NIOSH Oil and Gas Sector Program

Strategic Plan for Research and Prevention, 2016-2025

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Executive Summary

The U.S. oil and gas exploration and production industry includes activities involved in the identification and extraction of crude oil and natural gas from geologic formations below the earth's surface. The industry has experienced tremendous growth since 2003, resulting in a 70% increase in the number of drilling rigs and a two-fold increase in the number of workers employed in the industry. This growth has come at a cost. During 2003-2013, 1,189 oil and gas exploration and production workers were killed on the job, resulting in an annual fatality rate seven times higher than for all U.S. workers. While the industry's fatality rate remains elevated, recent analyses show that the rate is decreasing despite a decade of rapid growth. This plan proposes research and prevention efforts that if successful will improve safety and health in this high-risk industry.

The purpose of this strategic plan is to define and prioritize occupational safety and health research and prevention activities for NIOSH in the oil and gas exploration and production industry through 2025. This strategic plan focuses on conducting priority research to prevent injuries, illnesses, and fatalities to workers employed in the onshore, exploration and production industry. The plan's research goals are organized according to the four areas that make up the NIOSH Oil and Gas Sector Program: 1) epidemiology and surveillance, 2) exposure assessment, 3) control technologies, and 4) communications (Table 1). The plan also includes performance measures that describe specific research activities that will be used to guide research, measure progress, and evaluate the success of the NIOSH Oil and Gas Sector Program in improving safety and health in this high-risk industry.

Table 1. Strategic goals contained in this plan	
Epidemiology & Surveillance	**Strategic Goal 1**: Advance understanding of risk factors associated with injuries, illnesses, and fatalities in the oil and gas exploration and production industry through epidemiology and surveillance.
Exposure Assessment	**Strategic Goal 2:** Identify and characterize exposure hazards and other health risks associated with the oil and gas exploration and production industry.
Control Technologies	**Strategic Goal 3:** Develop, implement, and evaluate controls to reduce injuries, illnesses, and fatalities among oil and gas exploration and production workers.
Communications	**Strategic Goal 4:** Develop and promote the use of NIOSH guidance and recommendations to improve safety and health in the oil and gas exploration and production industry.

Through this strategic plan, NIOSH will use its resources and work with our partners to reduce some of the most critical risks associated with working in the oil and gas exploration and production industry. To evaluate progress in reaching the goals and associated metrics included in this strategic plan, the NIOSH Oil and Gas Sector Program will conduct a mid-course review of progress during 2020. With the input and participation of our diverse group of partners, the NIOSH Oil and Gas Sector Program will advance its mission to "Conduct research, partner with stakeholders, and develop and communicate workplace solutions to improve worker safety and health in the oil and gas exploration and production industry."

Contents

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NIOSH Oil and Gas Sector Program: Strategic Plan for Research and Prevention, 2016-2025

About NIOSH

The National Institute for Occupational Safety and Health (NIOSH) is the U.S. federal agency that conducts research and makes recommendations to prevent worker injury and illness. A number of Federal Agencies are conducting research activities focused on the U.S. exploration and production industry, but NIOSH is the only agency whose mission encompasses the prevention of work-related injuries, illnesses, and fatalities. NIOSH provides the only dedicated federal investment for research needed to prevent the societal cost of work-related fatalities, injuries and illnesses in the United States, estimated in 2007 at $250 billion in medical costs and productivity losses alone. These safety and health risks take huge tolls on workers, their families, businesses, communities, and the nation's economy; NIOSH works to promote a healthy, safe and capable workforce that can rise to the challenges of the 21st Century.

NIOSH Mission

NIOSH produces new scientific knowledge and provides practical solutions vital to reducing risks of injury, illness, and death in traditional industries, such as agriculture, construction, and mining. NIOSH also supports research to predict, prevent, and address emerging problems that arise from changes in the 21st Century workplace and workforce. NIOSH partners with diverse stakeholders to study how worker injuries, illnesses, and deaths occur. NIOSH scientists design, conduct, and support targeted research, both inside and outside the Institute, and support the training of occupational health and safety professionals to build capacity and meet increasing needs for a new generation of skilled practitioners. NIOSH and its partners support U.S. economic strength and growth by moving research into practice through concrete and practical solutions, recommendations, and interventions for the building of a healthy, safe, and capable workforce in this draft.

