrea & Reddy, 2018. These abnormalities included abnormal ECG, ventricular conduction delay, anterior fascicular block, sinus rhythm nonspecific T wave, sinus bradycardia ST and T wave abnormality, sinus rhythm early repolarization, and ventricular hypertrophy.

[62] Denic-Roberts H, Rowley N, Haigney MC, et al., 2022. Acute and longer-term cardiovascular conditions in the Deepwater Horizon oil spill Coast Guard cohort. *Environ Intl.* 158: doi.org/10.1016/j.envint.2021.106937

[63] Ibid., Denic-Roberts et al., 2022.

[64] Ibid., Denic-Roberts et al., 2022, at 8.

hydrocarbons," an inadequate surrogate for sum total of oil spill-derived hydrocarbons.[65] By the 10-year follow-up, exposure to increased $PM_{2.5}$ from the controlled burning of surface oil was linked with increased CHD risk among burning-exposed response workers.[66] The highest average exposure category had over twice the health hazard of CHD, compared to controls and was similar to the increase in CHD risk among men from smoking 20 cigarettes a day. *The finding of increased risk of CHD to workers several years after exposure is novel.* It demonstrates that even relatively short-term $PM_{2.5}$ exposure (days or weeks) to high levels of burning oil and gas can cause long-term harm.

The U.S. Coast Guard and GuLF epidemiology studies also found short- and long-term neurological harm. A symptom-based study identified acute symptoms (lightheadedness, headaches, difficulty concentrating, numbness/tingling sensation, blurred vision, and memory loss/confusion) that were associated with an increased frequency of self-reported crude oil exposure via inhalation and via skin contact (the latter except for memory loss/confusion)—and "appreciably greater" associations when exposed to oil and dispersants combined.[67]

Concentration-based studies conducted 4–6 years after the BP Deepwater Horizon oil spill[68] found only modest associations between "total hydrocarbon" levels (composite volatile hydrocarbons including BTEX) or job groups (based on concentration levels) and decreased neurobehavioral function (decreased sustained attention, memory, and response speed). The magnitude of the deficit in one measure (summary response latency) in workers across the range of exposure categories varied and was comparable to aging 4 to 9 years.[69] The "total hydrocarbon" levels to which most spill response workers were exposed, including n-hexane, "were at the lower end of levels typically encountered in occupational settings, but above levels typically experienced by the

[65] Strelitz J, Keil AP, Richardson DB, et al., 2019. Self-reported myocardial infarction and fatal coronary heart disease among oil spill workers and community members 5 years after *Deepwater Horizon. Environ Res.* 2019 Sept 22, 168:70–79. doi: 10.1016/j.envres.2018.09.026.

Strelitz J, Sandler DP, Keil AP, et al., 2019. Exposure to total hydrocarbons during cleanup of the Deepwater Horizon oil spill and risk of heart attack across 5 years of follow-up. May. *Amer J Epidemiology* 188(5:917–927. https://doi.org/10.1093/aje/kwz017

[66] Chen D, et al., 2023. Fine particulate matter and incident coronary heart disease events up to 10 years of follow-up among *Deepwater Horizon* oil spill workers. *Environ Res* 217:114841. https://doi.org/10.1016/j.envres.2022.114841

[67] Krishnamurthy JK, et al., 2019. Neurological symptoms associated with oil spill response exposures: Results from the Deepwater Horizon oil spill Coast Guard cohort study. *Environ Int* 131, 104963. doi: 10.1016/j.envint.2019.104963

[68] Quist AJL, Rohlman DS, Kwok RK, et al. 2019. Deepwater Horizon oil spill exposures and neurobehavioral function in GuLF study participants. *Environ Res.* Dec;179(Pt B):108834. doi: 10.1016/j.envres.2019.108834.

[69] Ibid., Quist et al., 2019, at 7.

general population." Authors concluded, "BTEX affects cognitive functions even when levels are below occupational exposure limits."[70]

Adverse impacts of oil spill exposure were also found on birth outcomes. Increased levels of $PM_{2.5}$, nitrogen dioxide, sulfur dioxide, and carbon monoxide in oil-impacted coastal counties from Louisiana to Florida were associated with increased incidence of low birthweight (<2500 grams) and premature born infants (<37 weeks of gestation) through 2012 compared to pre-spill data from 2006 to 2010.[71] Adverse infant health outcomes were more pronounced for black, Hispanic, less educated, unmarried, and younger mothers.[72] High levels of direct contact with oil were also associated with higher risk of lower birthweight and preterm births in coastal residents of southeast Louisiana up from 2011 to 2016.[73] These findings are consistent with the literature on adverse effects of oil and other environmental pollution on newborn birth outcomes and infant-child development in the U.S. and other countries.[74] Infant health predictors like birth weight are important predictors of cognitive development and school outcomes.[75]

Notably, the *Prestige* and *Hebei Spirit* oil spills were the first to find evidence of oil spill impacts from the cellular to the systemic—measured as blood damage, persistent oxidative stress biomarkers, persistent metabolic and genetic harm, development of hematological cancers, persistent cardiovascular harm, and reproductive harm in newborns and infants.

Oil spill exposure caused changes 2–5 years after the *Prestige* oil spill in various blood parameters of residents who participated in response activities and lived in the oiled area.[76] After the *Hebei Spirit* oil spill, levels of oxidative stress biomarkers [MDA (malondialdehyde) and 8-OHdG (8-hydroxy-2'-deoxyguanosine)[77]] increased with increasing duration of oil spill response work, were

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[70] Ibid., Quist et al., 2019, at 3 and 9.

[71] Beland L-P, Oloomi S, 2019. Environmental disaster, pollution, and infant health: Evidence from the [BP] Deepwater Horizon oil spill. *J Environ Econ Mgmt.* Nov 98:102265. doi.org/10.1016/j.jeem.2019.102265

[72] Ibid., Beland and Oloomi, 2019, Air quality, Oil spill, harms to infant health.

[73] Harville EW, et al., 2017. Self-reported oil spill exposure and pregnancy complications: The GROWH study. *Int'l J Envt'l Res and Public Health* 14(7), Article 692. https://doi.org/10.3390/ijerph14070692

[74] For example, see Apergis N, Hayat T, Saeed T, 2019. Fracking and infant mortality: Fresh evidence from Oklahoma. *Envt'l Sci Pollut Res* 26(31):32360–32367. https://doi.org/10.1007/s11356-019-06478-z

Eleke C, et al., 2021. Effects of environmental crude oil pollution on newborn birth outcomes: A retrospective cohort study. *J Nursing Res* 29(4):p_e161. doi: 10.1097/JNR.0000000000000435

[75] Figlio David, et al., 2014. The effects of poor neonatal health on children's cognitive development. *The American Economic Review* 104.12: 3921-3955.

[76] Choi Y-H, et al., 2017. A retrospective mid- and long-term follow-up study on the changes in hematologic parameters in the highly exposed residents of the *Hebei Spirit* oil spill in Taean, South Korea. *Osong Public Health Res Perspect* 8(5):358–366. https://doi.org/10.24171/j.phrp.2017.8.5.10

[77] MDA indicates oxidative DNA damage, and 8-OHdG indicates lipid peroxidation, which degrades the lipids within cell membranes, leading to cell damage and eventually death.

positively associated with urinary metabolites of polycyclic aromatic hydrocarbons (PAHs), and persisted for 1.5 years.[78] Six years after the spill, residents living near the oiled coast had significantly higher levels of 8-OHdG, and levels of both biomarkers were still positively associated with duration of response activities.[79] Further, the risk of metabolic syndrome—a cluster of conditions that occur together and increase risk of heart disease, stroke, and type 2 diabetes—was significantly higher 1 year after the spill among people who worked response activities longer and lived closer to the oiled coast.[80]

Damage to several genetic regions (genotoxicity) most significantly affected by oil exposure were associated with increased risk of hematological cancers.[81] *Prestige* studies found a strong correlation between oil-induced chromosome breakpoints and "fragile sites"—large chromosome regions, over megabases, that are prone to breakage upon replication stress and are a driving force of cancer initiation or oncogenesis.[82] Studies identified four specific chromosome bands (2q21, 3q27, 5q31, and 17p11.2) in peripheral blood lymphocytes[83] with a greater tendency to break over time after an acute oil spill exposure.[84] These four bands were found only in exposed individuals after the spill and in both the 2- and 6-year visits.[85] Since these four bands are different from the bands previously identified in fragile sites most frequent in the general population, authors suggested that *the four breakpoints originating from oil exposure may affect the genome regions,*

[78] Noh SR, et al., 2015. Oxidative stress biomarkers in long-term participants in clean-up work after the *Hebei Spirit* oil spill. *Sci Total Environ* 515-516:207–14. doi: 10.1016/j.scitotenv.2015.02.039

[79] Kim JA, et al, 2017. Urinary oxidative stress biomarkers among local residents measured 6 years after the *Hebei Spirit* oil spill. *Sci Total Environ* 580:946-952. doi: 10.1016/j.scitotenv.2016.12.044

[80] Lee I-J, et al., 2015. Association between metabolic syndrome and participation in cleanup work at the *Hebei Spirit* oil spill. *Korean J Environ Health Sci* 41:335–348. doi: 10.5668/JEHS.2015.41.5.335

[81] Laffon B, et al., 2014. Follow-up study of genotoxic effects in individuals exposed to oil from the tanker Prestige, seven years after the accident. *Mutat Research Gen Toxicol Envtl Mutagen* 10(6):760, finding greater rates of micronuclei formation following exposure to oil spill cleanup emissions. Micronuclei are small extracellular bodies containing chromosome fragments that failed to properly incorporate into the nuclei of the daughter cells following cell division, which typically results from exposure to a toxin affecting DNA.

[82] Frances A, et al., 2016. Persistence of breakage in specific chromosome bands 6 years after acute exposure to oil. *PLoS One* 11(8): e0159404. doi:10.1371/journal. pone.0159404

Rodriguez-Trigo, G, et al., 2010. Health changes in fishermen 2 years after clean-up of the *Prestige* oil spill. *Annals Intern Med* 153:489–499. doi: 10.7326/0003-4819-153-8-201010190-00279

[83] Peripheral blood lymphocytes are one of several types of white blood cells that are crucial for the immune system. They comprise T cells, B cells, and natural killer cells, which produce antibodies that are used to attack invading bacteria, viruses, and toxins.

[84] See note 82, Frances A, et al., 2016, Persistence of chromosome damage.

[85] See note 82, Frances A, et al., 2016, Persistence of chromosome damage; Rodriguez-Trigo, G, et al., 2010, Health changes after 2 years.

which themselves are prone to breakage, leading to chromosome instability and the earliest stages of cancer development.[86]

For example, a significant number of chromosome alterations in blood diseases, such as T-cell lymphoma, acute lymphoblastic leukemia, and acute myeloid leukemia, are associated with these four bands and, specifically, with 5q31 in patients with acute lymphoblastic leukemia, myelodysplastic syndrome, chronic myelomonocytic leukemia, and acute myeloid leukemia.[87] Acute oil exposure could affect the stem cells of bone marrow, leading to genomic instability and an increased risk of blood malignancies.[88]

Hebei Spirit studies found an increased incidence rate of prostate cancer and, in women, leukemia in Taean compared to coastal areas and nationwide after the oil spill.[89] However, the latter was not significantly high because leukemia is a rare disease and Taean has a small population. Due to the latency period of cancer development, BP Deepwater Horizon oil disaster studies have not yet been published. However, community organizations, filmmakers, and media have witnessed and raised awareness of increases in clusters of rare and unusual illnesses and cancers associated with oil spill exposures in adults and children from oil-impacted Gulf Coast communities.[90]

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[86] See note 82, Frances A, et al., 2016, Persistence of chromosome damage, at 9/14.

[87] Monyarch G, et al., 2013 Chromosomal bands affected by acute oil exposure and DNA repair errors, 8(11) *PLoS One* 8(11): e81276. doi.org/10.1371/journal.pone.0081276

[88] Hildur K, et al., 2015. Follow-up genotoxic study: Chromosome damage two and six years after exposure to the *Prestige* oil spill, *PLoS One* 10(7): e0132413. doi: 10.1371/journal.pone.0132413, cautioning that persistent evidence of genetic damage may indicate impacts to bone marrow cells.

[89] Choi KH, et al., 2018. Cancer incidence trend in the *Hebei Spirit* oil spill area, from 1999 to 2014: An ecological study. *Int J Environ Res Public Health* 15(5):1006. doi:10.3390/ijerph15051006

[90] Eastern Shore Community Health Project, using National Cancer Institute statistics for 2013–2017. Updated in 2021. http://easternshorechp.org/cluster-maps/

Government Accountability Project, 2015. Addendum Report to Deadly dispersants in the Gulf: Are public health and environmental tragedies the new norm for oil spill cleanups? Devine S, Devine T. https://whistleblower.org/wp-content/uploads/2018/11/GAPAddendumReportFinal.pdf

———, 2020. Ten Years After [BP] Deepwater Horizon: Whistleblowers continue to suffer an unending medical nightmare triggered by Corexit. Apr 2020. Devine T, Arnold A. https://whistleblower.org/wp-content/uploads/2020/04/Ten-Years-After-Deepwater-Horizon.pdf

———, 2024. DEEP IMPACT: Ongoing vulnerability in oil spills from the deadly dispersant Corexit. Pacey L, Devine T.

Conception Media Films, 2020. *The Cost of Silence,* executive producer Mark Manning. https://www.costofsilencefilm.com/about-the-film

Sneath S, Laughland O. 2023. "They cleaned up BP's massive spill. Now they're sick – and want justice," *The Guardian* 4/20/2023. https://www.theguardian.com/environment/2023/apr/20/bp-oil-spill-deepwater-horizon-health-lawsuits

A *Hebei Spirit* study also found increased risk of heart disease (angina, a symptom of coronary artery disease, or heart attack) in residents and workers/volunteers.[91] The risk of angina or heart attack increased with longer duration of exposure—from 15–59 days, 60–179 days, and more than 180 days.

To access assess the scale of health damage at the population level and the associated costs of health care and loss of economic productivity, the World Health Organization developed a way to measure the "burden of disease" (BOD) from mental and physical harm from the oil spill using disability-adjusted life year (DALY) to calculate the difference between an adverse health situation and the ideal situation where everyone lives up to the national standard life expectancy in perfect health.

Hebei Spirit oil spill researchers calculated the years lived with disability (DALYs) one year after the spill for six diseases (asthma, allergic rhinitis, dermatitis, conjunctivitis, Post Traumatic Stress Disorder (PTSD), and depression) by sex, age, and region.[92] Asthma was the most prominent disease burden, followed by PTSD and rhinitis. The asthma burden was 6.5 times higher than the national asthma burden in 2008 with significant direct economic costs and loss of productivity costs in the areas with smaller populations where the spill occurred. The DALY of mental health disease (PTSD and depression) were higher among men than women, and for residents in their 20s, while the DALY of asthma and allergic disease (rhinitis, dermatitis, and conjunctivitis) were higher among women than men, and for residents in their 40s. The area with the oil spill site had the highest incidence of additional diseases and the highest burden of disease (DALY).[93]

Corroborating studies on harm to animals from oil spill exposures

The human health findings are corroborated by lab and field studies with animals. For example, animal studies confirm respiratory damage and genotoxicity at the cellular and organism levels. A study with mice found that Corexit dispersant and oil combinations promoted genotoxicity and DNA damage, cell death, inflammation (one of the hallmarks of cancer), and tumor formation in the pulmonary system.[94] Also similar to the earlier RNA-sequence studies with human tissue,[95] Corexit 9527 treatments with mice tissue affected genetic expression and

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[91] Lee M, Park M-S, Cheong H-K, 2020. An association between oil spill clean-up work and cardiovascular disease. *Ecotoxicol Environ Saf* 194:110284. doi: 10.1016/j.ecoenv.2020.110284

[92] Kim, Young-Min, et al. 2013. Burden of disease attributable to the Hebei Spirit oil spill in Taean, Korea. BMJ Open. Sept 20; 3(9):e003334. http://www.ncbi.nlm.nih.gov/pubmed/24056482

[93] Ibid., Kim et al., 2013.

