

Complex Operating Environment – Oil and Natural Gas Refineries

With approximately 700 oil and natural gas refineries worldwide and 139 refineries in 30 states in the US, securing refineries and their associated facilities, technologies, and employees poses a significant challenge to security stakeholders and first responders. The economy, health, and security of the nation depend on oil and natural gas refineries, which in turn allow the government, people, and businesses to function safely and securely. Terrorists may view oil and natural gas infrastructures as lucrative targets for several reasons: the volatile nature of the chemicals used and produced, their restricted flow through critical chokepoints, and the infrastructure’s strategic importance to the global economy. This product highlights the importance of being aware of and understanding the inherent complexities and hazards related to an emergency response at a refinery. Identification of the chemicals involved will lead to an effective response. The following list is not all-inclusive:

SCOPE: This product provides situational awareness to security stakeholders and first responders of potential threats and hazards to oil and natural gas refineries, as well as considerations for preparedness and response.

CHEMICAL(S)	DANGERS	INDICATORS	SIGNS & SYMPTOMS	CONTROL MEASURES
Petroleum-derived gases, liquids, and vapors	<ul style="list-style-type: none"> Flammable Toxic to the nervous system, liver, kidneys Sudden death in high exposures 	<ul style="list-style-type: none"> Presence of a sweet or pungent odor Can quickly evaporate in the open air Oily look while floating on top of water Obvious release point where material is dispersing quickly into the air 	<ul style="list-style-type: none"> Drowsiness, Dizziness Rapid, irregular heartbeat Headaches, Confusion Tremors Unconsciousness Death 	<ul style="list-style-type: none"> Remove exposed clothing Wash skin with soap and water Move away from exposed area Immediately get fresh air Wear self-contained breathing apparatus (SCBA) and flame-resistant (FR) clothing
Anhydrous Hydrofluoric Acid (HF)	<ul style="list-style-type: none"> Extremely corrosive and volatile Quickly penetrates skin and muscle tissue Death can occur even at lower concentrations May burn, but does not ignite readily 	<ul style="list-style-type: none"> Dangerous corrosive cloud Colorless fuming liquid Strong irritating odor 	<ul style="list-style-type: none"> Eye irritation Immediate pain and tissue destruction Immediate skin irritation 	<ul style="list-style-type: none"> Wear Chemical, Biological, Radiological, Nuclear (CBRN) and SCBA with a Level A protective suit Be sure areas are well ventilated Never work alone First aid kits must include Calcium Gluconate gel
Hydrogen sulfide (H ₂ S)	<ul style="list-style-type: none"> Flammable, colorless gas Toxic in low concentrations Can be odorless in high concentrations 	<ul style="list-style-type: none"> Referred to as “sour gas” “Rotten egg” odor Heavier than air Likely to settle in low-lying areas 	<ul style="list-style-type: none"> Deadened smell Fatigue, Dizziness Headaches, Nausea Loss of consciousness Death 	<ul style="list-style-type: none"> Wear a SCBA Use 4-gas monitors with audio or visual alarms Use safety lines for rapid extraction Use forced-air systems, such as ventilation and exhaust fans
Diesel exhaust	<ul style="list-style-type: none"> Carbon, ash, metallic abrasive particles, sulfites, and silicates produced during the combustion process of diesel engines Health effects range from respiratory disease to lung cancer 	<ul style="list-style-type: none"> Black smoke in air Exhaust fume odor 	<ul style="list-style-type: none"> Headaches Nausea Eye and nose irritation Carcinogenic and prolonged exposure 	<ul style="list-style-type: none"> Avoid black smoke Use CO2 detectors Seek open air Use well-ventilated areas
Mercury (including its vapor)	<ul style="list-style-type: none"> Dangerous neurotoxin Damage to brain and nervous system through inhalation, ingestion, or skin contact 	<ul style="list-style-type: none"> Damaged or breached refinery equipment Compromised pipes Shiny metallic liquid 	<ul style="list-style-type: none"> Anxiety, Depression Mood changes Numbness Memory problems Tremors 	<ul style="list-style-type: none"> Avoid damaged or compromised equipment Conduct a site-risk assessment prior to entry Wear personal protective equipment (PPE) including coveralls, gloves, face shields, goggles, and shoe coverings
All other flammable gases and toxic substances	<ul style="list-style-type: none"> Risk of fire and explosion Multiple products have low flash points or may be compressed After an incident or attack, warning systems and emergency procedures may be disabled leaving little to no warning of escape or exposure 	<ul style="list-style-type: none"> Cloud of vapor hugging the ground (dense gas) Whistling or hissing noise White clouds of dust or mist Bubbles in water or liquids Visibly damaged pipes Dead vegetation and plants in the area 	<ul style="list-style-type: none"> Difficulty breathing Fatigue, Dizziness Flu-like symptoms Headaches, Nausea Eye and nose irritation 	<ul style="list-style-type: none"> Use 4-gas monitoring equipment, maintain and calibrate regularly Wear PPE, FR clothing, Use safety lines for rapid extraction Use forced-air systems, such as ventilation and exhaust fans



NOTICE: This is a Joint Counterterrorism Assessment Team (JCAT) publication. JCAT is a collaboration by the NCTC, DHS and FBI to improve information sharing among federal, state, local, tribal, territorial governments and private sector partners, in the interest of enhancing public safety. This product is NOT in response to a specific threat against the United States. It provides general awareness of, considerations for, and additional resources related to terrorist tactics, techniques and procedures, whether domestic or overseas. Consider the enclosed information within existing laws, regulations, authorities, agreements, policies or procedures. For additional information, contact us at JCAT@NCTC.GOV. This document is best printed in an 11 X 17 format.