Purpose of the Strategic Plan

The purpose of this strategic plan is to define and prioritize occupational safety and health research and prevention activities for NIOSH in the oil and gas exploration and production industry through 2025. The U.S. oil and gas exploration and production industry includes activities involved in the identification and extraction of crude oil and natural gas from geologic formations below the earth's surface. Recent advances in technology, specifically horizontal drilling and hydraulic fracturing, have made the extraction of previously unrecoverable crude oil and natural gas possible. This resulted in a steady increase in industry activity, and introduced new occupational safety and health risks, during the last decade. During 2003-2013, the number of workers employed in the exploration and production industry doubled (from 293,000 to 587,000) and the number of active drilling rigs increased by 70% (1,2). Much of the work in this industry is physically demanding, repetitive, and conducted outside in all weather conditions. Shift work is typical; 12 hour shifts for two or more consecutive weeks are common. Well sites are often located in remote locations, requiring workers to travel long distances, putting them at increased risk of fatigue and being involved in a motor vehicle crash. All of these factors have contributed to the industry's historically elevated fatality rate, which was seven times greater than the rate for all U.S. workers during 2003-2013 (25.0 and 3.5 deaths per 100,000 workers, respectively) (3).

This plan includes strategic goals that identify the most pressing safety and health issues in the industry. The plan's research goals are organized according to the four areas that make up the NIOSH Oil and Gas Sector Program: 1) epidemiology and surveillance, 2) exposure assessment, 3) control technologies, and 4) communications (Table 2). The plan also includes performance measures for specific research activities that will be used to guide research, measure progress, and evaluate the success of the Program in improving safety and health in this high-risk industry.

Table 2. Description of the NIOSH Oil and Gas Sector Program Activities

Program Component	Description
Epidemiology & Surveillance	Conduct epidemiologic investigations of fatal and nonfatal events, and associated risk factors, in the oil and gas exploration and production industry.
Exposure Assessment	Conduct investigations of worker exposures to chemical, physical, and biological hazards, and other health risks during oil and gas exploration and production operations.
Control Technologies	Develop and evaluate control technologies to prevent fatal and nonfatal injuries and exposures to chemical, physical, and biological hazards in the oil and gas exploration and production industry.
Communications	Conduct qualitative research and develops effective communication products in support of the NIOSH Oil and Gas Sector Program.

Occupational Safety and Health Issues in the Exploration and Production Industry

During 2003–2013, 1,189 oil and gas exploration and production workers were killed on the job, resulting in an annual fatality rate seven times higher than the rate among all U.S. workers (25.0 versus 3.5 deaths per 100,000 workers)(3,4). While the fatality rate remains elevated, NIOSH found that the fatality rate decreased by 33% ($p<.05$) during 2003-2013, despite a 70% increase in the number of active drilling rigs and a two-fold increase in the number of workers employed in the industry.

Transportation incidents were the leading cause of death in this industry, accounting for 40% of all fatalities during 2003-2013 (4). The majority (80%) of these incidents were motor vehicle crashes. Many workers within this industry drive long distances to remote well sites on rural roads, which may lack safety features such as lighting, guard rails, and adequate road grading. Previous NIOSH research has shown that lack of seatbelt use is a contributing factor in at least half of the motor vehicle fatalities in the oil and gas exploration and production industry (5). The largest proportion of workers (51.5%) who die are occupants of light-duty vehicles (e.g. pickup trucks).

The second leading cause of death among oil and gas exploration and production workers is contact injuries, which include being struck by objects (tools, drill pipe, equipment, etc.), or being crushed or caught in equipment. Contact injuries make up 26% of all fatalities. A recent NIOSH study showed that installing automated equipment on drilling rigs that removes the worker from hazardous tasks can reduce contact injury rates for rig workers (6).

Certain employer and worker groups in the oil and gas exploration and production industry are at greater risk of being killed on the job: contractor employees, employees of small companies, and short-service employees (7). Workers employed as *contractors* were two to three times more likely to be killed on the job than workers employed by oil and gas operators. This is not surprising, as these companies are largely responsible for drilling, completing, and servicing wells, which include the activities most often associated with fatal events. Drilling contractors had the highest fatality rates – more than three times higher than the rate among oil and gas operators (48.8 and 15.4 per 100,000,

respectively) (7). The same study found that workers employed by *small companies*[1] were five times as likely to be killed on the job as workers employed by large companies. According to the BLS, 43.5% of the workers in the oil and gas exploration and production industry were employed by a small company during 2010-2014 (1). Workers employed by small oil and gas companies may find themselves at increased risk because their employers often don't have the resources to employ a full-time safety and health professional or develop a comprehensive occupational safety and health program. In addition, small companies may own older and less-automated equipment and rigs, as compared to larger companies that have the capital to invest in more advanced, and potentially safer equipment. The third group of workers that are at an increased risk is *short service employees* – those employees with less than one year of experience with their current employer. Where documented, more than half of all fatalities in the industry occur to short service employees (8).

