Environmental Studies Program: Ongoing Study

Field	Study Information
Title	Pipeline Gas Release Frequency, Scenarios, and Impacts (AK-23-03)
Administered by	Alaska Regional Office
BOEM Contact(s)	Caryn Smith (caryn.smith@boem.gov)
Procurement Type(s)	Contract
Conducting Organization(s)	ABSG Consulting, Inc.
Total BOEM Cost	$200,566.84
Performance Period	FY 2023–2025
Final Report Due	March 2025
Date Revised	October 18, 2023
Problem	Information about pipeline gas release frequency and release scenarios is dispersed throughout peer reviewed and gray literature, and modeled scenarios specific to the Alaska Outer Continental Shelf (OCS) are unavailable. Impacts of natural gas releases to the environment are difficult to document or locate.
Intervention	This study will collate and synthesize existing technical information on U.S. onshore, offshore, and offshore OCS pipeline gas releases and their impacts to the environment. This study will also model pipeline gas release scenarios relevant to the Alaska OCS using readily available software models or mathematical algorithms.
Comparison	The results will support gas release scenarios used in National Environmental Policy Act (NEPA) assessments by modeling gas release, ignition, and explosion frequencies, spatial footprint of hazards using Alaska OCS relevant data, and synthesizing documented impacts to resources.
Outcome	The project will produce a synthesis report on historic onshore and offshore gas pipeline releases including documentation of impacts to the environment. This synthesis will include quantitative gas release information, such as release frequencies, or hazard footprints derived from modeling or mathematical algorithms, for use in gas release scenarios in Alaska OCS NEPA documents.
Context	All Alaska OCS areas

BOEM Information Need(s): Modeled gas pipeline release scenarios specific to the Alaska OCS are unavailable and impacts of natural gas releases are not well documented and consequently are difficult to locate in the literature. BOEM uses information about the general impacts of natural gas and natural gas release scenarios to estimate impacts in NEPA documents. Better information on natural gas impacts to the environment and quantitative scenario factors from gas pipeline release models or mathematical algorithms will facilitate informed and refined NEPA analyses of potential natural gas impacts. Frequency estimates are not readily available in the literature. This study will use historical gas release data and specific modeled pipeline gas release results relevant to the Alaska OCS to provide quantitative

information on U.S. onshore, offshore, or offshore OCS pipeline gas releases caused by small or large-scale punctures, ruptures, ignition and/or explosions. Finally, this study will synthesize documented impacts to resources from natural gas releases for use in impact analyses.

Background: Natural gas pipelines are associated with potential hazards and risks that can lead to a natural gas pipeline failure. Major causal factors for pipeline failure, such as third-party digging, may differ substantially for the Alaska North Slope, where population density is unusually low. Estimates used for quantitative scenario elements, such as the hazard area, are difficult to generate without modeling. Serious impacts can occur from the release, dispersion, fire, and/or explosion of natural gas. Fire and ignition of a gas release can increase the impact area, as compared to dispersion. Depending upon the circumstances and conditions, the type of open fire may vary. For example, ignited releases can produce jet fires, vapor cloud fires, or fireballs (Shan *et al*. 2020). Models or mathematical algorithms can be used with confidence to estimate the hazard distance or hazard area from a natural gas pipeline release.

The impacts of natural gas releases to the environment are not widely reported and are often located in incident reports produced by the regulatory agency. However, some information on the impacts of natural gas to resources is dispersed throughout the body of scientific and gray literature.

Objectives:

- Synthesize technical information on the frequency, spatial and temporal footprint, modeling, and consequences of historical U.S. natural gas pipeline releases.
- Estimate the frequency of occurrence of U.S. onshore , offshore, and offshore OCS natural gas pipeline releases or ruptures using relevant historical information from the Department of Transportation, Pipeline and Hazardous Materials Safety Administration and the Department of Interior, Bureau of Safety and Environmental Enforcement.
- Estimate the frequency of occurrence of onshore and offshore pipeline gas releases resulting in ignition, fire, and explosion for the Alaska North Slope and Cook Inlet regions. Discuss causal factors that are similar to or different from the onshore and offshore continental U.S.
- Utilize specific pipeline release scenarios and a software system to model the behavior, dispersion, ignition, fire, and explosion of natural gas in order to quantify the spatial and temporal footprint of the hazard.

Methods: Researchers will collect existing U.S. onshore and offshore pipeline natural gas release and impact information found in journal publications and gray literature reports produced by government, private sector, non-governmental, and academic entities, as well as information produced from regulatory agencies. Effort will focus on historical U.S. onshore, offshore, and offshore OCS pipeline gas releases, ignition, or explosion frequency, and spatial and temporal footprints. Researchers will identify the best readily available model(s) to test specific parameters of U.S. onshore or offshore OCS pipeline natural gas release or rupture and subsequent fire and or explosion (e.g., MMS 2009; Stephens *et al*. 2002). Using two to four pipeline scenarios developed with BOEM Alaska Regional Office the researchers will model specific input parameters. Products will include a technical summary reference for the frequency of onshore or offshore pipeline gas releases caused by small or large-scale punctures, ruptures, ignition and/or explosions, modeled scenario results, and quantitative parameters such as hazard area. Finally, this study will synthesize documented impacts to environmental, social, or economic resources from natural gas releases for use in impact analyses.

Specific Research Question(s):

1. What is the frequency of natural gas pipeline releases, and/or subsequent fire, and/or explosion?
2. Are there differences in frequencies of a natural gas pipeline release between U.S. onshore, offshore, and offshore OCS natural gas pipeline releases?
3. What modeled or calculated gas release parameters provide quantitative information to assess impacts from a natural gas release or rupture, ignition, and/or explosion from an onshore or offshore pipeline?
4. What are the documented impacts of natural gas releases or subsequent fire or explosion to the types of resources analyzed in BOEM NEPA documents?

Current Status: Ongoing, data analysis underway.

Publications Completed: N/A

Affiliated WWW Sites: http://www.boem.gov/akstudies/

References:

MMS [Prepared by S.L. Ross, Environmental Research Ltd., SINTEF and Wellflow Dynamics]. 2009. Assessing risk and modeling a sudden gas release due to gas pipeline ruptures. Herndon (VA): U.S. Department of the Interior, Marine Minerals Service. 93 p. https://www.bsee.gov/research-record/tap-607-assessing-risk-and-modeling-sudden-gas-release-due-gas-pipeline-ruptures.

Shan K, Shuai J, Yang G, Meng W, Wang C, Zhou J, Wu X, Shi L. 2020. Numerical study on the impact distance of a jet fire following the rupture of a natural gas pipeline. International Journal of Pressure Vessels and Piping. 187:104159. https://doi.org/10.1016/j.ijpvp.2020.104159.

Stephens MJ, Leewis K, Moore DK. 2002. A model for sizing high consequence areas associated with natural gas pipelines. In International Pipeline Conference; 2002 Sep 29–Oct 03; Calgary, Canada. 36207:759–767.