[94] Liu YZ, et al., 2020. The impact of the Deepwater Horizon oil spill upon lung health-mouse model-based RNA-seq analyses. *Int J Environ Res Public Health* 17(15):5466. *doi: 10.3390/ijerph17155466*

[95] See note 38, Lui et al., 2016, Impact of oil spill to lung health; Lui et al., 2017, Carcinogenic effects of oil dispersants (humans).

triggered more cancer pathways than Corexit 9500 (19 versus 7, respectively).[96] Other damage to lung function included airway hyperresponsiveness and pulmonary emphysema. Significantly, the death of large numbers of these alveolar septal cells in peripheral regions was sufficient to cause emphysema *without inflammation* in mice exposed to airborne crude oil pollutants at levels modeled after the BP Deepwater Horizon exposure.[97] This indicates that oil and dispersant exposures may involve a different pathway or mechanism than the inflammatory mechanism for cigarette smoke-induced emphysema.

After the *Exxon Valdez* oil spill, direct respiratory damage (e.g., interstitial pulmonary emphysema) was found in 43–73% of the moderately to heavily oiled sea otters that were necropsied.[98] Similarly, after the BP Deepwater Horizon oil disaster, Barataria Bay (Louisiana) dolphins were five times more likely to have persistent moderate to severe lung disease (e.g., substantial alveolar interstitial syndrome, lung masses, and pulmonary consolidation) than the unoiled control group from Sarasota Bay, Florida.[99] Further, the pulmonary abnormalities and impaired stress response persisted for at least 4 years after the BP Deepwater Horizon disaster.[100] The damage was thought to be "due largely to exposure to oil and volatile compounds produced from the dispersing products."[101]

Like the findings from the human epidemiology studies, the epidemiology studies on the Barataria Bay bottlenose dolphin also found mechanisms of action and disease pathogenesis that progressed from molecular and cellular effects to organ dysfunction and systemic effects that

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[96] Liu YZ, et al., 2020. The impact of the Deepwater Horizon oil spill upon lung health-mouse model-based RNA-seq analyses. *Int J Environ Res Public Health* 17(15):5466. doi: 10.3390/ijerph17155466

[97] Amor-Carro O, et al., 2020. Airway hyperresponsiveness, inflammation, and pulmonary emphysema in rodent models designed to mimic exposure to fuel oil-derived volatile organic compounds encountered during an experimental oil spill. *Environ Health Perspect* 128(2): 27003. https://doi.org/10.1289/EHP4178 Notably, researchers found significantly increased numbers of dead alveolar septal cells, likely from DNA damage, in exposed mice and an unusual pattern of distribution over the most peripheral areas of the lung parenchyma. Healthy septal cells maintain a barrier to prevent leakage of fluid and protein across the alveolar wall into the air spaces. Researchers suggested an alternative disease mechanism for inhalation of fuel oil-derived VOCs, i.e., that the death of large numbers of these cells in peripheral regions was sufficient to cause emphysema without inflammation, which is different than the inflammatory mechanism for cigarette smoke-induced emphysema.

[98] Lipscomb, et al., 1993. Histopathologic lesions in sea otters exposed to crude oil. *Veterinary Pathology* 30(1):1–11.

[99] Schwacke L, et al., 2014. Health of common bottlenose dolphins (*Tursiops truncatus*) in Barataria Bay, Louisiana, following the Deepwater Horizon Oil Spill. *Environ Sci Technol* 48:93–103. dx.doi.org/10.1021/es403610f

Venn-Watson S, et al., 2015. Adrenal gland and lung lesions in Gulf of Mexico Common Bottlenose Dolphins (*Tursiops truncatus*) found dead following the Deepwater Horizon Oil Spill. *PLoS ONE* 10(5):e0126538. doi: 10.1371/journal.pone.0126538.

[100] Smith CR, et al., 2017. Slow recovery of Barataria Bay dolphin health following the Deepwater Horizon oil spill (2013–2014), with evidence of persistent lung disease and impaired stress response. *Endangered Species Research* 33:127–142. doi: 10/esr00778. https://repository.library.noaa.gov/view/noaa/20544

[101] See note 7, NAS, 2022, *Oil in the Sea IV*, at 276.

compromised fitness, growth, reproductive potential, and survival[102] or, in cases of high concentrations, led to multiple organ failure and death.

Implications for health monitoring & risk assessment

This scientific synopsis finds that oil spill exposures are causally-linked with long-term in multiple organ systems and that symptom-based studies were more accurate in predicting the harm than dose-based studies that quantified concentrations with traditional analytical methods.

This is because oil spill exposures are not simply from a single chemical in a defined setting, but rather from complex, multi-phase mixtures of oil-chemical hazards in constantly variable physical and environmental settings. Environmental epidemiology uses a multi-disciplinary, semi-quantitative approach with metrics based on *qualitative* expressions of symptoms, duration, and estimates of exposure *as surrogates for dose measurements* that are often not available when exposures from complex mixtures occur in a broad geographical setting.[103] Traditional analytical methods underestimate oil exposure and create a low-biased impression of the true scale and nature of an oil spill's harmful consequences, as discussed previously.[104]

The science synopsis bears this out. Due to differences in cohort makeup and study design, the two epidemiology studies undertaken after the BP Deepwater Horizon oil disaster demonstrate a greater reliability of symptom-based studies to detect harm than concentration-based studies that rely on air monitoring of select hydrocarbon contaminants. In general, the US Coast Guard symptom-based studies,[105] consistently delineated clear relationships between oil and chemically-dispersed oil exposures and long-term health symptoms and function of the respiratory system,[106] cardiovascular system,[107] and neurological system.[108]

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[102] Lane SM et al., 2015. Reproductive outcome and survival of common bottlenose dolphins sampled in Barataria Bay, Louisiana, USA, following the BP DHOS. *Proc. R. Soc. B* 282:20151944. doi: 10.1098/rspb.2015.1944

Schwacke L, Thomas L, Wells RS, et al. 2017. Quantifying injury to common bottlenose dolphins from the BP DHOS using an age-, sex- and class-structured population model. *Endangered Species Res*. 33:265–279. doi: 10.3354/esr00777 https://repository.library.noaa.gov/view/noaa/15430

[103] For example, noted toxicologist Bernard Goldstein wrote that for "many epidemiological studies of toxic agents, dose is a binary—yes or no—determination instead of a quantitative expression" or "qualitative estimates of high and low exposure." Goldstein BD, 2009. Toxic Torts: The Devil is in the Dose. *J Law & Pol'y*. 16(2):551-587, at 563 and footnote 27. https: //brooklynworks.brooklaw.edu/ilp/vol16/iss2/2/

[104] See notes 13–19 and accompanying text.

[105] See note 29, Rusiecki et al., 2018, US Coast Guard (USCG) cohort.

[106] See note 32, Alexander et al., 2018, USCG study acute respiratory symptoms; Rusiecki et al., 2022, USCG study chronic respiratory conditions.

[107] See note 62, Denic-Roberts et al., 2022. USCG study cardiovascular conditions.

[108] See note 67, Krishnamurthy JK, et al., 2019. USCG study neurological symptoms.

In comparison, the GuLF studies that were based on the Job-Exposure-Matrix (concentration-based approach using BP's incomplete and biased low dataset)[109] still consistently found exposure relationships with short-term health symptoms while long-term health symptoms and function ranged from unclear, to suggested (trend not statistically significant), to significant for the respiratory system,[110] cardiovascular system,[111] and neurological system.[112] The latter relationships were the clearest perhaps since 30% of the air samples contained the more highly neurotoxic BTEX (benzene, toluene, ethylbenzene, and xylene) and n-hexane compounds.[113]

Most tellingly, when one concentration-based GuLF study concluded that respiratory harm did not persist after 1 to 3 years,[114] another GuLF study reanalyzed the data using a symptom-based approach and found increased asthma 1 to 3 years after the spill—with the same cohort.[115] The latter study reported a "true undercounting of clinical asthma" in medically-underserved Gulf Coast populations that were assessed with the concentration-based approach that was unable to capture the full range of harm from uncertain exposures to complex, multi-phase mixtures of oil compounds.[116]

The National Academy of Sciences in its 2023 review of some of these same studies in this science synopsis observed that the "current understanding of the toxicological mechanism of action of THC components would not readily explain the observed [associations between response and concentration]" nor the lack of attenuation of the associations over time.[117]

There are other hints throughout this science synopsis that a symptom-based approach is more accurate in detecting and understanding human health effects than a concentration-based approach with traditional methods. For example, biomarkers of blood and liver damage varied

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[109] Stewart PA, et al., 2018. Development of a total hydrocarbon ordinal job exposure matrix for workers responding to the BP DHOS: The GuLF STUDY. *J Expo Sci Environ Epidemiol* 28(3):223–230. doi: 10.1038/jes.2017.16.

[110] See note 32, McGowan et al., 2017, Symptoms associated with Corexit dispersants.

Gam KB, et al., 2018a. Association between Deepwater Horizon oil spill response and cleanup work experiences and lung function. *Environ Int'nat'l* 121(Pt1):695–702. doi: 10.1016/j.envint.2018.09.058.

[111] See note 65, Strelitz et al., 2019, Impacts on heart function 5 years after spill; Strelitz et al., 2019, Oil spill exposure and risk of heart attack.

[112] See note 68, Quist et al., 2019, Oil spill impacts on neurological function.

[113] Ibid., Quist et al., 2019, Oil spill impacts on neurobehavioral function.

[114] Gam KB, et al. 2018b. Lung function in oil spill response and clean-up workers 1-3 years after the Deepwater Horizon disaster. *Epidemiology* 29(3):315-322. doi: 10.1097/EDE.0000000000000808.

[115] Lawrence KG, et al., 2022 Associations between airborne crude oil chemicals and symptom-based asthma. Environ Int 167:107433. doi: 10.1016/j.envint.2022.107433

[116] Ibid., Lawrence et al., 2022, Airborne crude oil and symptom-based asthma, at 5.

[117] See note 7, NAS, 2022, *Oil in the Sea IV*, 2022, at 347. For example, "[l]ung function was unrelated to the extent of estimated THC [total hydrocarbon] exposure."

among individuals, indicating presence of health hazards, as exposure to such contaminants does not uniformly affect those exposed.[118] Also, reports of new or worsening symptoms over time,[119] and reports of worse impacts in people with prior history of chemical exposures,[120] make PELs and air concentrations unsuitable for assessing harm and risk of harm from oil spill exposures.

Further, the respiratory, cardiovascular, neurological, and skin symptoms that are used in the epidemiology studies of the three major oil spills discussed in this science synopsis are also described in the mandatory OSHA HAZWOPER health hazard criteria as indicative of exposure to respiratory and dermal irritants and sensitizers often present in chemical mixtures, especially those containing health hazards.[121] The OSHA standards recognize that such exposures are exceptions to (PEL) concentration-based approach to health monitoring and risk assessment.[122]

As detailed in the H&S Task Force Report, a two-part, cell-mediated immunological mechanism explains why responses to exposures of certain health hazards and complex chemical mixtures such as crude oil may not be related to dose or duration and may be occurring at levels below those thought to be protective, why harm may increase worsen) over time,[123] and why symptom-based standards and health monitoring programs are needed to mitigate short- and long-term harm to these contaminates.

This scientific synopsis supports the need, discussed in the H&S Task Force Report, for symptom-based health monitoring and surveillance for workers and the exposed public as part of disaster responses for oil spills and chemical releases—as well as the need to codify such programs into law—to mitigate the long-term health harm that the initial symptoms of exposure portend.[124]

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[118] See note 25, D'Andrea & Reddy, 2013, Acute health symptoms.

[119] See note 28, D'Andrea & Reddy, 2018, Chronic health harm.

[120] See note 30, Lawrence et al., 2021, Neighborhood deprivation, lung function; and note note 71, Beland & Oloomi, 2019, Environmental pollution & infant health.

[121] OSHA, 2012. 1910 Subpart Z. Toxic and Hazardous Substances. 1910.1200 Appendix A – Health Hazard Criteria (Mandatory), at A.0.4.2. https://www.osha.gov/laws-regs/regulations/standardnumber/1910/1910.1200AppA

[122] Ibid., OSHA, 2012, 1910.1200 Appendix A Health Hazard Criteria, at A.0.4.2.

[123] See "Uncertain Exposures & The Need for Environmental Exposure Surveys," at 24–27, and notes 36–47.

Masri S, et al., 2021. Toxicant-induced loss of tolerance for chemicals, foods, and drugs: Assessing patterns of exposure behind a global phenomenon. *Environ Sci Eur* 33:65. https://doi.org/10.1186/s12302-021-00504-z

Miller CS, et al., 2021. Mast cell activation may explain many cases of chemical intolerance. *Environ Sci Eur* 33:129. https://doi.org/10.1186/s12302-021-00570-3

[124] A court ruled that people not covered by the medical settlement must file individual lawsuits. Thousands did. Kirby B, 2022. "12 years later, BP still fighting hundreds of lawsuits over Deepwater Horizon spill." *Fox10 TV* 7/8/2022. https://www.fox10tv.com/2022/07/08/12-years-later-bp-still-fighting-hundreds-lawsuits-over-deepwater-horizon-spill/ Mostly the claims came to naught because of the court's reliance on air monitoring rather than symptom-based health monitoring, as per rules established by the lawyers involved in the BP medical benefits settlement. See note 3, Ott, 2023, Amicus letter; note 90, Sneath & Laughland, 2023, *The Guardian*.

APPENDIX B.

National Response Team
Emergency Responder Health Monitoring and Surveillance (ERHMS):
A Guide for Key Decision Makers (2012)

https://www.nrt.org/sites/2/files/ERHMS_Decisionmakers_060512.pdf

NRT

Emergency Responder Health Monitoring and Surveillance (ERHMS):

A Guide for Key Decision Makers

January 26, 2012

Chair

Vice Chair

Member Agencies

This document is a companion document to the Emergency Responder Health Monitoring and Surveillance, National Response Team Technical Assistance Document found at: ERHMS.nrt.org

A high priority of the National Response Team (NRT) is the preparation of emergency responders and decision makers for planning and conducting effective response and recovery activities while maintaining high standards of responder safety and health. The Emergency Responder Health Monitoring and Surveillance (ERHMS) NRT Technical Assistance Document (TAD) is designed to provide the response community with a comprehensive framework for collecting important elements of responder safety and health in an organized, systematic manner and to utilize this data to optimize the health and safety of emergency responders and recovery workers prior to, during, and after their response to man-made or natural incidents. It is also intended for use by emergency response planners developing local and regional response plans in the context of the U.S. National Response Framework, the National Incident Management System, and other federal and state guidance that has been issued in recent years.