While the most frequent fatal events in this industry have been identified and described, there remains much more research to be done to improve safety and health in the oil and gas exploration and production industry. Existing fatality surveillance systems do not contain oil and gas specific variables that would allow for better identification of vulnerable workers and high-risk activities in this industry. Information on non-fatal injuries and illnesses is incomplete, and little is known about the health hazards that may exist in the many diverse activities in the industry. The goals contained in this plan seek to improve fatality surveillance in this industry, improve data collection for nonfatal injuries and illnesses, and provide estimates of exposure (such as hours worked and miles driven). In addition to providing information and controls that are scalable and relevant for small businesses, additional research is needed to further characterize exposure hazards and other health risks to workers.

[1] To be consistent with research conducted in other industries, this study defined small companies as those with fewer than 20 employees. However, the strategic goals contained in this plan consider any company with fewer than 100 employees as a small company.

History of the NIOSH Oil & Gas Safety & Health Program

Safety Research

The NIOSH Oil and Gas Safety and Health Program began in 2005 in response to the increase in the number and rate of fatal injuries in the industry. According to the Bureau of Labor Statistics (BLS), 98 oil and gas exploration and production workers were killed on the job in 2004, resulting in an occupational fatality rate nearly eight times higher than the rate among all U.S. workers (31.9 and 4.3 deaths per 100,000 workers, respectively) (9). As a result, the NIOSH Oil and Gas Safety and Health Program focused its initial research activities on learning about the industry and collecting and analyzing data to describe the most frequent fatal events, the groups of workers most at risk, and associated risk factors. Early NIOSH research targeted specific types of fatal events such as motor vehicle crashes, workers struck by objects, falls, and fires and explosions[2]. The results and recommendations generated by that research were published in scientific journals, trade journals, presented at professional conferences and meetings, and included in a series of training videos targeting specific risk factors and high-risk operations (10,11). NIOSH scientists continue to conduct research to more fully describe fatal events and associated risk factors, enhance surveillance activities, publish findings and recommendations, and partner with industry to implement effective workplace solutions.

The Vision and Mission of the NIOSH Oil and Gas Sector Program

Vision
A safe and healthy workplace for all workers in the oil and gas exploration and production industry.

Mission
Conduct research, partner with stakeholders, and develop and communicate workplace solutions to improve worker safety and health in the oil and gas exploration and production industry.

Health Research

In 2008, scientists at the NIOSH conducted initial well site visits to learn about exploration and production processes and possible health hazards. While data and information about fatal events in the industry were available, NIOSH scientists found few published studies

[2] A list of NIOSH oil and gas exploration and production research projects organized by program component and year funded can be found in the appendix.

describing occupational health risks to workers employed in the U.S. onshore exploration and production industry. To address this lack of information, NIOSH partnered with oil and gas companies to conduct research to better understand potential health risks associated with chemical exposures. Industrial hygiene exposure characterizations were conducted for chemical and mineral substances, with initial exposure assessment studies focused on exposures to respirable crystalline silica (RCS) during hydraulic fracturing. A sentinel article was published by NIOSH in 2013 describing workplace exposures to RCS (12), which resulted in awareness of a previously unrecognized hazard, the formation of an industry workgroup to mitigate the hazard, and the development of several control technologies to reduce or eliminate the hazard (13). Additional field and laboratory-based studies are ongoing at NIOSH to enhance what is known about potential chemical hazards to workers employed in the exploration and production industry.

Partnerships

In addition to building a research program focused on the most pressing safety and health issues in the industry, NIOSH staff identified and invited broad stakeholder participation in the National Occupational Research Agenda (NORA) Oil and Gas Sector Council, a partnership program that was formed in 2008 and continues to collaborate with NIOSH on a variety of worker safety and health activities. More information about the NORA Oil and Gas Sector Council can be found at: (www.cdc.gov/niosh/nora/councils/oilgas/).

Scope of the Strategic Plan

Exploration and production industry

This strategic plan focuses on conducting priority research to prevent injuries, illnesses, and fatalities to workers employed in the exploration and production industry. The exploration and production industry is defined by the North American Industry Classification System (NAICS) as:

> "Industries in the Oil and Gas Extraction subsector operate and/or develop oil and gas field properties. Such activities may include exploration for crude petroleum and natural gas; drilling, completing, and equipping wells; operating separators, emulsion breakers, desilting equipment, and field gathering lines for crude petroleum and natural gas; and all other activities in the preparation of oil and gas up to the point of shipment from the producing property. This subsector includes the production of crude petroleum, the mining and extraction of oil from oil shale and oil sands, and the production of natural gas, sulfur recovery from natural gas, and recovery of hydrocarbon liquids." (14)

The NAICS identifies three types of companies in the exploration and production industry: oil and gas operators who control and manage leased areas (NAICS 211), drilling contractors who drill the wells (NAICS 213111) and well servicing companies who provide all other types of support operations that prepare a well for completion and production (NAICS 213112).

