DATA REQUEST REFERENCE INFORMATION

Agency	Data Request Date	Letter Request No.
ADEC	May 12, 2022 (via e-mail)	RFI-690

REQUEST:

E-mail from Aaron Simpson (ADEC) to Lisa Haas (AGDC) on May 12, 2022 indicated:

The Department is requesting assistance in responding to public comments for AGDC's Liquefaction Plant construction permit submitted by Sara Laumann on behalf of the National Parks Conservation Association, Center for Biological Diversity, and Northern Alaska Environmental Center and by Jessica Winnestaffer on behalf of the Chickaloon Village Traditional Council.

Please provide a detailed evaluation of potential alternative control technologies for the flares, EUs 14 – 19, related to the technical feasibility of replacing the flares with thermal oxidizers/incinerators and capturing excess gas for use at the facility or other off-site locations. In this evaluation, please identify any control technologies associated with these types of emissions units (e.g., low NOx burners for thermal oxidizers/incinerators). Please see comments from NPCA including the Stamper Report.
If it is shown that other technologies are infeasible, or cost ineffective, please provide a flare minimization plan that indicates how AGDC proposes to limit flaring at the stationary source. Please indicate in the plan what practices will be used to reduce emissions during startups, shutdowns, process upsets, and other maintenance events. Areas that need to be addressed can be found in the Stamper Report. The Department intends to include the plan in the permit as enforceable conditions.

ALASKA LNG RESPONSE:

Clarification of Original Flaring Emissions Estimates

AGDC's permit application, as analyzed in ADEC draft permit, included maximum flaring emissions estimates for ground flares (EUs 14-19) that were conservative for purposes of modeling potential air quality impacts. This included the maximum flaring at 500-hr per unit per year operating limit. AGDC has previously provided the following clarifying information regarding the realistic maximum flaring events and operating design basis for flares.

- In AGDC October 9, 2020 response to ADEC's September 30, 2020 information requests (see AGDC RFI-685-ADEC-001 response), we stated the maximum relief events from the flares would occur infrequently and during upset conditions when other daily operating equipment would be shut down. Based on the major flaring load parameters, depressuring valving conditions, and flare capacities, the wet and dry flares cannot operate simultaneously. Given that, the real-world worst-case operating condition would be two dry flares operating concurrently with four power generation turbines. This would be less emissions than were estimated and modeled in AGDC's application Attachment 5 - Appendix D to Alaska LNG Resource Report 9 *Liquefaction Facility Air Quality Modeling Report*, which included the following conservative basis:

- All equipment located at the Liquefaction Facility is assumed to operate concurrently, even intermittently used equipment.
- Power generation turbines were modeled at maximum emissions rates and minimum temperature and velocity stack exit parameters.
- Even though flare relief events would only occur during maintenance or upset conditions, they were conservatively modeled as part of normal operations.

- In AGDC's response to ADEC email request on October 2, 2020, we confirmed the project design indicates that two ground flares (one wet and one dry) of the six total flares are spares and will not regularly operate. The spares will be brought online when the operational flares are taken offline for maintenance.
- Flaring event durations were also evaluated based on current design and operating constraints as part of the FERC EIS noise impacts for the Alaska LNG project. That evaluation clarified that routine Ground Dry flaring events would be less than 30 minutes per event and 2 events per year per train (see FERC RFI-466-RR09-031, FERC Docket Accession No. 20171201-5211(32556572)).

Flaring Design and Operating Basis Summary

Alaska LNG Project Facility will be provided with a Wet Ground Flare (x3), a Dry Ground Flare (x3) (EUs 14-19], and an elevated LP Flare (x1)[EU 20]. The flare systems will be common to three LNG liquefaction trains and supporting facilities.

The flare system will be installed to protect personnel and equipment from the potential hazards created by unexpected operating excursions as well as controlled reliefs during various operations (e.g., start-up, off-spec flaring etc.) from the LNG liquefaction trains and the supporting facilities. The design and operating basis do not include routine or continuous venting of gas to flare for general service disposal purposes.