In an effort to provide a concise and practical overview of the ERHMS system for the supervisory personnel involved in emergency response planning and execution, this "Guide for Key Decision Makers" was written to serve as a companion to the complete technical assistance document. It provides a step by step summary of the components of the ERHMS system, its primary data requirements, primary recommendations, and key decision points, and it outlines the type of health and safety reports that the ERHMS system can provide to decision makers. To function optimally, the ERHMS system requires the support and involvement of senior response personnel. This companion piece will help supervisory personnel understand how they can facilitate the implementation of the ERHMS system, anticipate its safety and health data requirements, and utilize ERHMS recommendations to optimize the safety and health of emergency responders under their command.

Target Audiences

This document is intended for those organizations and individuals responsible for planning and executing an incident response that optimizes the health and safety of response, remediation and recovery workers. The intended audience is decision makers at the local, regional, state, tribal, and federal levels who are responsible for decisions affecting the occupational safety and health of responders. These decision makers include:

- Elected and appointed officials
- Incident commanders
- Planners across disciplines that support emergency response
- Leaders of emergency-response departments
- Managers of healthcare/public safety organizations
- Voluntary organizations active in disasters

Key Emergency Responder Protection Principles

When disaster strikes, the nation depends on emergency response workers who are prepared and trained to respond effectively. Response work can range from well-contained, localized efforts to massive, diffuse mobilizations and involves a broad array of activities including search, rescue, investigation, assessment, recovery, cleanup and restoration. Such work is carried out by individuals from emergency management, fire service, law enforcement, emergency medical services, public health, construction and other skilled support, disaster relief, mental health, and volunteer organizations. To ensure that emergency workers can meet the challenges of disasters, every effort must be made to protect them from the safety and health risks inherent in their work. Concerns about worker safety and health are apparent in nearly every type of response, and an effective framework of health monitoring and surveillance of workers is necessary to recognize possible health issues and bring these potentially devastating hazardous situations under control.

Previous emergency events have demonstrated that despite analyzing and applying 'lessons learned', significant gaps continue to exist in emergency response workers health monitoring and surveillance. These gaps were documented in the Government Accounting Office and Rand reports prepared following the World Trade Center response, but these problems have persisted and, despite improvements, were observed again in Hurricane Katrina and Deepwater Horizon responses.

The persistence of these gaps in emergency responder health monitoring and surveillance, despite considerable attempts to anticipate and correct them, emphasizes that there remains a need for a coherent, comprehensive

approach to protecting emergency response workers and a need for detailed, practical guidance on how to implement such an approach. Any effort to meet this need must incorporate a variety of measures, including the following:

- Medical screening that focuses on assessment of readiness and ability to safely and effectively deploy on a response
- Training regarding hazards to be anticipated and protective measures to mitigate them
- Approaches to centralized tracking or rostering of responders
- Surveillance and monitoring for exposures and adverse health effects, including supporting efforts in environmental monitoring and assessment
- Out-processing assessments on completion of response duties and deployments
- Follow-up including long-term surveillance or monitoring for potential delayed or long-term adverse effects of the deployment experience

The guidelines, recommendations, and procedures utilized to implement these protections are designed to be fully compatible with and function within the National Incident Management System (NIMS), which has been adopted as the accepted standard organizational focus for emergency response at all levels (local, state and federal) and for all incident sizes and types. Before a response occurs, it is crucial that the ERHMS system is well understood and incorporated into planning and procedures by Incident Command leadership, as well as health, safety, and medical personnel.

Concise Overview for Incident Commanders

The ERHMS system is designed to provide real time data and recommendations on health and safety issues that arise among the responders involved in an emergency response. For example, it could potentially provide incident command with:

- A complete roster of responders involved in the response to date (including spontaneous volunteers)
- A summary of data regarding responder readiness (health status, incoming training level, receipt of on-site training, certifications, and credentials)
- A summary of occupational health and safety issues that have occurred among responders to date, with recommendations for reducing concerning trends
- Identification of responders or responder groups who have experienced hazardous exposures during the response, with recommendations for tracking of their health after the event for future health effects

To ensure that the valuable information produced by the ERHMS system is made readily available to Incident Command, the Incident Commander should identify a component of the ICS structure that will be given the responsibility for implementing ERHMS, ideally soon after the ICS command has been identified. We recommend that this function be assigned to the Safety command within the ICS structure and should act in cooperation with the medical assets involved in the response. The lead members of this “ERHMS Unit” will have several responsibilities, which include:

- Ensuring that all safety officers are given the knowledge and tools they need to carry out ERHMS functions
- Serving as the central point for the collection of data that is necessary to allow ERHMS to fulfill all its functions (A software system is being designed by NIOSH to facilitate this process.)
- Assigning qualified personnel for the analysis and interpretation of the data, and the production of updates, reports, and recommendations based on these reports

The complete ERHMS technical assistance document is designed to prepare and assist the ERHMS Unit by providing them with the knowledge and tools they will need to implement the full range of functions within the ERHMS system. The following is a brief overview of these key functions and responsibilities, the key deliverable items that the Incident Command can expect to receive from the ERHMS Unit, and the steps that the Incident Command should take to help facilitate the functioning of ERHMS.

Summary of ERHMS Functions, Decision Points, and Deliverables

Pre-deployment: There are a number of key activities that should ideally be conducted by a responder organization before they deploy their responders to an emergent event, such as medical screening, credentialing, and safety training. The responder organization should document these activities either in electronic or written format, and the data from these records should then be made available to the ERHMS Unit for utilization during and after a response. If these activities were not completed prior to the response or the data is not readily available, then such functions can be carried out, for example, through the use of responder surveys near the outset of the response.

> Decision Point: A key initial task of the ICS command structure is to determine if the activities required for ERHMS in the pre-deployment phase have in fact been completed by participating responder organizations and that the data from these activities is made available to the ERHMS Unit. If not, they should facilitate the procurement of such data by direct survey of participating responders.

The following is a brief overview of the pre-deployment activities that should ideally be conducted by responder organizations and the deliverables that the Incident Command can expect to receive based on these data:

Rostering and Credentialing:A basic tenet of safety and health in emergency response is to maintain accountability for all emergency responders. The registration and credentialing system of emergency response and recovery workers should be designed to support four interdependent, interoperable functions: (1) registration (records basic and credential information on each worker); (2) emergency credentialing (assigning a credential level based on responder certifications and education); (3) re-verification (periodically verifies responder information); and (4) emergency badging (assigning an identification badge in accordance with the credential level). Since the information requirements of each function are interdependent, these four functions should ideally be integrated within a single database.

> Deliverable: Each participating response organization should develop a complete roster of their responders that includes data on each responder's credentials.

Health Screening: Within the framework of an ERHMS system, pre-deployment health screening is intended to establish a baseline physical and emotional health status. Such information may be obtained from an entrance physical examination to determine fitness for duty, or from subsequent medical examinations. This baseline information allows for more informed interpretation of possible post-deployment adverse health effects and is particularly valuable when exposure information is difficult to obtain, interpret, or is completely absent. Baseline health status should address not only the responder's physical health status but also emotional health status and immunization status.

In addition to providing baseline health information, the pre-deployment screening can serve as an opportunity to assess whether the responder has the appropriate education, training, and experience to perform assigned response duties.

> Deliverable: Each response organization's roster should include the designation of "fit for response duty" for each responder listed, as appropriate. Data related to this determination may later be needed for analysis purposes.

Training: Training is critical for the preparedness of the responder. The responder is required to be fully certified to perform duty-specific tasks, which may have federal, state or locally mandated training requirements. In addition, the ability of the responder to recognize and avoid possible health and safety risks will affect the responder's performance, survivability and resilience during and after the disaster response. Regardless of the training a responder has received prior to a disaster, there will be a need for additional training focused on site-specific hazards, operating procedures, and available resources. This training is sometimes referred to as "orientation," "just-in-time (JIT)," and "toolbox or tailgate talks" during the disaster but will be referred to as "site-specific training" in this document. The ERHMS system could provide insight into areas that may be responsive to increased responder training or require adjustment to reduce possible injuries or near misses. Additionally, the ERHMS system could provide a valuable source of post-disaster data to evaluate the impact that responder training had on minimizing responder illness and injury. The ERHMS system may be used as an evaluation tool to determine the effectiveness of preparedness training, as well as the impact of site-specific training on specific types of injuries or accidents.

> Deliverable: Each response organization's roster should include a listing of key training courses completed by each responder.

During deployment: Over the course of an emergency response, there are various health and safety functions that should be conducted by various components of the Incident Command, including the Safety, Planning, and Logistics sections. Such functions include on-site training, exposure assessment, development of health and safety plans, and surveillance for injuries and illnesses occurring to responders. The ERHMS Unit must be able to collaborate and work closely with the various command components responsible for these functions in order to obtain all the necessary data that is crucial to the functioning of the ERHMS system.

> Decision Point: Soon after an ICS Command has been identified for a given response, the command should appoint an ERHMS Unit in charge of collecting and analyzing the responder safety and health data that is required by the ERHMS system. The command should facilitate collaboration and sharing of data between this unit and other key sections of the ICS command, such as Safety, Planning, and Logistics.

The following are the list of functions that the ERHMS system recommends be conducted during a response (and their subsequent data made available to the ERHMS Unit), the deliverables that the Incident Command can expect to receive, and the considerations that the Incident Command should take to help facilitate the functioning of ERHMS during the response.

On-site Rostering: The process of personnel identification, accountability, and tracking can be referred to as the responder roster. Whenever the level of response is greater than what the first tier of local responders can handle, a roster should be used to log everyone who reports to the disaster area and is engaged in response or remediation work. The Logistics Section is responsible for collecting this information into a comprehensive rostering system, but components of accountability also include parallel and linkable procedures conducted by Planning (example–demobilization) and by Command (Safety Officer). Site-specific training (SST) should be performed prior to responders entering a designated disaster control zone and is required under 29 CFR 1910.120. Strategies for implementing SST should be pre-planned to the extent feasible with consideration given to different training materials necessary to meet expected and unexpected health and safety hazards on site. A variety of PPE may be needed by response workers and volunteers, and for many workers, this equipment will be issued to them during their SST training or during check-in procedures as they arrive at the response scene and are placed on the response roster. This central function or location for issuing PPE to responders serves as an opportunity for recording the amount, type, and condition of the PPE that is issued, allowing for documentation of these data within the ERHMS system.

Decision Point: The Incident Command should facilitate on-site rostering by leveraging opportunities from other command functions, such as check-in procedures, badging procedures, or on-site training events.

Deliverable: The ERHMS Unit will compile an on-site roster of all responders who are physically present at the response event.

Health Monitoring and Surveillance: Health monitoring and surveillance are two different but complementary methods to protect the health and safety of incident responders during an emergency operation. Monitoring refers to the ongoing and systematic collection, analysis, interpretation, and dissemination of data related to an individual incident responder's injury and illness and exposures status. This allows for the evaluation of the occurrence of an exposure, determination of the level of exposure an individual responder might experience during duties, and assessment of how that exposure is affecting the individual responder. Surveillance refers to the ongoing and systematic collection, analysis, interpretation, and dissemination of illness and injury data related to an event's emergency responder population as a whole. This allows for the tracking of emergency responder health (illness and injury) trends within a defined population during response and recovery. A mechanism to allow surveillance should be an integral part of the response to any event.

Decision Point: The Incident Command should facilitate the acquisition of injury and illness data from a variety of sources, including safety records, on-site medical facilities, state and local emergency departments and clinics, and federal medical resources assigned to the event.

Deliverable: The ERHMS Unit will compile and assess available data regarding injuries and illnesses that occur to responders over the course of the response, as well as compile and assess any health monitoring data available for those responders whose health and safety are being closely monitored.

Response Activity Documentation and Safety Controls Documentation: Response workers and volunteers may be exposed to many different chemical and environmental hazards in the course of their work. Obtaining accurate and useful worker exposure information is a crucial element in ensuring exposures are correctly characterized, risk is communicated appropriately, and sufficient information is available for making evidence-based decisions (i.e., PPE and work practice controls) to protect the health and safety of response workers. The exposures addressed in this document include chemical and physical hazards, as well as "psychological toxins", fatigue, and the factors contributing to and increasing fatigue. Psychological toxins include sights and smells of death, exposure to the wounded, and risk of becoming a casualty. There are three risk management decisions, as described later in this document that safety officers, industrial hygienists and other public health professionals ascertain from the assessment process: acceptability of exposures, unacceptability of exposures and uncertainty of exposures (which requires further information gathering).

Decision Point: The Incident Command should facilitate the documentation of responder activities by leveraging various sources of data, including daily safety plans, check-in and out logs, and pay records

Deliverable: The ERHMS Unit will compile available data regarding responder activities, their use of personal protective equipment, fatigue risk factors, and pertinent data from the Health and Safety Plan.

Communication of Exposure and Health Monitoring and Surveillance Data during an Emergency Response: Communication is critical throughout the course of an emergency response. There are multiple components to communications during an emergency response, including psychology (phase-dependent), messaging (content, timing), audiences, and spokespersons. The collection of environmental exposure data and individual health and safety monitoring data, along with aggregate surveillance data, are relevant to protecting all the responders involved in an event both in the short-term and long-term, but it is not an end unto itself. This information must be communicated to workers, intra-organizationally, inter-organizationally, and inside and outside the ICS structure. Although it is common for organizations to track and report data they are collecting within their own operational structures, the need for tracking and communicating more broadly than a single organization is key to informing responders (e.g., workers, contractors, volunteers) about proactive steps they can take to protect themselves from hazardous exposures while attempting to protect the environment, identify survivors, or recover those who have died.

Decision Point: The Incident Command should assist in the development of a Communications plan early in a response that will include and accommodate the findings and recommendations arising from the ERHMS system.

Deliverable: The ERHMS Unit will provide the Incident Command with periodic reports on the health and safety of the responders involved in the event and work with the Liaison and Information Officers to develop appropriate messaging for other stakeholders and the general public.

Post-deployment: Although listed as post-deployment in nature, the following activities of the ERHMS system should be initiated while the response is ongoing. The first function assigned to this phase of ERHMS is the out-processing assessment, which captures data from the individual responder as they are completing their time spent at the response. Data and information obtained from departing responders can, on an ongoing basis, be included in analyses that might lead to identification of responders that would benefit from post-event tracking of their health. This determination may be made for certain groups of responders before the overall response has finished, and thus is really a function that begins during the event, though often may be delayed until complete exposure assessment and environmental analysis becomes available. The following is a summary of the "post-deployment" activities of the ERHMS system and the deliverables that the Incident Command can expect to receive. The ERHMS Unit conducts these functions during the timeframe of the response and may then hand off this function to appropriate authorities who are officially assigned such duties in the formal post-response phase.