Priority operations, workers, and issues

Because NIOSH resources are limited, this strategic plan focuses on priority occupational safety and health operations, workers, and issues based on what is currently known about safety and health risks in the exploration and production industry. These priority operations, workers, and issues include:

- *Onshore* exploration and production activities;
- Workers employed by *small companies*;
- *Short service employees*: workers with one-year or less of experience in this industry;
- Employers working as *contractors or sub-contractors; and*
- *Emerging* safety and health issues.

How this plan was developed

This strategic plan was developed by NIOSH scientists actively involved in conducting research in the oil and gas exploration and production industry, NIOSH scientists with subject matter expertise in areas important to the development of research goals, and additional NIOSH staff with expertise in strategic planning. An initial face-to-face meeting and additional follow up meetings were held at NIOSH to develop and refine the goals and seek input from a variety of NIOSH scientists.

This strategic plan was also reviewed by external stakeholders. Members of the NORA Oil and Gas Sector Council and other key stakeholder agencies and organizations were contacted directly to request their review. Additional stakeholder comments were solicited when the plan was published in the *Federal Register*, and a docket established. The plan was also reviewed by external subject-matter experts in occupational safety and health. Every effort was made to incorporate the comments that were received during the review process. The individuals and organizations that made significant contributions to this strategic plan are identified in the acknowledgements section.

Strategic Goals for the NIOSH Oil and Gas Sector Program, 2016-2025

Strategic Goal 1: Advance understanding of risk factors associated with injuries, illnesses, and fatalities in the oil and gas exploration and production industry through epidemiology and surveillance.

Intermediate Goal 1.1: Employers and safety organizations will use findings from NIOSH surveillance activities to develop programs, policies, and interventions to mitigate risk factors associated with injuries, illnesses, and fatalities in the oil and gas exploration and production industry.

Activity/Output Goal 1.1.1: Conduct and enhance surveillance activities to track priority injuries, illnesses, hazards and associated risk factors.

Performance Measure 1.1.1-1: Publish at least one NIOSH-numbered surveillance report each year summarizing the most frequent fatal events in the industry.

Performance Measure 1.1.1-2: Publish at least one NIOSH-numbered surveillance report each year on a special topic, hazard, or operation associated with worker fatalities.

Performance Measure 1.1.1-3: Partner with two states to improve the collection and dissemination of industry-specific surveillance data by 2018.

Performance Measure 1.1.1-4: Review surveillance data annually to identify emerging issues and trends that might have safety and health implications.

Activity/Output Goal 1.1.2: Develop new activities to expand the scope of surveillance for priority conditions not covered by existing surveillance activities.

Performance Measure 1.1.2-1: Conduct a pilot project to determine methods for tracking prevalence of work-related chronic health conditions among oil and gas exploration and production workers by 2025.

Performance Measure 1.1.2-1: Conduct research (surveillance, epidemiologic studies, or field studies) to assess the extent, severity, and risk factors for work-related respiratory diseases by 2025.

Activity/Output Goal 1.1.3: Conduct research to describe risk factors and develop recommendations for preventing the most frequent fatal events in the industry.

Performance Measure 1.1.3-1: Publish at least one NIOSH-numbered document or peer reviewed paper describing ways to reduce worker exposure to fall hazards on drilling and workover rigs by 2017.

Performance Measure 1.1.3-2: Publish at least one NIOSH-numbered document or peer reviewed paper describing fatal fire and explosion events and recommendations for prevention in the industry by 2017.

Performance Measure 1.1.3-3: Identify barriers to the proper use of fall protection equipment in the industry and strategies to remove those barriers by 2018.

Intermediate Goal 1.2: Employers, workers, trade associations, and insurance companies will use NIOSH recommendations and products to reduce transportation-related injuries and fatalities among oil and gas exploration and production workers.

Activity/Output Goal 1.2.1: Conduct research and develop recommendations and products that target risk factors for motor vehicle crashes in the industry.

Performance Measure 1.2.1-1: Partner with at least one oil and gas company to evaluate the effectiveness of in-vehicle monitoring technology to improve driver performance by 2016.

Performance Measure 1.2.1-2: Publish a NIOSH-numbered document describing the risks associated with fatigued driving and recommendations tailored to the industry by 2017.

Performance Measure 1.2.1-3: Publish one peer reviewed paper describing the results from motor vehicle module of the national survey of oil and gas workers by 2018.

Performance Measure 1.2.1-4: Publish as least one peer reviewed paper providing an update on trends in motor vehicle fatalities and/or effective interventions to reduce motor vehicle crashes by 2020.