Complex Operating Environment – Oil and Natural Gas Refineries (continued):

CONSIDERATIONS: Oil and natural gas refineries vary in size and complexity, posing challenges to first responders. Refineries often have their own security and response capabilities that can overlap jurisdictional responsibilities and require close coordination with response stakeholders. Recognition and understanding of the critical components and elements of the oil supply chain, including refinery-system functions, can aid response. In an emergency, refinery personnel have the ability to assess their operating systems and components to restore essential services; however, they may not be trained to deal with a complex terrorist attack. The following preparedness and response considerations can assist in training, planning, and operating within oil and gas refineries:

PREPAREDNESS: First responders, security stakeholders, and refinery personnel can work jointly to broaden awareness and increase preparedness through routine contact, exercises, and training, improving overall incident response. Although the majority of the response strategy for oil and gas refineries happens at the local level, preparedness at all levels should include the following:

- Understand the specific hazards and complexities of refineries within your area of responsibility.
- Review physical security measures, such as perimeter fencing, video surveillance, controlled access gates, 100% identification checks, vehicle searches, manifest checks, and physical searches of all packages and personnel entering the facility.
- Establish and use suspicious activity reporting (SAR) mechanisms by all stakeholders.
- Ensure proper screening measures for delivery drivers and employees. Transportation Worker Identification Credential (TWIC) cards alone are not sufficient for entry.
- Ensure all stakeholders are familiar with the Incident Command System (ICS) principles and procedures.
- Engage allied agencies, local Joint Terrorism Task Forces (JTTFs), and state and major urban area fusion centers to improve awareness of the threat environment and incident response.
- Visit supply chain contractors and suppliers regularly to ensure controls within the procurement process, to defend against the introduction of malicious physical or digital weaknesses to the production or operational environment.
- Conduct realistic, routine, and unconventional joint exercises to educate partners on the capabilities and expectations of all response stakeholders.

PREPAREDNESS (continued):

- Develop and share standard operating procedures and mutual-aid agreements.
- Maintain an up-to-date list of points of contact for all response stakeholders, including refinery personnel and local hazardous materials teams.
- Understand which stakeholders to notify, including those with refinery-specific expertise, and understand what equipment is required to mitigate incidents.
- Perform after-action reviews that include all levels of response and refinery operations, to study lessons learned, update response plans, determine critical refinery functions, and build relationships.
- Implement the National Response Framework, ICS, and Presidential Policy Directive 8 into joint training to improve preparedness and response.

INSIDER THREAT: Oil and gas refineries are vulnerable to insider threats, such as an employee with access to sensitive information that can be provided to a foreign or domestic adversary. Insider threats can begin as early as the job application process, when adversaries may direct applicants to seek employment with access to facility layouts, site security, intellectual property, and customer information.

RESPONSE:

- Set up command posts uphill and upwind from the facility that can expand or contract as the incident and affected zone change in size, per established guidelines.
- Use push notifications to cell phones and other electronic devices in the event of an emergency.
- Designate a refinery liaison within the command post to relay pertinent information, such as continual feedback to response actions, and to provide subject-matter expertise on refinery operations.
- Ensure communications interoperability between first responders and refinery operators.
- Designate white-hat locations, where first responders will meet plant personnel prior to entry into a facility, in order to maintain safety.
- Disseminate up-to-date incident-related information to the workers, media, and residents for increased safety.

CYBER THREAT: The increased use of computer-based automation and management systems in the oil and natural gas industry has vastly increased the efficiency of refineries, while also creating cyber security vulnerabilities that illicit actors (criminal hackers, insiders, cyber terrorists, violent extremists, and rogue nation states) may exploit. State actors have used advanced persistent threats, such as phishing emails containing malware, to gain unauthorized access to a facility's industrial control system, causing loss of life and physical damage. A cyber attack against a refinery industrial control system could cause more damage and disruption than an attack on its physical infrastructure.

RESOURCES:

- **DHS/Cybersecurity and Infrastructure Security Administration (CISA) – Chemical Facility Anti-Terrorism Standards Resources:**
<https://www.cisa.gov/cfats-resources>
- **DHS/CISA – Chemical Sector Security Awareness Guide:**
<https://www.cisa.gov/sites/default/files/publications/DHS-Chemical-Sector-Security-Guide-Sept-2012-508.pdf>
- **Department of Transportation/Pipeline and Hazardous Materials Safety Administration – Emergency Response Guidebook:**
<https://www.phmsa.dot.gov/sites/phmsa.dot.gov/files/docs/ERG2016.pdf>
- **DHS/Federal Emergency Management Agency – ICS Resource Center:**
<https://training.fema.gov/emiweb/is/icsresources>
- **Coast Guard – National Response Center: 1-800-424-8802 and**
<http://nrc.uscg.mil/Default.aspx>



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ADDITIONAL COMMENTS, SUGGESTIONS, OR QUESTIONS.

WHAT TOPICS DO YOU RECOMMEND?