Out-processing Assessment: The out-processing assessment is the minimum post-deployment evaluation that should be conducted for responders. Out-processing assessments are conducted to determine the extent, if any, to which individual responders have been adversely affected by their work during deployment and to assess trends within the population of workers for the purpose of identifying potential risks to others. Responders often encounter complex, uncontrolled environments which can involve multiple or mixed chemical exposures, hazardous substances, microbial agents, physical agents (temperature, noise, etc.), long work shifts, or stressful experiences. Therefore, all responders should receive an out-processing assessment as part of the demobilization process or as soon as possible after demobilization. Out-processing assessment should be simple, concise, and standardized. Ideally, the out-processing assessment would be a face-to-face interview in the field as responders are preparing to depart back to their routine duty station; however, other good options could include different formats (paper, website, or phone interview) or conducting the assessment 1 to 2 weeks before or after demobilization.

Decision Point: The Incident Command should facilitate the participation of all responders in an out-processing assessment. The assessment can be conducted using a variety of formats, including paper forms, oral surveys, and online surveys. Employing a combination of formats will likely lead to increased participation.

Deliverable: The ERHMS Unit will create an out-processing assessment survey that is conducted for all responders at or near the completion of their duties for the event.

Tracking of Emergency Responder Health and Function: Because of potential health and safety risks inherent in emergency response work, post-event tracking of responder health may be appropriate. The goal is to identify adverse health or functional consequences potentially associated with response work (e.g., exposure, illness, injury, or disability–including emotional trauma), to intervene early to maximize the chances for recovery, and to stop further exposure for workers remaining on-scene (i.e., through exposure control or medical treatment). The decision to opt for further tracking should be based on a wide variety of factors, including information regarding the responders' hazardous work exposures, hazardous work activities, concerns expressed by the responder or safety and health personnel, the adequacy of control measures (and adherence), and injuries and illnesses incurred during their deployment. Such information should be viewed in the context of the workers' prior physical and mental health status and the extent of their prior knowledge and experience with disaster work. Post-event tracking of health may be difficult or costly to conduct on a case-by-case basis, and it is often more suitable for such decisions to be made for categories of responders with similar exposure histories. High-priority worker groups for post-event health tracking would include those most likely to have exposures to hazardous agents or conditions and those reporting similar adverse health outcomes.

Decision Point: The Incident Command should assist in identifying the most appropriate organization for implementing post-event health tracking recommended by the ERHMS Unit. Note that this tracking recommendation may range from short, informal health surveys mailed to responders to long-term intensive monitoring of responder health under the supervision of a physician.

Deliverable: The ERHMS Unit will identify those responders or responder groups whose health would benefit from periodic tracking after the event, make recommendations regarding the most suitable method of tracking, and suggest an appropriate duration for health tracking.

Lessons-learned and After-action Assessments: At the conclusion of an event, there is a need to assess how the emergency response has been conducted through the pre-deployment, deployment, and post-deployment phases and try to identify ways to improve during each of these periods. This ensures that best practices are used and that mistakes are identified and measures taken so that they are not repeated the next time. Often this is accomplished through a document called an After-Action Report (AAR). It is essential that ERHMS be included in the general after action report or similar document. Practices such as identifying deficiencies in communications of safety and health protocols; examining when and where there were exposures; and noting any difficulties involved in compiling a complete, accurate, and timely roster; all help organizers improve the safety environment and better protect emergency responder safety and health during the next emergency.

Decision Point: The Incident Command should incorporate the After-Action Report from the ERHMS Unit into the overall After-Action Report that is developed for the response as a whole.

Deliverable: The ERHMS Unit will compile an After-Action Report for ICS leadership that should be made available to all responder organizations involved in the response, so they can benefit from these insights.

APPENDIX C.

Tools—Environmental Exposure and Sensitivity Inventory Surveys

https://tiltresearch.org/self-assessment/

FOR REVIEW PURPOSES ONLY

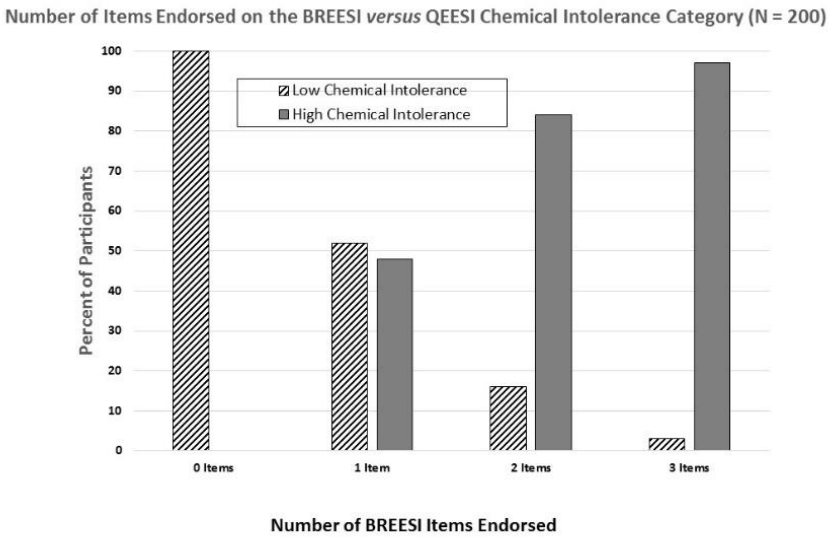
Researchers must contact Dr. Claudia Miller for permission to use the **BREESI**© and **QEESI**© in their studies.

Contact

Dr. Claudia Miller, Professor
Department of Family & Community Medicine
University of Texas School of Medicine
7703 Floyd Curl Drive
San Antonio, TX 78229-3900
Fax: (210) 567-7457
Email: MillerCS@uthscsa.edu

BREESI©

The Brief Environmental Exposure and Sensitivity Inventory (BREESI)[1] is a screening tool whose three questions determine whether an individual should take the Quick Environmental Exposure and Sensitivity Inventory (QEESI).[2] The QEESI is a validated 50-item questionnaire used worldwide to assess chemical intolerance (CI) whose prevalence is 8-33% in population-based surveys.[3, 4] To learn more about CI's underlying disease process (Toxicant-Induced Loss of Tolerance, TILT) and the QEESI, visit www.TILTresearch.org.



Our research revealed that 97% of persons answering "Yes" to all three items on the BREESI had high CI scores as assessed by the QEESI. If two items were endorsed, approximately 84% of the sample had high CI scores. If one item was endorsed, 48% had high CI scores. 100% of those who answered "No" to all of the BREESI items, showed no evidence of CI on the QEESI. Any individual answering "Yes" to one or more of the three BREESI screening items should take the full QEESI at www.TILTresearch.org.

Brief Environmental Exposure and Sensitivity Inventory

Instructions: Please answer these three questions by checking Yes or No

1. Do you feel sick when you are exposed to tobacco smoke, certain fragrances, nail polish/remover, engine exhaust, gasoline, air fresheners, pesticides, paint/thinner, fresh tar/asphalt, cleaning supplies, new carpet or furnishings? By sick we mean: headache, difficulty thinking, difficulty breathing, weakness, dizziness, upset stomach, etc.

❑ *Yes* ❑ *No*

2. Are you unable to tolerate or do you have adverse or allergic reactions to any drugs or medications (such as antibiotics, anesthetics, pain relievers, X-ray contrast dye, vaccines or birth control pills), or to an implant, prosthesis, contraceptive chemical or device, or other medical/surgical/dental material or procedure?

❑ *Yes* ❑ *No*

3. Are you unable to tolerate or do you have adverse reactions to any foods such as dairy products, wheat, corn, eggs, caffeine, alcoholic beverages, or food additives (e.g., MSG, food dye)?

❑ *Yes* ❑ *No*

[1] The BREESI© (pending publication) was developed as part of the Hoffman TILT Research Program funded by the Marilyn B. Hoffman Foundation. For more information, contact Ray Palmer, PhD, at palmerr@uthscsa.edu or (210) 358-5870.

[2] Miller CS, Prihoda T. The Environmental Exposure and Sensitivity Inventory (EESI): a Standardized Approach for Measuring Chemical Intolerances for Research and Clinical Applications. *Toxicol Ind Health* 1999;15 (3-4):370-85.

[3] Katerndahl DA, Bell IR, Palmer RF, Miller CS. Chemical Intolerance in Primary Care Settings: Prevalence, Comorbidity, and Outcomes. *Ann Fam Med* 2012; 10(4):357-365.

[4] Azuma et al., Prevalence and Characteristics of Chemical Intolerance: A Japanese Population-based Study. *Arch Environ Occup Health* 2015; 70:341–353.

QEESI©

This validated questionnaire, **The Quick Environmental Exposure and Sensitivity Inventory**, or **QEESI©,** helps researchers, doctors, and their patients identify individuals with multiple chemical intolerances. The **QEESI©** involves personal health information. Its use should be restricted to patients, their personal physicians, and researchers using the **QEESI©** as part of a protocol approved by an appropriate institutional review board (such as one registered with the U.S. Department of Health and Human Services Office for Human Research Protections).

Please do not re-post the **QEESI©** or its image on any websites without written permission.

Doctors

This instrument is provided free of charge. Please do not charge patients for its use. Physicians are encouraged to use the **QEESI©**, as part of their clinical practice with patients when chemical intolerance or TILT (Toxicant Induced Loss of Tolerance) is suspected.

Patients

Patients are welcome to download and complete the **QEESI©**, and are encouraged to take it and the interpretation sheet to their doctors.

Researchers

Researchers must contact Dr. Claudia Miller for permission to use the **QEESI©** in their studies.

Contact

Dr. Claudia Miller, Professor
Department of Family & Community Medicine
University of Texas School of Medicine at San Antonio
7703 Floyd Curl Drive
San Antonio, TX 78229-3900
Fax: (210) 567-7457
Email: MillerCS@uthscsa.edu

Additional information is available at www.drclaudiamiller.com.

Dr. Miller is not available to consult on individual cases or to serve as an expert witness.

QEESI©

The Quick Environmental Exposure and Sensitivity Inventory (QEESI©) was developed as a screening questionnaire for multiple chemical intolerances (MCI). The instrument has four scales: Symptom Severity, Chemical Intolerances, Other Intolerances, and Life Impact. Each scale contains 10 items, scored from 0 = "not a problem" to 10 = "severe or disabling problem." A 10-item Masking Index gauges ongoing exposures that may affect individuals' awareness of their intolerances as well as the intensity of their responses to environmental exposures. Potential uses for the QEESI© include:

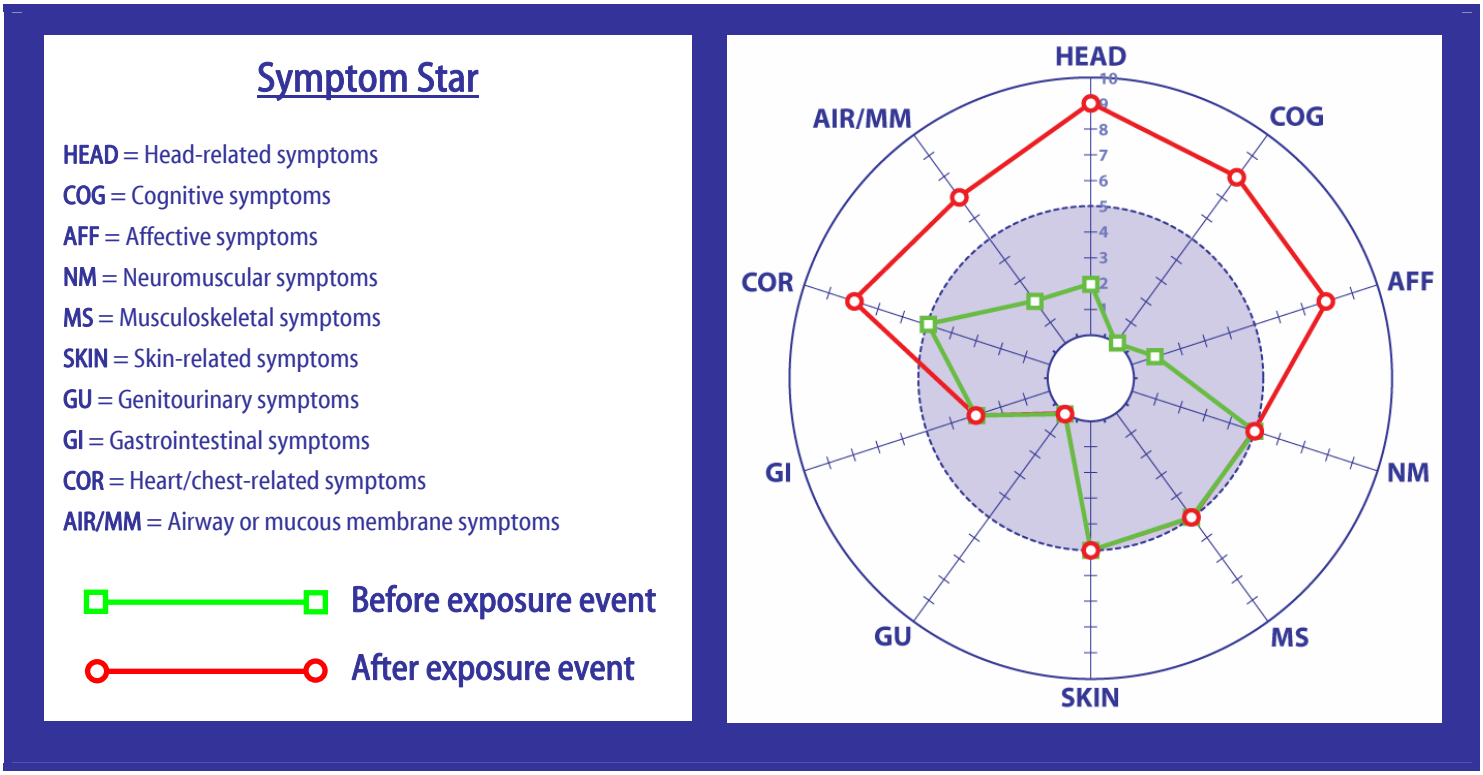
1. Research—to characterize and compare study populations, and to select subjects and controls.

2. Clinical evaluations—to obtain a profile of patients' self-reported symptoms and intolerances. The QEESI© can be administered at intervals to follow symptoms over time or to document responses to treatment or exposure avoidance.

3. Workplace or community investigations—to identify and assist those who may be more chemically susceptible or who report new intolerances. Affected individuals should have the option of discussing results with investigators or their personal physicians.

Individuals whose symptoms began or intensified following a particular exposure event can fill out the QEESI© using two different ink colors, one showing how they were before the event, and the second how they have been since the event. On the cover of the QEESI© is a "Symptom Star" (Figure 1) which provides a graphical representation of patients' responses on the Symptom Severity Scale.

Figure 1. QEESI Symptom Star illustrating symptom severity in an individual before and after an exposure event (e.g., pesticide application, indoor air contaminants, chemical spill)



For additional copies of the QEESI©, contact Claudia S. Miller, M.D., M.S., University of Texas Health Science Center at San Antonio, Department of Family and Community Medicine, 7703 Floyd Curl Drive (222 MCS), San Antonio, Texas 78229-3900. Phone: (210) 567-7407; fax: (210) 567-7457; email: millercs@uthscsa.edu. For further information see Chemical Exposures: Low Levels and High Stakes by Nicholas A. Ashford and Claudia S. Miller, John Wiley & Sons, 1998 (1-800-225-5945) http://www.wiley.com.