Performance Measure 1.2.1-5: Partner with at least one oil and gas company to evaluate the effectiveness of a journey management system to improve fleet safety and publish results by 2022.

Intermediate Goal 1.3: Employers and safety organizations will use findings from NIOSH research to develop programs, policies, and interventions to reduce nonfatal injuries and illnesses in the oil and gas exploration and production industry.

Activity/Output Goal 1.3.1: Conduct epidemiologic studies to enhance what is known about nonfatal injuries and illness in the industry.

Performance Measure 1.3.1-1: Complete a national survey of oil and gas workers that collects detailed information on risk factors related to occupational safety and health by 2017.

Performance Measure 1.3.1-2: Publish at least two peer reviewed papers describing the results of the national survey of oil and gas workers by 2018.

Performance Measure 1.3.1-3: Compile list of all available nonfatal injury and illness data sources related to the oil and gas exploration and production industry by 2017.

Performance Measure 1.3.1-4: Identifying stakeholders willing to share nonfatal injury and illness datasets with NIOSH for the purpose of improving the collection, analysis, and reporting of nonfatal injuries and illness in the industry by 2018.

Performance Measure 1.3.1-5: Publish one peer reviewed paper describing the results of analyses conducted on nonfatal injury and illness datasets by 2020.

Intermediate Goal 1.4: The research community will use results of NIOSH research on exposure-based estimates to prioritize future research activities in the exploration and production industry.

Activity/Output Goal 1.4.1: Identify and evaluate data sources for exposure-based worker estimates, such as miles driven, and hours worked for the purpose of creating better estimates of risk for workers.

Performance measure 1.4.1-1: Initiate at least one research project to identify and evaluate sources of exposure-based worker estimates (e.g. hours worked, miles driven) by 2018.
Performance measure 1.4.1-2: By 2020, if initial efforts are successful, begin to utilize exposure data to calculate risk by factors such as occupation, company type, and region.

Intermediate Goal 1.5: Employers, insurance companies, and safety organizations will use results from NIOSH economics research to implement effective programs and technologies in the exploration and production industry.

Activity/Output Goal 1.5.1: Measure the economic burden of occupational illnesses, injuries, and fatalities and conduct cost effectiveness research of safety and health interventions used in this industry.

Performance Measure 1.5.1-1: Complete at least one research project to identify and describe the economic burden associated with illness, injuries, or fatalities by 2020.
Performance Measure 1.5.1-2: Complete at least one research project to determine the cost effectiveness of a safety/health intervention used in this industry by 2020.

Intermediate Goal 1.6: Employers will incorporate NIOSH recommendations and products to develop programs, policies, and interventions to prevent occupational injuries, illnesses, and fatalities to vulnerable workers in the exploration and production industry.

Activity/Output Goal 1.6.1: Identify vulnerable workers in the oil and gas exploration and production industry and describe unique risk factors for occupational injuries, illnesses, and fatalities.

Performance Measure 1.6.1-1: Analyze surveillance data to identify and describe vulnerable workers in the industry (such as temporary, young, non-English speaking workers, etc.) by 2017.
Performance Measure 1.6.1-2: Review surveillance data annually beginning in 2018 to identify emerging issues and trends that could affect vulnerable workers.

Performance Measure 1.6.1-3: Develop and publish recommendations and strategies to reduce injuries, illnesses, and fatalities among vulnerable workers by 2020.

Intermediate Goal 1.7: Oil and gas operators and small companies will incorporate NIOSH recommendations and products to develop programs, policies, and interventions to prevent occupational injuries, illnesses, and fatalities among workers employed by small oil and gas exploration and production companies.

Activity/Output Goal 1.7.1: Identify and prioritize occupational safety and health issues within small businesses.

Performance Measure 1.7.1-1: Conduct a needs assessment to understand safety and health issues unique to small businesses and to guide future research and outreach activities by 2018.
Performance Measure 1.7.1-2: Publish one peer reviewed paper describing results of needs assessment and future plans for work with small businesses by 2019.
Performance Measure 1.7.1-3: Review surveillance data annually to identify emerging issues and trends that could affect small businesses.

Strategic Goal 2: Identify and characterize exposure hazards and other health risks associated with the oil and gas exploration and production industry.

Intermediate Goal 2.1: Employers, workers, trade associations, and safety organizations will use results from NIOSH research to develop programs, policies, and interventions to reduce workplace exposures to identified hazards in the exploration and production industry.

Activity/Output Goal 2.1.1: Identify and prioritize the most prevalent and serious health hazards.

Performance Measure 2.1.1-1: Perform initial hazard identification and develop a comprehensive list of health hazards by 2017; review and update biannually thereafter.

Performance Measure 2.1.1-2: Establish a method for identifying priority health hazards and publish the methodology on the NIOSH website by 2017.

Performance Measure 2.1.1-3: Develop and maintain a list of NIOSH projects focused on the priority hazards. Publish a summary of those research projects on the NIOSH website by 2018.

Activity/Output Goal 2.1.2: Conduct in-depth exposure assessments, encompassing industrial hygiene and biomonitoring assessment methodologies, to characterize the scope and magnitude of hazards and potential impacts on worker health.

Performance Measure 2.1.2-1: Perform four exposure assessment site visits annually to assess exposures, including but not limited to, the following hazards: silica, volatile organic compounds, diesel particulate matter, physical hazards, hazardous toxic gases/vapors, other exposure hazards, and hazardous atmospheres.

Performance Measure 2.1.2-2: Prepare and provide reports of individual participant sample results no later than one month after receiving final laboratory sample analysis.

Performance Measure 2.1.2-3: Develop appropriate communication products targeting high-risk workers and operations based on the results of exposure assessments and biological monitoring.

Activity/Output Goal 2.1.3: Adapt, develop, and evaluate sampling strategies and new technologies for assessing health hazards and control efficacy within the oil and gas exploration and production industry.

Performance Measure 2.1.3-1: Evaluate the efficacy and limitations of personal explosivity meters for complex flammable mixtures by 2020.

Performance Measure 2.1.3-2: Incorporate video technology (FLIR and traditional video exposure monitoring) for assessing health hazards on 25% of the site visits made on an annual basis.

Performance Measure 2.1.3-3: Develop or enhance one assessment methodology per year focusing on, but not limited to: direct reading instrumentation, new NIOSH Manual of Analytical Methods (NMAM) methods, and biological monitoring.

Performance Measure 2.1.3-4: Establish an oil and gas exposure assessment working group of internal and external partners and conduct meeting annually beginning in 2017.

Performance Measure 2.1.3-5: Develop and publish a peer reviewed paper on lessons learned from sampling strategies and approaches for characterizing hazards, or a novel assessment method, once per year.

Activity/Output Goal 2.1.4: Conduct laboratory toxicology research to identify and evaluate the potential impacts of exposures on worker health.

Performance Measure 2.1.4-1: Identify and prioritize agents for study based on unique exposure situations, complexity of mixtures, paucity of existing information, or other rationales by 2017; review and update biannually thereafter.

Performance Measure 2.1.4-2: Complete laboratory health effects study evaluating toxicity associated with dermal exposure to amines in crude oil and publish peer-reviewed peer reviewed paper detailing study results by 2018.

Performance Measure 2.1.4-3: Complete laboratory health effects study of crude oil inhalation exposures and publish peer-reviewed peer reviewed paper detailing study results by 2018.

Performance Measure 2.1.4-4: Complete laboratory health effects study evaluating mixed silica and diesel particulate matter exposures and publish peer-reviewed peer reviewed paper detailing study results by 2018.

Performance Measure 2.1.4-5: Conduct basic toxicology research, including inhalation toxicology studies, to better characterize mechanisms of work-related respiratory diseases by 2025.

Activity/Output Goal 2.1.5: Provide reports to employers that are evidence-based and include practical recommendations to assess and control hazards identified during well site visits.

Performance Measure 2.1.5-1: Develop post-site visit interim reports after each exposure assessment site visit with recommendations to decrease exposures and improve worker safety and health. Interim reports will be provided to the employer no later than one month after receiving the final laboratory sample analysis.

Performance Measure 2.1.5-2: Develop and deliver a final study report to the employer after the last site visit and no later than six months after receiving final laboratory sample analyses.

Strategic Goal 3: Develop, implement, and evaluate controls to reduce injuries, illnesses, and fatalities among oil and gas exploration and production workers.

Intermediate Goal 3.1: Employers, manufacturers, and other stakeholder groups will utilize engineering controls to prevent fatal and nonfatal injuries and illnesses caused by known hazards in the oil and gas exploration and production industry.

Activity/Output Goal 3.1.1: Identify, describe, and evaluate existing engineering controls designed to reduce safety and health hazards to workers.

Performance Measure 3.1.1-1: Identify and describe best practices in engineering controls to reduce fatal and nonfatal injuries and illnesses by 2018; review and update biannually thereafter.

Performance Measure 3.1.1-2: Conduct at least five site visits to determine the effectiveness of implemented engineering controls in reducing worker exposures to safety and health hazards by 2025. Submit reports to companies describing the findings and publish to the NIOSH website.

Performance Measure 3.1.1-3: Evaluate the effectiveness of at least one advanced rig technology designed to reduce contact injuries and publish in a peer reviewed paper by 2020.