Date: ID:

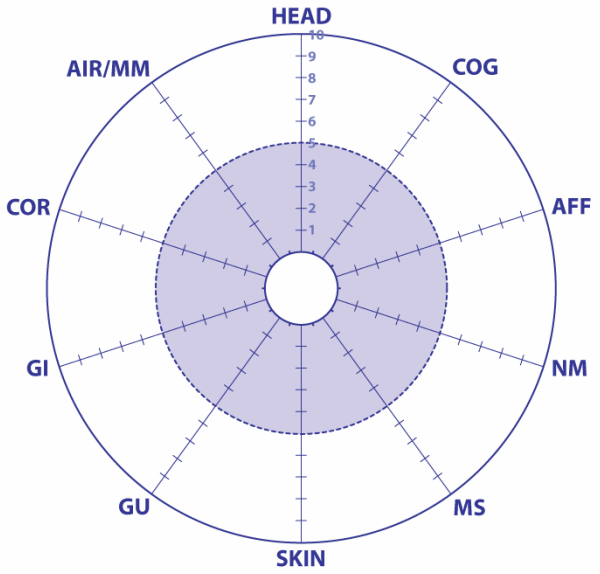
QEESI©

Quick Environmental Exposure and Sensitivity Inventory V-1

The purpose of this questionnaire is to help identify health problems you may be having and to understand your responses to various exposures. Complete pages 1-5, describing how you are now. Then fill in the "target" diagram below.

If your health problems began suddenly or became much worse after a particular exposure event, such as a pesticide exposure or moving to a new home or office building, then go back through pages 1-3 and indicate how you were before the exposure event. Use different colors or symbols (circles, squares) for "before" and "after."

Symptom Star



Instructions: Place page 3 so that it lies next to this page. Place a dot on the corresponding spoke for each symptom item. Connect these points. Indicate "before" and "after" scores by using different colors or dotted versus solid lines.

— Chemical Exposures —

The following items ask about your responses to various odors or chemical exposures. Please indicate whether or not these odors or exposures would make you feel sick, for example, you would get a headache, have difficulty thinking, feel weak, have trouble breathing, get an upset stomach, feel dizzy, or something like that. For any exposure that makes you feel sick, on a 0-10 scale rate the severity of your symptoms with that exposure. For exposures that do not bother you, answer "0." Do not leave any items blank.

For each item, circle one number only:
[0 = not at all a problem] [5 = moderate symptoms]
[10 = disabling symptoms]

1.	Diesel or gas engine exhaust	0 1 2 3 4 5 6 7 8 9 10
2.	Tobacco smoke	0 1 2 3 4 5 6 7 8 9 10
3.	Insecticide	0 1 2 3 4 5 6 7 8 9 10
4.	Gasoline, for example at a service station while filling the gas tank	0 1 2 3 4 5 6 7 8 9 10
5.	Paint or paint thinner	0 1 2 3 4 5 6 7 8 9 10
6.	Cleaning products such as disinfectants, bleach, bathroom cleansers or floor cleaners	0 1 2 3 4 5 6 7 8 9 10
7.	Certain perfumes, air fresheners or other fragrances	0 1 2 3 4 5 6 7 8 9 10
8.	Fresh tar or asphalt	0 1 2 3 4 5 6 7 8 9 10
9.	Nailpolish, nailpolish remover, or hairspray	0 1 2 3 4 5 6 7 8 9 10
10.	New furnishings such as new carpeting, a new soft plastic shower curtain or the interior of a new car	0 1 2 3 4 5 6 7 8 9 10

Total Chemical Intolerance Score (0-100):

Name any additional chemical exposures that make you feel ill and score them from 0 to 10: _____

_____

_____

_____

_____

_____

_____

— Other Exposures —

The following items ask about your responses to a variety of other exposures. As before, please indicate whether these exposures would make you feel sick. Rate the severity of your symptoms on a 0-10 scale. Do not leave any items blank.

For each item, circle one number only:
[0 = not at all a problem] [5 = moderate symptoms]
[10 = disabling symptoms]

1.	Chlorinated tap water	0 1 2 3 4 5 6 7 8 9 10
2.	Particular foods, such as candy, pizza, milk, fatty foods, meats, barbecue, onions, garlic, spicy foods, or food additives such as MSG	0 1 2 3 4 5 6 7 8 9 10
3.	Unusual cravings, or eating any foods as though you were addicted to them; or feeling ill if you miss a meal	0 1 2 3 4 5 6 7 8 9 10
4.	Feeling ill after meals	0 1 2 3 4 5 6 7 8 9 10
5.	Caffeine, such as coffee, tea, Snapple, cola drinks, Big Red, Dr. Pepper or Mountain Dew, or chocolate	0 1 2 3 4 5 6 7 8 9 10
6.	Feeling ill if you drink or eat less than your usual amount of coffee, tea, caffeinated soda or chocolate, or miss it altogether	0 1 2 3 4 5 6 7 8 9 10
7.	Alcoholic beverages in small amounts such as one beer or a glass of wine	0 1 2 3 4 5 6 7 8 9 10
8.	Fabrics, metal jewelry, creams, cosmetics, or other items that touch your skin	0 1 2 3 4 5 6 7 8 9 10
9.	Being unable to tolerate or having adverse or allergic reactions to any drugs or medications (such as antibiotics, anesthetics, pain relievers, x-ray contrast dye, vaccines or birth control pills), or to an implant, prosthesis, contraceptive chemical or device, or other medical, surgical or dental material or procedure	0 1 2 3 4 5 6 7 8 9 10
10.	Problems with any classical allergic reactions (asthma, nasal symptoms, hives, anaphylaxis or eczema) when exposed to allergens such as: tree, grass or weed pollen, dust, mold, animal dander, insect stings or particular foods	0 1 2 3 4 5 6 7 8 9 10

Total Other Intolerance Score (0-100): _____

— Symptoms —

The following questions ask about symptoms you may have experienced commonly. Rate the severity of your symptoms on a 0-10 scale. Do not leave any items blank.

For each item, circle one number only:
[0 = not at all a problem] [5 = moderate symptoms]
[10 = disabling symptoms]

1.	Problems with your muscles or joints, such as pain, aching, cramping, stiffness or weakness?	MS 0 1 2 3 4 5 6 7 8 9 10
2.	Problems with burning or irritation of your eyes, or problems with your airway or breathing, such as feeling short of breath, coughing, or having a lot of mucus, post-nasal drainage, or respiratory infections?	AIR/MM 0 1 2 3 4 5 6 7 8 9 10
3.	Problems with your heart or chest, such as a fast or irregular heart rate, skipped beats, your heart pounding, or chest discomfort?	COR 0 1 2 3 4 5 6 7 8 9 10
4.	Problems with your stomach or digestive tract, such as abdominal pain or cramping, abdominal swelling or bloating, nausea, diarrhea, or constipation?	GI 0 1 2 3 4 5 6 7 8 9 10
5.	Problems with your ability to think, such as difficulty concentrating or remembering things, feeling spacey, or having trouble making decisions?	COG 0 1 2 3 4 5 6 7 8 9 10
6.	Problems with your mood, such as feeling tense or nervous, irritable, depressed, having spells of crying or rage, or loss of motivation to do things that used to interest you?	AFF 0 1 2 3 4 5 6 7 8 9 10
7.	Problems with balance or coordination, with numbness or tingling in your extremities, or with focusing your eyes?	NM 0 1 2 3 4 5 6 7 8 9 10
8.	Problems with your head, such as headaches or a feeling of pressure or fullness in your face or head?	HEAD 0 1 2 3 4 5 6 7 8 9 10
9.	Problems with your skin, such as a rash, hives or dry skin?	SKIN 0 1 2 3 4 5 6 7 8 9 10
10.	Problems with your urinary tract or genitals, such as pelvic pain or frequent or urgent urination? (For women: or discomfort or other problems with your menstrual period?)	GU 0 1 2 3 4 5 6 7 8 9 10

Total Symptom Score (0-100): _____

— Masking Index —

The following items refer to *ongoing* exposures you may be having. Circle "0" if the answer is "NO," or if you don't know whether you have the exposure. Circle "1" if the answer is "YES," you do have the exposure. Do not leave any items blank.

Circle "0" or "1" only:

1.	Do you smoke or dip tobacco once a week or more often?	NO=0	YES=1
2.	Do you drink any alcoholic beverages, beer, or wine once a week or more often?	NO=0	YES=1
3.	Do you consume any caffeinated beverages once a week or more often?	NO=0	YES=1
4.	Do you routinely (once a week or more) use perfume, hairspray, or other scented personal care products?	NO=0	YES=1
5.	Has either your home or your workplace been sprayed for insects or fumigated in the past year?	NO=0	YES=1
6.	In your current job or hobby, are you routinely (once a week or more) exposed to any chemicals, smoke or fumes?	NO=0	YES=1
7.	Other than yourself, does anyone routinely smoke inside your home?	NO=0	YES=1
8.	Is either a gas or propane stove used for cooking in your home?	NO=0	YES=1
9.	Is a scented fabric softener (liquid or dryer sheet) routinely used in laundering your clothes or bedding?	NO=0	YES=1
10.	Do you routinely (once a week or more) take any of the following: steroid pills, such as prednisone; pain medications requiring a prescription; medications for depression, anxiety, or mood disorders; medications for sleep; or recreational or street drugs?	NO=0	YES=1

Masking Index (0-10):
(Total number of YES answers) _____

— Impact of Sensitivities —

If you are sensitive to certain chemicals or foods, on a scale of 0-10 rate the degree to which your sensitivities have affected various aspects of your life. If you are not sensitive or if your sensitivities do not affect these aspects of your life, answer "0." Do not leave any items blank.

How much have your sensitivities affected:
[0 = not at all] [5 = moderately] [10 = severely]

1.	Your diet?	0 1 2 3 4 5 6 7 8 9 10
2.	Your ability to work or go to school?	0 1 2 3 4 5 6 7 8 9 10
3.	How you furnish your home?	0 1 2 3 4 5 6 7 8 9 10
4.	Your choice of clothing?	0 1 2 3 4 5 6 7 8 9 10
5.	Your ability to travel to other cities or drive a car?	0 1 2 3 4 5 6 7 8 9 10
6.	Your choice of personal care products, such as deodorants or makeup?	0 1 2 3 4 5 6 7 8 9 10
7.	Your ability to be around others and enjoy social activities, for example, going to meetings, church, restaurants, etc.?	0 1 2 3 4 5 6 7 8 9 10
8.	Your choice of hobbies or recreation?	0 1 2 3 4 5 6 7 8 9 10
9.	Your relationship with your spouse or family?	0 1 2 3 4 5 6 7 8 9 10
10.	Your ability to clean your home, iron, mow the lawn, or perform other routine chores?	0 1 2 3 4 5 6 7 8 9 10

Total Life Impact Score (0-100): _____

For copies of the QEESI, call 210-567-7407 or email millercs@uthscsa.edu.

REFERENCES:

Background information:

Chemical Exposures: Low Levels and High Stakes (2nd Ed.) by Nicholas A. Ashford and Claudia S. Miller, John Wiley & Sons, Inc., New York, 1998.

Sensitivity, specificity, reliability and validity of the QEESI:

Miller CS, Prihoda TJ: The Environmental Exposure and Sensitivity Inventory (EESI): a standardized approach for measuring chemical intolerances for research and clinical applications. *Toxicology and Industrial Health* 15:370-385, 1999.

Miller CS, Prihoda TJ: A controlled comparison of symptoms and chemical intolerances reported by Gulf War veterans, implant recipients and persons with multiple chemical sensitivity. *Toxicology and Industrial Health* 15:386-397, 1999.

— Interpreting the QEESI© —

In a study of 421 individuals, including four exposure groups and a control group, the QEESI© provided sensitivity of 92% and specificity of 95% in differentiating between persons with multiple chemical intolerances (MCI) and the general population (Miller and Prihoda 1999a,b).

Cronbach's alpha reliability coefficients for the QEESI©'s four scales—Symptom Severity, Chemical Intolerances, Other Intolerances and Life Impact—were high (0.76-0.97) for each of the groups, as well as over all subjects, indicating that the questions on the QEESI© form scales showing good internal consistency. Pearson correlations for each of the four scales with validity items of interest, i.e., life quality, health status, energy level, body pain, ability to work and employment status, were all significant and in the expected direction, thus supporting good construct validity.

Information on the development of this instrument, its interpretation, and results for several populations have been published (Miller and Prihoda 1999a,b). Proposed ranges for the QEESI©'s scales and guidelines for their interpretation appear in Tables 1 and 2 below:

Table 1. Criteria for low, medium, and high scale scores

Scale/Index	Score		
	Low	Medium	High
Symptom Severity	0-19	20-39	40-100
Chemical Intolerance	0-19	20-39	40-100
Other Intolerance	0-11	12-24	25-100
Life Impact	0-11	12-23	24-100
Masking Index	0-3	4-5	6-10

Table 2. Distribution of subjects by group using "high" cutoff points for symptom severity (≥ 40) and chemical intolerances (≥ 40), with masking low or not low (< 4 or ≥ 4)

Degree to Which MCI is Suggested[2]	Risk Criteria[1]			Percentage of Each Group Meeting Risk Criteria				
	Symptom Severity Score	Chemical Intolerance Score	Masking Score	Controls n=76	MCS – No Event n=90	MCS – Event n=96	Implant n=87	Gulf War Veterans n=72
Very suggestive	≥ 40	≥ 40	≥ 4	7	16	23	39	45
Very suggestive	≥ 40	≥ 40	< 4	0	65	66	36	4
Somewhat suggestive	≥ 40	< 40	≥ 4	3	1	2	16	26
Not suggestive	≥ 40	< 40	< 4	0	0	2	3	6
Problematic	< 40	≥ 40	≥ 4	7	3	1	1	0
Problematic	< 40	≥ 40	< 4	3	13	4	2	0
Not suggestive	< 40	< 40	≥ 4	68	1	0	2	18
Not Suggestive	< 40	< 40	< 4	12	1	2	1	1
				100	100	100	100	100

[1] Subjects must meet all three criteria, i.e., Symptom Severity, Chemical Intolerance, and Masking scores, as indicated in each row of this table.

[2] "Very suggestive" = high symptom and chemical intolerance scores.
"Somewhat suggestive" = high symptom score but possibly masked chemical intolerance.
"Not suggestive" = either (1) high symptom score but low chemical intolerance score with low masking, or (2) low symptom and chemical intolerance scores.
"Problematic" = low symptom score but high chemical intolerance score. Persons in this category with low masking (<4) may be sensitive individuals who have been avoiding chemical exposures for an extended period (months or years).

References:

Miller CS, Prihoda TJ: The Environmental Exposure and Sensitivity Inventory (EESI): a standardized approach for measuring chemical intolerances for research and clinical applications. *Toxicology and Industrial Health* 15:370-385, 1999a.

Miller CS, Prihoda TJ: A controlled comparison of symptoms and chemical intolerances reported by Gulf War veterans, implant recipients and persons with multiple chemical sensitivity. *Toxicology and Industrial Health* 15:386-397, 1999b.

APPENDIX D.