Performance Measure 3.1.1-4: Produce communications products and publish at least one peer reviewed paper detailing findings from the evaluation of engineering controls by 2025.

Activity/Output Goal 3.1.2: Develop, or enhance, and evaluate engineering controls to reduce worker exposures to previously characterized safety and health hazards.

Performance Measure 3.1.2-1: Identify gaps in effective engineering controls using information collected during fieldwork and from stakeholders (Activity/Output Goal 3.1.1) by 2019; review and update biannually thereafter.

Performance Measure 3.1.2-2: Publish at least two peer reviewed papers describing the development and evaluation of two engineering controls by 2025.

Performance Measure 3.1.2-3: Develop at least one peer reviewed paper summarizing the results of exposure control technology assessments by 2025.

Activity/Output Goal 3.1.3: Conduct engineering control research to reduce worker exposures to new, emerging, or previously uncharacterized safety and health hazards.

Performance Measure 3.1.3-1: Identify new or changing exploration and production processes and possible implications for worker safety and health (PM 3.2.1-1).

Performance Measure 3.1.3-2: Identify or develop engineering controls to reduce worker exposures to new, emerging, or previously uncharacterized safety and health hazards.

Intermediate Goal 3.2: Employers, manufacturers, and other stakeholder groups will utilize new or improved methods of controlling hazards in the oil and gas exploration and production industry.

Activity/Output Goal 3.2.1: Evaluate new or improved methods for controlling hazards in the oil and gas exploration and production industry.

Performance Measure 3.2.1-1: Beginning in 2016, annually assess the availability of promising new or improved methods for controlling hazards by querying key stakeholder groups.

Performance Measure 3.2.2-1: Conduct research and develop interventions to understand and address the personal protective equipment requirements of oil and gas workers and to develop innovative materials, technologies, respiratory protection, and best practice recommendations or guidance which can meet their needs by 2025.

Performance Measure 3.2.1-2: Identify and evaluate at least two new or improved methods for controlling hazards for possible application by 2025.

Strategic Goal 4: Develop and promote the use of NIOSH guidance and recommendations to improve safety and health in the oil and gas exploration and production industry.

Intermediate Goal 4.1: Employers, trade associations and other government agencies will work with NIOSH to assess worker safety and health hazards in the oil and gas exploration and production industry.

Activity/Output Goal 4.1.1: Identify and engage new research partners and enhance current partnerships.

Performance Measure 4.1.1-1: Develop an internal NIOSH database of current and potential research partners by 2016.

Performance Measure 4.1.1-2: Develop, maintain, and review health communication materials for recruiting new research partners on an annual basis.

Performance Measure 4.1.1-3: Develop formal relationships (via a letter of agreement) with one new research partner each year.

Performance Measure 4.1.1-4: Conduct an exit interview at the termination of each letter of agreement to evaluate the effectiveness of the partnership.

Performance Measure 4.1.1-5: Develop health communication materials to better inform, recognize, and thank formal research partners of NIOSH activities by 2017; review and update annually thereafter.

Intermediate Goal 4.2: Stakeholder groups will utilize NIOSH products to improve safety and health practices in the oil and gas exploration and production industry.

Activity/Output Goal 4.2.1: Conduct qualitative research to identify appropriate messaging and effective methods for disseminating products in the oil and gas exploration and production industry.

Performance Measure 4.2.1-1: Collect information related to messaging and dissemination from at least two stakeholder groups annually beginning in 2017.

Performance Measure 4.2.1-2: Use information collected (PM 4.2.1-1) to identify the occupational safety and health issues most important to specific stakeholder groups by 2018.

Performance Measure 4.2.1-3: Determine which communication channel will be most effective for each stakeholder group by 2018.

Performance Measure 4.2.1-4: Disseminate findings throughout the oil and gas extraction industry for each new product developed through 2025.

Performance Measure 4.2.1-5: Evaluate the effectiveness of information dissemination using channels identified as the most effective for reaching the specific stakeholder groups by 2025.

Activity/Output Goal 4.2.2: Enhance the communication activities of the NIOSH Oil and Gas Sector Program to more broadly and effectively share research results and recommendations.

Performance Measure 4.2.2-1: Develop a communications plan for the NIOSH Oil and Gas Sector Program by the end of 2016 that describes a process for communicating research findings to stakeholder groups.

Performance Measure 4.2.2-2: Conduct at least five seminars to share oil and gas research with NIOSH scientists and to encourage their participation in NIOSH oil and gas research activities by 2025.

Performance Measure 4.2.2-3: Meet with NIOSH scientists engaged in oil and gas research at least once annually to monitor project activity and to identify communication needs.