Analysis of NWRCP Health & Safety Sections

by
Laura Hayes, Washington Dept. of Ecology
&
Don Pettit, Oregon Dept. of Environmental Quality

NWRCP Section #	Title	Incorporate PHAU? How?	Incorporate ERHMS? How?	Incorporate BREESI & QEESI? How?	Notes
2230	Safety Officer		Add section titled Safety Officer Function and Tracking of Responder Health		Only covers personnel involved in the response
2234	Safety Officer Function and Crude Oil	Identify in section that crude oils present different risks to the public and to consider standing up a PHAU	Identify in section that crude oils present different risks to the public and to consider initiating ERHMS	Identify in section that crude oils present different risks to the public and to consider initiating the use of the BREESI/ QEESI into Public Health and Responder Health tracking	
2235	Safety Officer Sampling and Monitoring Requirements	No	Yes	Yes	4) Evaluating employee exposure to hazardous substances during clean-up operations
2236	NEW: Safety Officer and Monitoring for Responder Health	No	Yes - New section	Yes - New section	Needed: new section covering use of ERHMS and BREESI/ QEESI to determine if responder health is threatened due to complex mixtures, individual sensitivities, or unknown constituents in response or cleanup; this will be complemented by a new Appendix that covers the use of the responder health tools.
3310	Situation Assessment	Yes - Section covering special circumstances should reflect need to stand up PHAU	Yes - Section covering special circumstances should reflect need to stand up ERHMS	Yes - Section covering special circumstances should reflect need to stand up BREESI/ QEESI	

Table 1. Analysis of NWRCP Health & Safety Sections

NWRCP Section #	Title	Incorporate PHAU? How?	Incorporate ERHMS? How?	Incorporate BREESI & QEESI? How?	Notes
3320.1	Gasoline and Other Flammable Liquids	Add statement near end about need to stand up PHAU, especially if large quantities of volatile liquids will be allowed to evaporate	Add statement near end about need to stand up ERHMS, especially if large quantities of volatile liquids will be allowed to evaporate	Add statement near end about need to stand up BREESI/ QEESI, especially if large quantities of volatile liquids will be allowed to evaporate	
3320.1	Operational Safety Issues Associated with Bakken Crude Oil	Add statement about need to stand up PHAU, especially if large quantities of volatile liquids will be allowed to evaporate	Add statement about need to stand up ERHMS, especially if large quantities of volatile liquids will be allowed to evaporate	Add statement about need to stand up BREESI/ QEESI, especially if large quantities of volatile liquids will be allowed to evaporate	This section does not cover all crude oils… Consider expanding this section to cover diluted bitumen crudes or creating a second brief section covering Dilbit
4326	Use of Volunteers to Assist in Oil Spill Responses	N/A	Yes - Section covering special circumstances should reflect need to stand up ERHMS	Yes - Section covering special circumstances should reflect need to stand up BREESI/ QEESI	Policy is to use volunteers only for low-risk activities and only after appropriate safety training is received for activities to be conducted; this should be protective of volunteer worker health, but ERHMS and BREESI/ QEESI should be stood up to protect volunteer health for same reasons as other responders
4619.2	During an In Situ Burning Action	N/A	Yes - Brief statement about the needs to monitor responder health beyond OSHA reqs due to the risk posed by the action	Yes - Brief statement about the needs to monitor responder health beyond OSHA reqs due to the risk posed by the action	Reference to use of Health and Safety Job Aid (9203) should be supplemented with statement about the need for responder health monitoring during ISB use

Table 1. Analysis of NWRCP Health & Safety Sections

NWRCP Section #	Title	Incorporate PHAU? How?	Incorporate ERHMS? How?	Incorporate BREESI & QEESI? How?	Notes
4619.2.2	Public Health/Safety and In Situ Burning Air Monitoring Program	Yes - Section covering special circumstances should reflect need to stand up PHAU	N/A	N/A	Section needs to be reviewed and edited to include standing up a PHAU at most in situ burn operations where the public may be exposed
4622	Gasoline and Other Flammable Liquids Response Policy	Yes - Section covering special circumstances should reflect need to stand up PHAU	Yes - Brief statement about the needs to monitor responder health beyond OSHA reqs due to the risk posed by the action	Yes - Brief statement about the needs to monitor responder health beyond OSHA reqs due to the risk posed by the action	Adequately characterizes the risks from complex mixtures of gasoline and crude oils and their potential to effect responder and public health, but reminder that establishing a PHAU, and/or implementing ERHMS and BREESI/ QEESI should be considered
7000	Hazardous Substances (including WMDs)				Update generally to add need for PHAU/ERHMS/BREESI/ QEESI; Add section about standing up a PHAU near end where special teams are discussed
7120	Authorities (for Hazardous Substance Response)	N//A	N//A	N//A	This section identifies resources (agencies) that would be active in PHAU establishment, use of ERHMS/BREESI/QEESI
7250	Health and Safety (for Hazardous Substance Response)				References section 7700

Table 1. Analysis of NWRCP Health & Safety Sections

NWRCP Section #	Title	Incorporate PHAU? How?	Incorporate ERHMS? How?	Incorporate BREESI & QEESI? How?	Notes
9105	Incident Specific R10 RRT Activation Quick Response Guide	Under Type of Situation, add prompt to consider establishing a PHAU	?	?	
9203	Health and Safety Job Aid	Develop new section (brief, at ~9203.1.1) in H&S Job Aid for PHAU and reference separate PHAU Annex (TBDev)	Develop new section in H&S Job Aid for ERHMS and BREESI/ QEESI	Develop new section in H&S Job Aid for ERHMS and BREESI/ QEESI	Generally incorporate element of responder health with regard to exposures and symptoms outside of injury.
9210	Liaison Manual	Incorporate throughout annex	N/A	N/A	Issue of Public Health messaging and coordination with food safety is there but needs to be generally updated to incorporate liaison support to a Public Health Assessment Unit if stood up.
9220	96-Hour Plan for Major Incidents	Incorporate decision to stand up PHAU	Incorporate decision to initiate ERHMS (or make standard to do so)	Incorporate decision to initiate BREESI/ QEESI (or make standard to do so)	
9301	Oil Spill Best Management Practices	Yes - Into each BMP as appropriate	Yes - Into each BMP as appropriate	Yes - Into each BMP as appropriate	Note that review was of 2020 plan still in effect, not updated BMP Annex; There are many components of the new BMP that could need to be updated to incorporate PHAU/ERHMS/ BREESI/QEESI into the response.
9407	In Situ Burning Operations Planning Tool	Update 9407.3.2 Public H&S/Air Monitoring	Update 9407.3.1 Responder H&S	Update 9407.3.1 Responder H&S	Add paragraph in 9407.3.3 that discusses standing up PHAU to incorporate the work of the Local Air & Public Health Depts.

Table 1. Analysis of NWRCP Health & Safety Sections

NWRCP Section #	Title	Incorporate PHAU? How?	Incorporate ERHMS? How?	Incorporate BREESI & QEESI? How?	Notes
9409	Managing Impacts to Commercial, Recreational and Tribal Fisheries	See note about adding language and reference to PHAU Annex at front of the section	N/A	N/A	Add paragraph in introduction that discusses standing up PHAU to incorporate the work of the Local Public Health Departments and provides reference to PHAU Annex
9418	Emergency Response Community Air Monitoring		N/A	BREESI/ QEESI may be utilized to support public health tracking during and after the incident. Incorporate reference to annex (TBD) on ERHMS/ BREESI/QEESI	Add paragraph in introduction that discusses standing up PHAU to incorporate the work of the Local Public Health Departments and provides reference to PHAU Annex
9418 Attachment B	Contaminants of Concern and Recommended Action Levels				What are PACs? Does not define the term.
	Use of cleaning agents				
9418	Community Air Health Monitoring	Update to reflect utility of a PHAU			Table 9418.1 could add incorporation of a PHAU into larger responses
9701	Hazard Assessment Worksheet		Add section on ERHMS into the HAW	Add section on BREESI/QEESI into the HAW	Worksheet could be expanded to include elements of longitudinal assessment of responder health, identify whether ERHMS or BREESI/ QEESI process be incorporated into the response.

APPENDIX E.

Draft Decision Matrices for an ERHMS Unit and a PHA Unit

Includes drafts of the:

- Emergency Responder Health Monitoring & Surveillance (ERHMS) Unit Decision Matrix—drafted by the H&S Task Force
- Public Health Assessment (PHA) Unit Decision Matrix—drafted by the H&S Task Force
- PHA Unit Decision Tree—drafted by RRT 9/CAL OSPR work group

Updated* ERHMS Unit Decision Matrix
for Emergency Responder Health Monitoring and Surveillance
(* Updated with environmental exposure surveys BREESI and QEESI)

1) **Oil spill or chemical release hazards:** Are there, or are there anticipated to be any chemical mixtures or other health hazards in the air or water?
(*Chemical mixtures* include complex, unknown or mixtures of substances with similar, dissimilar or unknown toxicological endpoints or *health hazards* with known carcinogenicity, germ cell mutagenicity or reproductive toxicity, because Occupational Exposure Limits are not reliable indicators of health risk, as described in the mandatory OSHA Health Hazard Criteria.)
   NO —> 2.
   YES —> Initiate updated* ERHMS Unit.

2) **Factors increasing the hazards:** Is there, or is there anticipated to be any, of the following:
   - Open burning of oil or chemicals?
   - Application of dispersants or other products with surfactants such as chemical herders or cleaning products used in the response?
   - Extended work shifts (over OSHA standard of 8-hr work shift of a 40-hr work week)?
   - Workers living on site (potential 24/7 exposures)?
   - External environmental conditions such as extreme heat or cold or wildfire smoke that can increase stress on workers?

   NO —> 3.
   YES —> Initiate updated* ERHMS Unit.

3) **Routes of exposure:** Is there, or is there anticipated to be any, of the following:
   - Inhalation of chemical mixtures?
   - Dermal contact directly or indirectly from airborne mists or splashing?
   - Ingestion/drinking directly or indirectly through contamination of food products or bottled water or other beverages?

   NO —> 4a.
   YES —> Initiate updated* ERHMS Unit.

continued...

4) **Signs or symptoms of oil or chemical exposures:**

4a) Have all response workers been trained to recognize the signs or symptoms of potential exposure such as the following examples, as described in the mandatory OSHA Health Hazard Criteria?

- Skin rashes or ulcers, bleeding, or alopecia (hair loss) (A.2)?
- Cold- and flu-like symptoms such as coughing, difficulty breathing, or shortness of breath (A.8.2.2.1)?
- Central nervous system effects such as severe headaches or migraines, nausea or vomiting, dizziness or vertigo, irritability, fatigue, impaired memory function, deficits in perception and coordination, reaction time, or sleepiness (A.8.2.2.1)?
- Symptoms listed in other sources such as the NIOSH Pocket Guide?

NO —> Initiate updated* ERHMS Unit.
YES —> 4b.

4b) Have any response workers reported any signs or symptoms of potential exposure, as described in the mandatory OSHA Health Hazard Criteria?

NO —> 5a.
YES —> Initiate updated* ERHMS Unit.

5) **Medical surveillance:**

5a) Are all response workers, including subcontractors such as Vessel of Opportunity crews and beach workers, covered under an employer-sponsored medical monitoring and surveillance program?

NO —> Initiate updated* ERHMS Unit.
YES —> 5b.

5b) Is there more than one employer involved in the response?

NO —> No ERHMS Unit.
YES —> Initiate updated* ERHMS Unit.

Draft Public Health Assessment (PHA) Unit* Decision Matrix

(* PHA Unit includes environmental exposure surveys BREESI and QEESI)

1) **Oil spill or chemical release**: Did the Incident Commander or the Safety Officer initiate an updated ERHMS Unit for emergency response workers?
   NO —> 2a.
   YES —> Initiate PHA Unit.

2) **Populations and places most at-risk:**

2a) Does the incident have the potential to impact vulnerable communities?
(*Vulnerable communities* experience heightened risk and increased sensitivity to environmental and toxic exposures and have less capacity and fewer resources to cope with, adapt to, or recover from toxic impacts. These disproportionate effects are caused by physical (built and environmental), social, political, and/or economic factor(s), which are exacerbated by climate impacts. These factors include, but are not limited to, race, class, sexual orientation and identification, national origin, and income inequality.)
   NO —> 2b.
   YES —> Initiate PHA Unit.

2b) Does the incident have the potential to impact **areas of cultural or recreational use**:
- Schools, hospitals, or health care centers or elder, youth, or other care facilities?
- Community centers or places of worship?
- Outdoor public gathering spaces such as parks, marinas, or school sport or recreational areas?

   NO —> 3.
   YES —> Initiate PHA Unit.

3) **Other factors increasing the hazards**: Is there, or is there anticipated to be any, of the following:
- Open burning of oil or chemicals?
- Application of dispersants or other products with surfactants such as chemical herders or cleaning products used in the response?
- External environmental conditions such as extreme heat or cold or wildfire smoke that can increase stress on public health?
- Staging of response operations such as DECON activities or dispersant loading/unloading in neighborhoods or public spaces such as marinas?
- Residents who are working as responders while residing in the impacted zone (potential for 24/7 exposures)?

   NO —> 4.
   YES —> Initiate PHA Unit.

4) **Routes of exposure**: Is there, or is there anticipated to be any, of the following:
   - Inhalation of chemical mixtures?
   - Dermal contact directly or indirectly from swimming, boating, or recreating in or near the impacted coastal areas?
   - Ingestion of food or beverages from water that may have been contaminated by the incident, such outdoor home gardens or drinking water.

   NO —> 5a.
   YES —> Initiate PHA Unit.

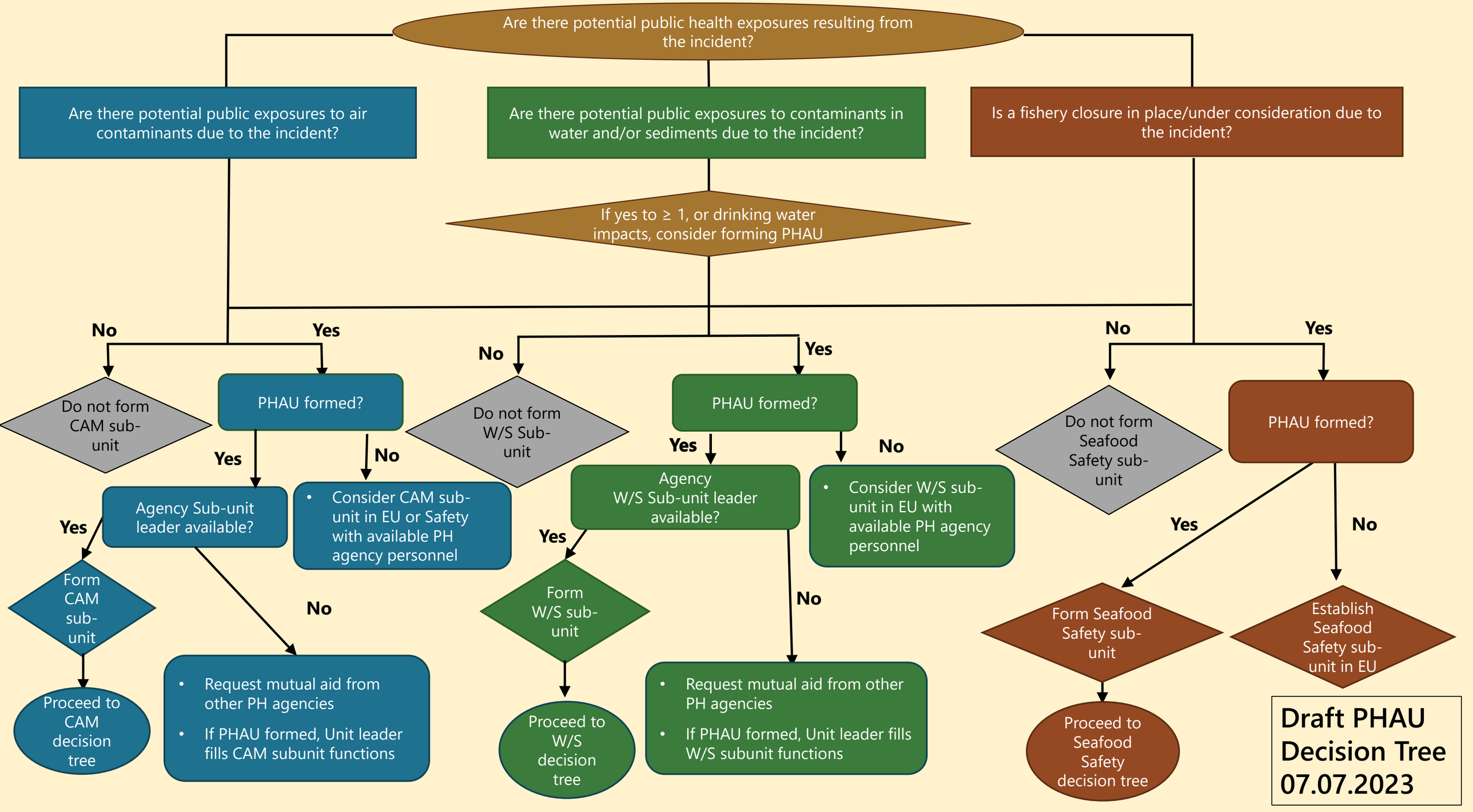
5) **Signs or symptoms of oil-chemical exposures**:

a) Has the public reported any signs or symptoms of potential exposure such as the following examples, as described in the OSHA Health Hazard Criteria?
   - Skin rashes or ulcers, bleeding, or alopecia (hair loss) (A.2)?
   - Cold- and flu-like symptoms such as coughing, difficulty breathing, or shortness of breath (A.8.2.2.1)?
   - Central nervous system effects such as severe headaches or migraines, nausea or vomiting, dizziness or vertigo, irritability, fatigue, impaired memory function, deficits in perception and coordination, reaction time, or sleepiness (A.8.2.2.1)?

   NO —> 5b.
   YES —> Initiate PHA Unit.

b) Have there been higher-than-normal purchases from local pharmacies of over-the-counter medication for self-treatment of the signs or symptoms of oil-chemical exposures?

   NO —> No PHA Unit.
   YES —> Initiate PHA Unit.


Are there potential public health exposures resulting from the incident?
Are there potential public exposures to air contaminants due to the incident?
Are there potential public exposures to contaminants in water and/or sediments due to the incident?
Is a fishery closure in place/under consideration due to the incident?
If yes to ≥ 1, or drinking water impacts, consider forming PHAU
No
Yes
Do not form CAM sub-unit
PHAU formed?
Yes
No
Agency Sub-unit leader available?
Consider CAM sub-unit in EU or Safety with available PH agency personnel
Yes
No
Form CAM sub-unit
Request mutual aid from other PH agencies
If PHAU formed, Unit leader fills CAM subunit functions
Proceed to CAM decision tree
No
Yes
Do not form W/S Sub-unit
PHAU formed?
Yes
No
Agency W/S Sub-unit leader available?
Consider W/S sub-unit in EU with available PH agency personnel
Yes
No
Form W/S sub-unit
Request mutual aid from other PH agencies
If PHAU formed, Unit leader fills W/S subunit functions
Proceed to W/S decision tree
No
Yes
Do not form Seafood Safety sub-unit
PHAU formed?
Yes
No
Form Seafood Safety sub-unit
Establish Seafood Safety sub-unit in EU
Proceed to Seafood Safety decision tree
Draft PHAU Decision Tree 07.07.2023

APPENDIX F.

Federal OSHA HAZWOPER Standards 1910.120(a) & 1910.120(q): Suggested Language for Certain Paragraphs

by Dr. Riki Ott
Subject Matter Expert
The ALERT Project

DRAFT 2.14.2023

29 CFR 1910.120(a)(3):
Definitions.

NEW LANGUAGE UNDERLINED

Health hazard means a chemical or a complex chemical mixture that is classified in accordance with the Hazard Communication Standard, 29 CFR 1910.1200, as posing one or more of the following acute or chronic health effects: Acute toxicity (any route of exposure); skin corrosion or irritation; serious eye damage or eye irritation; respiratory or skin sensitization; germ cell mutagenicity; carcinogenicity; reproductive toxicity; specific target organ toxicity (single or repeated exposure); aspiration toxicity or simple asphyxiant. (See Appendix A to § 1910.1200 – Health Hazard Criteria (Mandatory) for the criteria to determine whether a chemical or a chemical mixture is classified as a health hazard.)

NEW DEFINITION

Complex chemical mixture means a material made up of one or more hazardous substances and/or health hazards with similar, dissimilar, or unknown toxicological endpoints, any of which are or may be in multiple phases as solids, liquids, dissolved states, colloids, suspensions, aerosols, and/or vapors simultaneously. Complex chemical mixtures are presumed to be health hazards until proven otherwise.

NEW DEFINITION

Signs or symptoms of exposure to health hazards, as described in the Health Hazard Communication Standard, 29 CFR 1910.1200 Appendix A, include skin rashes or ulcers, bleeding, bloody scabs, alopecia (hair loss) or scars from skin corrosive/ irritants (A.2); cold- and flu-like symptoms such as wheezing, coughing, difficulty breathing or shortness of breath, chest tightness, watery eyes, runny nose from respiratory irritants (A.8.2.2.1); and severe headaches or migraines, nausea or vomiting, dizziness or vertigo, irritability, fatigue, impaired memory function, deficits in perception and coordination, reaction time, or sleepiness from central nervous system effects (A.8.2.2.2).

NEW DEFINITION

Uncertain exposures often involve complex chemical mixtures and occur when the toxicity of the hazard is unknown or when safe limits for exposure have not been established or when health monitoring indicates the presence of signs or symptoms of potential chemical overexposure. Uncertain exposures may also involve individual hazardous substances or health hazards when health monitoring indicates the presence of signs or symptoms of potential chemical overexposure below a pre-determined occupational exposure limit.

29 CFR 1910.120(q):
Emergency Response to Hazardous Substance Releases.

PARAGRAPH 1910.120(q)(2):
Elements of an emergency response plan.

ADD A NEW PARAGRAPH & RENUMBER ONES THAT FOLLOW.

1910.120(q)(2)(ix)

Incident-specific medical monitoring and surveillance.

PARAGRAPH 1910.120(q)(4):
Skilled support personnel.

REPLACE 1910.120(q)(4) WITH:

RETITLED.

(q)(4)

Skilled support personnel and temporary designated responders.

RENUMBERED & NEW LANGUAGE UNDERLINED.

(q)(4)(i)

Skilled support personnel. Personnel, not necessarily an employer's own employees, who are skilled in the operation of certain equipment, such as mechanized earth moving or digging equipment or crane and hoisting equipment, and who are needed temporarily to perform immediate emergency support work that cannot reasonably be performed in a timely fashion by an employer's own employees, and who will be or may be exposed to the hazards at an emergency response scene, are not required to meet the training required in this paragraph for the employer's regular employees. However, these personnel shall be given an initial briefing at the site prior to their participation in any emergency response. The initial briefing shall include instruction in the wearing of appropriate personal protective equipment, what chemical hazards are involved, <u>how to recognize signs or symptoms of potential over exposure to oil and chemical hazards,</u> and what duties are to be performed. All other appropriate safety and health precautions provided to the employer's own employees shall be used to assure the safety and health of these personnel. Skilled support personnel must register with the incident-specific medical monitoring and surveillance program and complete the environmental exposure survey (BREESI).

ADD NEW SECTION WITH NEW LANGUAGE.

(q)(4)(ii)

Temporary designated responders. Personnel, not necessarily an employer's own employees, who are needed temporarily for weeks or months to perform emergency response and/or post-emergency response work, such as participate in a designated task force for oil spill response, that cannot reasonably be performed in a timely fashion by an employer's own employees, and who will be or may be exposed to the health and other hazards at an emergency response scene, are required to meet the minimum training required in paragraph 1910.120(q)(6)(i) for first responder operations level. Additional training shall be provided, based on the duties and function to be performed by each temporary designated responder, in accordance with paragraphs 1910.120(q)(6)(i)–(v). All temporary designated responders shall

receive such training or have had sufficient experience to objectively demonstrate competency in the areas specific to the highest level of responsibility to which they may be assigned, and their employer shall so certify. The skill and knowledge levels required for temporary designated responders shall be conveyed to them through training before they are permitted to take part in actual emergency operations on an incident. Temporary designated responders shall be given an initial briefing at the site prior to their participation in any emergency response. All other appropriate safety and health precautions provided to the employer's own employees shall be used to assure the safety and health of these responders. Temporary designated responders must register with the incident-specific medical monitoring and surveillance program, complete the environmental exposure survey (BREESI), and be given physical and mental health pre-screening examinations.

PARAGRAPH 1910.120(q)(6):
Training.

NEW LANGUAGE UNDERLINED.

REPLACE 1910.120(q)(6)(i) WITH:

(q)(6)(i)

First responder awareness level. First responders at the awareness level are individuals who are likely to witness or discover a hazardous substance release and who have been trained to initiate an emergency response sequence by notifying the proper authorities of the release. They would take no further action beyond notifying the authorities of the release. First responders at the awareness level shall have <u>received at least eight hours of</u> training or have had sufficient experience to objectively demonstrate competency in the following areas <u>and the employer shall so certify</u>:

REPLACE (q)(6)(i)(A) through (D) WITH:

(q)(6)(i)(A)

An understanding of what hazardous substances <u>and health hazards and complex mixtures of chemicals</u> are, and the risks associated with them in an incident.

(q)(6)(i)(B)

An understanding of the potential outcomes associated with an emergency created when hazardous substances<u>, health hazards, and/or complex mixtures of chemicals</u> are present.

(q)(6)(i)(C)

The ability to recognize the presence of hazardous substances <u>and health hazards and complex mixtures of chemicals, and the signs or symptoms of potential over exposure</u> in an emergency.

(q)(6)(i)(D)

The ability to identify hazardous substances, <u>health hazards, and complex mixtures of chemicals,</u> if possible.

PARAGRAPH 1910:120(q)(9):
Medical surveillance and consultation.

REPLACE 1910.120(q)(9), (9)(i) and (9)(ii) WITH:

RETITLED.

(q)(9)

Health monitoring and surveillance.

NEW LANGUAGE UNDERLINED.

(q)(9)(i)

Members of an organized and designated HAZMAT team and hazardous materials specialists shall receive a baseline physical and mental health examination, and an environmental exposure examination as described in (q)(9)(ii), and be provided with medical monitoring and surveillance as required in paragraph (f) or (q) of this section. If there is a conflict or overlap, the provision more protective of employee safety and health shall apply without regard to 29 CFR 1910.5(C)(1).

NEW LANGUAGE.

(q)(9)(ii)

Pre-deployment. For the purpose of paragraph (q), all "on-site field responders"[1] means those emergency responders, including those in (q)(9)(i), temporary designated responders under (q)(4)(ii), and post-emergency response workers in (q)(11)(A)(i). All on-site field responders shall receive baseline physical and mental health examinations, and environmental exposure sensitivity examinations, prior to deployment. These health screening examinations shall follow, at a minimum, the guidance and recommendations in the National Response Team's *Emergency Responder Health Monitoring and Surveillance* Technical Assistance Document (*ERHMS*). The environmental exposure examinations shall consist of the Brief Environmental Exposure Sensitivity and Inventory (BREESI) for initial screening, and the Quick Environmental Exposure Sensitivity and Inventory (QEESI) for those who answered "Yes" to at least one of the BREESI questions, both developed by the Hoffman TILT Research Program, University of Texas.

continued...

[1] 40 CFR § 300.5. "On-site" is defined by the regulations governing the NCP.

NEW SECTIONS & LANGUAGE.

(q)(9)(iii)

During Deployment. Employers shall conduct incident-specific medical monitoring and surveillance of all in-site field responders. Medical monitoring and surveillance shall be carried out under the supervision of qualified medical and health and safety professionals familiar with occupational and environmental medicine and toxicological and immunological principles.

(q)(9)(iii)(A)

Medical surveillance shall be sufficient to allow for tracking health trends potentially due to exposures within defined populations of emergency responders with data organized by the smallest working unit (ICS task force). Medical monitoring assessments shall be based on both toxicological and immunological principles and shall consider that on-site field responders may experience uncertain exposures from health hazards and complex mixtures chemical for which PELs are an unreliable indicator of health risk.

(q)(9)(iii)(B)

Cold- and flu-like symptoms are recorded every calendar week for each operable unit[2] during an oil spill response and must be reported to OSHA within 24 hours of that week, for the duration of the incident response, by electronic submission using the reporting application located on OSHA's public website at www.osha.gov.

(q)(9)(iii)(C)

Other signs and symptoms of potential over exposure to hazardous substances, health hazards, and complex mixtures of chemicals, as described in 1910.1200 Appendix A for acute toxicity (A.1), skin corrosion/irritation (A.2), serious eye damage/eye irritation (A.3), respiratory or skin sensitization (A.4), specific target organ toxicity for single exposure and repeated or prolonged exposure (A.8, A.9) such as respiratory tract irritation (A.8.2.2.1) and narcotic effects (A.8.2.2.2), and aspiration hazards (A.10), are recorded every calendar week for each operable unit during an oil spill response and must be reported to OSHA within 24 hours of that week, for the duration of the incident response, by electronic submission using the reporting application located on OSHA's public website at www.osha.gov.

continued...

[2] Ibid., "Operable unit" is defined by the regulations governing the NCP. Example: task force by job (nearshore, beach, offshore/source, decontamination, etc.), geographic location (state), time (specific calendar week).

NEW SECTIONS & LANGUAGE, continued.

(q)(9)(iii)(D)

When signs and symptoms of potential over exposure are reported.

(q)(9)(iii)(D)(1) & (D)(2)

(1) If any emergency responder is exhibiting signs or symptoms described in (q)(9)(iii)(B) or (C), the employer shall provide further medical consultation as required by paragraph (f)(3)(ii) at a minimum.

(2) If 10% or more of emergency responders within any given unit are exhibiting acute signs or symptoms described in (q)(9)(iii)(B) or (C) during any week, the employer shall consult with OSHA and take immediate actions to reduce or prevent further exposure to the unit members and shall provide long-term medical monitoring for the exposed individuals, as required in paragraph (q)(9)(iv) and (v) of this section.