Activity/Output Goal 4.2.3: Use content strategy and information design principles to develop content for the NIOSH Oil and Gas Sector Program. Promote and market the web content using traditional and new media.

Performance Measure 4.2.3-1: Conduct a needs assessment to determine the appropriate content for the Program's webpages by 2016.

Performance Measure 4.2.3-2: Develop new web architecture for the Program using the existing NIOSH web plan by 2017.

Performance Measure 4.2.3-3: Develop and publish web content to populate new NIOSH Oil and Gas Sector Program webpages by 2017.

Performance Measure 4.2.3-4: Develop and implement a web promotion and marketing plan by 2018.

Activity/Output Goal 4.2.4: Promote the adoption of information and recommendations from NOISH oil and gas research to key stakeholder groups.

Performance Measure 4.2.4-1: Complete a promotion and marketing plan for the effective dissemination of NIOSH research (such as NIOSH E-news, web-based, social media, and press releases) by 2016.

Performance Measure 4.2.4-2: Promote and market each significant research product among appropriate stakeholder groups through identified health communication channels (PM 4.2.1-3).

Performance Measure 4.2.4-3: Conduct at least five web-based presentations for stakeholders describing new, significant NIOSH products no more than six month after publication.

Performance Measure 4.2.4-4: Evaluate the degree to which stakeholders have adopted and used NIOSH products and recommendations by 2020.

Activity/Output Goal 4.2.5: Develop and promote the adoption of occupational safety and health products that are scalable and appropriate for small companies.

Performance Measure 4.2.5-1: Identify key intermediaries (such as trade associations, safety organizations, and insurers) and invite their participation in a small business workgroup that will provide feedback to NIOSH on an annual basis starting in 2016.

Performance Measure 4.2.5-2: By 2020, use information collected from the small business workgroup and the results from the small business needs assessment (PM 1.8.1-1) to identify communication needs and effective methods for disseminating information to small businesses.

Performance Measure 4.2.5-3: Publish or otherwise disseminate via OSHA Alliance or partners, selected small business ready products for adoption by 2022.

Performance Measure 4.2.5-4: Evaluate small business products for their effectiveness in reaching small oil and gas businesses.

Evaluate Progress

To evaluate progress in accomplishing the goals contained in this strategic plan, the NIOSH Oil and Gas Sector Program's Steering Committee will undertake a mid-course review during 2020 and conduct a final evaluation in 2025. Early in the implementation of this plan, existing NIOSH projects and outputs will be reviewed and aligned with the strategic and activity/output goals contained in this plan. Any NIOSH oil and gas research projects that begin after this plan is published will incorporate the goals in this plan. Outputs (publications, recommendations, products, presentations, etc.) generated by projects contributing to the Program will be monitored and attributed to specific activity/output goals and performance measures whenever possible. These activities will help to document progress on activity/output goals using the defined performance measures, as well as progress toward the intermediate goals, which reflect impact in the workplace. In addition, a concurrent review will be conducted by key stakeholders in 2020 to provide comments on the progress of the Program and to offer input on any necessary mid-course corrections or modifications.

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Appendix

Select NIOSH Oil and Gas Exploration and Production Research Projects by Program Component and Year*			
Epidemiology & Surveillance	**Exposure Assessment**	**Control Technologies**	**Communications**
NIOSH Oil and Gas Research Workgroup (2012)			
Addressing occupational safety and health hazards in oil and gas drilling and servicing (2014)		Evaluation of an intervention to reduce collisions in light truck drivers (2013)	Toolbox training for oil and gas extraction workers (2010)
Enhancing Surveillance in the Oil and Gas E&P Industry (2014)	Dermal permeation of benzene from gasoline and crude oil: Current and historical issues (2015)		PPE Research to Practice in the oil and gas extraction industry (2007)
Use of fall protection equipment by oil and gas workers (2012)	Fracking: Toxicological effects of silica & diesel exhaust exposure (2014)		
Injury research in offshore oil and gas extraction industry (2012)	Chemical exposure assessment of onshore oil and gas workers (2013)		
Preventing fires and explosions in oil and gas extraction (2011)	Health effects of inhaled crude oil (2013)		
Motor vehicle safety: Best practices in the oil and gas extraction industry (2010)	Investigation of amines in crude oil and dermal exposure induced toxicity (2013)		
Preventing contact injuries to oil and gas extraction workers (2009)	Assessment of chemical exposures to oil and gas workers (2010)		
Reducing fatalities in the oil and gas extraction industry (2007)	UV native fluorescence based monitor for workplace exposures (2010)		
Sector-based case studies on cost-effective interventions (2011)	Immunochemical biomonitoring for worker exposure and disease (2005)		
*Indicates the year the project began. Projects funded at any point during the duration of this strategic plan (2016-2020) are shaded.			