(q)(9)(iv)

Post-deployment. All on-site field responders shall receive post-deployment physical and mental health examinations following the guidance and recommendations in ERHMS and environmental exposure sensitivity assessments with BREESI. If an individual answers "Yes" to at least one of the BREESI questions, then the individual completes the QEESI questionnaire, and QEESI is used as the survey tool for future assessments.

(q)(9)(iv)(A)

Medical monitoring and surveillance shall be carried out under the supervision of qualified medical and health and safety professionals familiar with occupational and environmental medicine and toxicological and immunological principles.

(q)(9)(iv)(B)

The initial post-deployment physical and environmental exposure examinations must be completed as part of the deployment process or within a week after deployment. A copy must be provided to the individual immediately or within 48 hours of receipt by the former employer.

continued...

NEW SECTIONS & LANGUAGE, continued.

(q)(9)(iv)(C)

Long-term medical monitoring. Long-term medical monitoring is required for all emergency responders who were members of any ICS units that reported 10% or more of its members exhibited any acute signs or symptoms of exposure as described in 1910.120(a)(3) in any given week during the response operations. This shall consist of:

(q)(9)(iv)(C)(1)–(3)

(1) Quarterly post-deployment medical examinations that are completed once every three months for the first year after post-deployment.

(2) Annual post-deployment medical examinations that are completed at least once annually for the next five years. Annual post-deployment medical monitoring shall include environmental exposure sensitivity assessments with BREESI. If an individual answers "Yes" to at least one of the BREESI questions, then the individual completes the QEESI questionnaire, and QEESI is used as the survey tool for future assessments.

NEW OSHA 1910.120(q)(9)(v):
Data collection and recordkeeping for medical monitoring and surveillance

NEW SECTIONS & LANGUAGE.

(q)(9)(v)

Data collection and recordkeeping for medical monitoring and surveillance. Recordkeeping under paragraph (q) shall follow the requirements in (f)(8) of this section at a minimum for all on-site field responders. If there is a conflict or overlap, the provision more protective of employee safety and health shall apply without regard to 29 CFR 1910.5(1).

(q)(9)(v)(A)

An accurate record of the medical monitoring and surveillance required by paragraph (q)(9) of this section shall be retained. This record shall be retained for the period specified and meet the criteria of 29 CFR 1910.1020.

(q)(9)(v)(B)

Employers shall send a copy of records collected under paragraphs (9)(i) through (iii) to OSHA on a weekly basis for one year from the date of the incident and annually thereafter.

(q)(9)(v)(C)

At the end of deployment, employers shall provide on-site field responders with a copy of their health record and medical monitoring assessments, which shall include any data on personal exposure.

(q)(9)(v)(D)

Employers shall provide employees or former employees who were employed as on-site field responders with a copy of their quarterly and annual post-deployment medical monitoring assessments within a week of each visit.

continued...

NEW SECTIONS & LANGUAGE, continued.

(q)(9)(v)(E)

OSHA shall maintain medical monitoring data so medical surveillance can be conducted in real-time. Qualified OSHA medical and health and safety professionals familiar with occupational and environmental medicine and toxicological and immunological principles shall conduct an analysis of weekly monitoring records during emergency response and post-emergency response operations, and annually thereafter, with data organized by the smallest working unit (ICS task force) to understand trends.

(q)(9)(v)(F)

OSHA shall send a copy of all data, including medical records, from its incident-specific medical monitoring and surveillance analyses to the National Institute for Occupational Safety and Health (NIOSH) for further research into best practices, according to the following schedule:

(q)(9)(v)(F)(i)

(i) as it is collected under (q)(9)(i)–(iii) during the incident;(q)(9)(v)(F)(ii);

(ii) as it is collected under (q)(9)(iv)(C)(1) during the first year of long-term monitoring after the incident; and

(iii) annually as it is collected under (q)(9)(iv)(C)(2) for the next five years.

PARAGRAPH 1910.120(q)(11):
Post-emergency response operations.

REPLACE (q)(11)(i) WITH:

NEW SECTIONS & LANGUAGE.

(q)(9)(i)

If post-emergency response is performed by an employer's own employees or temporary designated responders who were part of the initial emergency response, meet all the requirements of (q)(9); or

(q)(9)(ii)

If post-emergency response is performed by an employer's own employees or contract workers (including prison labor) who were part of the initial emergency response, meet all the requirements of (q)(9); or

RENUMBERED & NEW LANGUAGE UNDERLINED.

(q)(9)(iii)

Where the clean-up is done on plant property using plant or workplace employees, such employees shall have completed the training requirements of the following: 29 CFR 1910.38, 1910.134, 1910.1200, and other appropriate safety and health training made necessary by the tasks they are expected to perform such as personal protective equipment and decontamination procedures. All equipment to be used in the performance of the clean-up work shall be in serviceable condition and shall have been inspected prior to use. <u>Meet all the requirements of paragraphs (q)(9)</u>.

APPENDIX G.

Washington Code (WAC) 296-824

Suggested Language for Certain Paragraphs

by Dr. Riki Ott
Subject Matter Expert
The ALERT Project

Draft 2.14.2023

WAC 296-824-099:
Definitions.

NEW LANGUAGE UNDERLINED

Health hazard means a chemical or a complex chemical mixture that is classified in accordance with the Hazard Communication Standard, 29 CFR 1910.1200, as posing one or more of the following acute or chronic health effects: Acute toxicity (any route of exposure); skin corrosion or irritation; serious eye damage or eye irritation; respiratory or skin sensitization; germ cell mutagenicity; carcinogenicity; reproductive toxicity; specific target organ toxicity (single or repeated exposure); aspiration toxicity or simple asphyxiant. (See Appendix A to § 1910.1200 – Health Hazard Criteria (Mandatory) for the criteria to determine whether a chemical or a chemical mixture is classified as a health hazard.)

NEW DEFINITION

Complex chemical mixture means a material made up of one or more hazardous substances and/or health hazards with similar, dissimilar, or unknown toxicological endpoints, any of which are or may be in multiple phases as solids, liquids, dissolved states, colloids, suspensions, aerosols, and/or vapors simultaneously. Complex chemical mixtures are presumed to be health hazards until proven otherwise.

NEW DEFINITION

Signs or symptoms of exposure to health hazards, as described in the Health Hazard Communication Standard, 29 CFR 1910.1200 Appendix A, include skin rashes or ulcers, bleeding, bloody scabs, alopecia (hair loss) or scars from skin corrosive/ irritants (A.2); cold- and flu-like symptoms such as wheezing, coughing, difficulty breathing or shortness of breath, chest tightness, watery eyes, runny nose from respiratory irritants (A.8.2.2.1); and severe headaches or migraines, nausea or vomiting, dizziness or vertigo, irritability, fatigue, impaired memory function, deficits in perception and coordination, reaction time, or sleepiness from central nervous system effects (A.8.2.2.2).

NEW DEFINITION

Uncertain exposures often involve complex chemical mixtures and occur when the toxicity of the hazard is unknown or when safe limits for exposure have not been established or when health monitoring indicates the presence of signs or symptoms of potential chemical overexposure. Uncertain exposures may also involve individual hazardous substances or health hazards when health monitoring indicates the presence of signs or symptoms of potential chemical overexposure below a pre-determined occupational exposure limit.

WAC 296-824-20005:
Develop an emergency response plan.

REPLACE 20005(1)(e) WITH:

(e) Medical.

(e)(i). Emergency medical treatment and first aid.

(e)(ii). Medical monitoring and surveillance.

NEW LANGUAGE UNDERLINED.

20005(2)

Table 1. Roles and Duties of Emergency Responders

If the employee's role is:	Then all of the following apply. They:
First responder awareness level	• Are likely to witness or discover a hazardous substance release • Are trained to initiate an emergency response by notifying the proper authorities of the release • Take no further action beyond notifying the authorities • <u>Are trained to recognize and report signs and symptoms of potential over exposure to hazardous substances, health hazards, and complex chemical mixtures</u>
ADD NEW LANGUAGE AFTER SKILLED SUPPORT PERSONNEL.	
Temporary designated responder	• Are needed temporarily for weeks or months to perform emergency response or post-emergency response work • Are assigned to a designated task force or other work team • Are trained or have had sufficient experience to objectively demonstrate competency in the areas specific to the highest level of responsibility to which they may be assigned, and their employer shall so certify

WAC 296-824-30005:
Train your employees.

NEW LANGUAGE UNDERLINED.

Table 2. Minimum Training Durations for All Responders

If you are a:	Then:
First responder awareness level	• You need a minimum of 8 hours of training or equivalent skills to provide the required competencies (see Table 3)

NEW LANGUAGE UNDERLINED.

Table 3. Competencies for First Responders at the Awareness Level and Operations Level

Employees must be able to show they:	When they are designated as first responders at the: Awareness Level	Operations Level
• Understand what hazardous substances and health hazards and complex chemical mixtures are and their associated risks	X	X
• Recognize the presence of hazardous substances and health hazards and complex chemical mixtures, and the signs or symptoms of potential over exposure in an emergency.	X	X
• Can identify the hazardous substances, health hazards, and complex chemical mixtures, when possible.	X	X
• Understand the potential consequences of hazardous substances and health hazards and complex chemical mixtures in an emergency.	X	X

WAC 296-824-40005:
Provide medical surveillance to employees.

RETITLE WITH NEW LANGUAGE.
Chapter 296-824-40005:
Provide an incident-specific medical monitoring and surveillance program for employees.

NEW LANGUAGE UNDERLINED.

Table 7. Medical Surveillance for Employee Categories

Incident-Specific Medical Monitoring and Surveillance of Employee Categories

If the employee is covered by this chapter and is:	Then you must:
• Exposed for at least 30 days a year to health hazards and/or complex chemical mixtures or hazardous substances at or above the permissible exposure limit or published exposure levels (even when respirators are used) **OR** • Required to wear a respirator for at least 30 days a year. • A hazardous materials (HAZMAT) team member • A hazardous materials specialist	• Offer standard medical monitoring and surveillance as specified in Table 8.
An emergency responder or temporary designated responder who: • shows immediate or delayed signs or symptoms possibly resulting from exposure to hazardous substances, health hazards, and/or complex chemical mixtures during an incident	• Provide incident-specific medical monitoring and surveillance as specified in Table 8.
OR • is exposed for at least two weeks during an incident-specific response to health hazards and/or complex chemical mixtures or hazardous substances at or above the permissible exposure limit or published exposure levels (even when respirators are used)	• Provide incident-specific medical monitoring and surveillance as specified in Table 8.
Not an emergency responder but was on-site during an incident and: - May be injured - Shows immediate or delayed signs or symptoms possibly resulting from exposure to hazardous substances or uncertain exposure to health hazards or complex chemical mixtures - May have been exposed to hazardous substances at concentrations above the permissible exposure limits (PELs) or the published exposure levels without appropriate PPE.	• Provide incident-specific medical monitoring and surveillance as specified in Table 8.

REPLACE Table 8 WITH:

Table 8. Frequency of Exams and Consultations

If the employee is covered by:	Then medical monitoring and surveillance must include:
• Incident-specific medical monitoring and surveillance	• Examinations and consultations: – Before assignment: baseline physical and mental health examinations, and environmental exposure sensitivity examinations with BREESI. – As soon as possible following the incident or development of signs or symptoms. – Immediately upon post-deployment from the incident: physical and mental health examinations ("medical examinations"). • Long-term medical monitoring for all emergency responders who were members of any ICS units that reported 10% or more of its members exhibited any acute signs or symptoms of exposure as described in WAC 296-824-099 in any given week during the incident. This shall consist of: – Quarterly post-deployment medical examinations that are completed once every three months for the first year after post-deployment. – Annual post-deployment medical examinations, starting from one-year post-deployment, that are completed at least once annually for the next five years and that include environmental exposure sensitivity assessments with BREESI. If an individual answers "Yes" to at least one of the BREESI questions, then the individual completes the QEESI questionnaire, and QEESI is used as the survey tool for future assessments.

WAC 296-824-40010:
Keep records.

REPLACE 40010 & title WITH:

40010. ***Keep incident-specific records to support medical monitoring and surveillance***

(1) An accurate record of the incident-specific medical monitoring and surveillance program required by paragraph 40005 of this section shall be retained. This record shall be retained for the period specified and meet the criteria of WAC 296-802-400.

(2) Employers shall send a copy of records collected under paragraphs (9)(i) through (iii) to the Washington Dept. of Labor and Industries, Division of Occupational Safety and Health (DOSH) on a weekly basis for one year from the date of the incident and annually thereafter.

(3) At the end of deployment, employers shall provide on-site field responders with a copy of their health record and medical monitoring assessments, which shall include any data on personal exposure.

(4) Employers shall provide employees or former employees who were employed as on-site field responders with a copy of their quarterly and annual post-deployment medical monitoring assessments within a week of each visit.

(5) DOSH shall maintain medical monitoring data so medical surveillance can be conducted in real-time. Qualified DOSH medical and health and safety professionals familiar with occupational and environmental medicine and toxicological and immunological principles shall conduct an analysis of weekly monitoring records during emergency response and post-emergency response operations, and annually thereafter, with data organized by the smallest working unit (ICS task force) to understand trends.

(6) DOSH shall send a copy of all data, including medical records, from its incident-specific medical monitoring and surveillance analyses to the National Institute for Occupational Safety and Health (NIOSH) Western States Division for further research into best practices, according to the following schedule:

ADD NEW SECTION & LANGUAGE.

(6)(a)–(c)

(a) as it is collected under section 40005 during the incident;

(b) as it is collected under section 40005 during the first year of long-term monitoring after the incident;

(c) annually as it is collected under section 40005 for the next five years.

WAC 296-824-50015:
Prepare skilled support personnel.

RETITLE.
50015
Prepare skilled support personnel and temporary designated responders.

NEW LANGUAGE UNDERLINED.
50015(1)
(1) You must make sure that your skilled support personnel and temporary designated responders (including those employees who are not regularly employed by you) who could be exposed to on-scene hazards are given an initial briefing at the site before they participate in any emergency response. The initial briefing must include:

50015(1)(a)
(a) What chemical hazards are involved, including health hazards and complex chemical mixtures;

ADD NEW LANGUAGE & RENUMBER REST AS (c) & (d).
50015(1)(b)
(b) The ability to recognize signs and symptoms of potential over exposure to health hazards and what steps to take should you or your buddy exhibit symptoms;

REPLACE 50015(2) WITH:
(2) You must make sure that:
(a) Health and safety precautions given to your employees are also given to skilled support personnel and temporary designated responders;
(b) skilled support personnel and temporary designated responders register with the medical monitoring and surveillance program and complete the BREESI questionnaire, at a minimum; and
(c) temporary designated responders are given physical and mental health examinations before deployment.

WAC 296-824-70005:
Follow the appropriate post-emergency response requirements.

NEW LANGUAGE UNDERLINED.

70005

2. When cleanup is done by the employees who were part of the initial emergency response, the employees are not covered by this section (however, training, PPE, medical monitoring and surveillance and other requirements in WAC are **296-824-20005** through **296-824-60015** apply to these employees).

Table 10

When response cleanup is performed by employees who were not part of the initial emergency response and:	**The following rules or requirements apply:**
It is necessary to remove hazardous substances, health hazards and contaminated materials (example: Soil) from the site.	• Chapter 296-843 WAC, Hazardous waste operations • Chapter 296-824-400 WAC, Incident-specific medical monitoring and surveillance