The major flaring contingencies included in the current design considered multiple scenarios/cases for the dry and wet ground flares and LP flare. The maximum flaring load cases in terms of volumetric and vapor flow rates (lbs/hour) occur with the dry flares. Those cases include the following operating events:

- Mixed Refrigerant (MR) Compressor Blocked Outlet - blocked outlet on the MR Compressor in Train 1 + Train 2 start-up
- Propane Compressor Blocked Outlet - blocked outlet on the Propane Compressor in Train 1 + Train 2 start-up
- Start-up Flaring (@ 35% of Normal Flow) - assumed that during start-up, 35% of the normal flow to 1 LNG train will be routed to the Dry Flare from downstream of the Dehydration Unit

- Governing Case for Dry Liquids - For the purpose of sizing Dry Flare KO Drum, it is assumed that it may be required to route 35% of LNG from one train to the Dry Liquid Disposal for short term.

The design basis for maximum governing case for the dry flares is for the vapor flow rate associated with a blocked outlet on the Propane Compressor in Train 1 + Train 2 start-up at 35% of normal flow.

This was also the basis used in modeling and emissions estimates in Attachment 5 - Appendix D to Alaska LNG Resource Report 9 *Liquefaction Facility Air Quality Modeling Report*.

Wet Flare governing cases are as follows:

- Vapor Flow Rate (from both volumetric flow and radiation point of view): Control Valve Failure in HP Fuel Gas System.
- Liquid Flow Rate: 30 minutes of liquid accumulation in the Wet Flare KO Drum at peak condensate production rate.

LP flare governing cases as follows:

- Vapor flow rate (from both volumetric flow and radiation point of view): BOG Compressor Failure during Loading Mode.
- Liquid flow rate: 30 minutes accumulation of condensed liquids in the LP Flare KO Drum when C5+ vents from Condensate Storage and Loading are co-incident with another cryogenic load.

<u>Potential Alternative Control Technologies</u>

Based on the clarification and design/operating basis above, the flares are designed for emergency/safety uses and for periodic/intermittent uses such as start-up, shutdown, maintenance, and off-spec flaring. The most appropriate BACT measure for these flares is implementation of a flare gas minimization plan, described in the ADEC draft permit BACT analysis, and detailed in Attachment 1. The bases for excluding other proposed measures described in the BACT analysis are provided below.

Flare gas recovery

Flare gas recovery is designed to recover flare gases, rather than combust these streams at the flares themselves. Of all of the technologies considered, flare gas recovery is the most-effective control technology. It is the most effective because the combustion of the flare gases is reduced/avoided. This results in not only lower VOC emissions, but also other contaminant emissions, including NOx, CO, SO2, PM-10/-2.5 and GHGs.

Flare gas recovery is most effective for general service flares. General service flares combust both continuous and intermittent flare gas streams. Continuous streams could be from vapor recovery systems and vent streams specifically directed to the flare on a continuous basis. Flare gas recovery fails as a control technology when it is employed for flares providing control for emergency or intermittent events. Additionally, flare gas recovery is infeasible for gases high in nitrogen, which can contaminate fuel gas sources. For intermittent and emergency events, flare gas recovery provides little to no emissions control.

Flare gas recovery is not effective for emergency and intermittent flare gas systems because intermittent and emergency flows breach the water seal system that is necessary to create a closed system and back pressure for the flare gas recovery compressors to operate. During emergency and intermittent flaring, the water seal is breached and gases are safely directed to the flare for combustion.

Since the Alaska LNG Project flares are not designed for continuous use as control devices, flare gas recovery provides very limited to no emissions control. Flare gas recovery is therefore eliminated as an effective BACT control measure.

Thermal oxidizers and incinerators

Thermal oxidizers and incinerators are also effective in combusting waste gas streams that are more continuous and predictable in nature. However, they are not designed for the efficient combustion of gases under emergency or intermittent conditions where gas flows and composition fluctuate significantly. Furthermore, the VOC destruction efficiency of a thermal oxidizer or incinerator may be compromised under these transient conditions. For example, incinerators are a poor choice for combusting gases under fluctuating conditions, as there is the potential for venting of uncombusted gases during high flow conditions. Likewise, thermal oxidizers are designed to efficiently combust gases within a specific range of flow rates and composition. If that composition varies, particularly during emergency or other intermittent or other events, the destruction efficiency of the burner system can be compromised.

Flares have been selected for the Project because they are designed to efficiently combust emergency and intermittent waste gas flows under varying conditions that affect flow and flare gas composition. The other technologies are either ineffective or not optimal for flares in emergency/intermittent flaring service. The Alaska LNG project is not using the flares to dispose of continuous flare gas streams.

<u>Flare Minimization Plan</u>

To comply with BACT, AGDC proposes implementation of flare gas minimization techniques to minimize VOC emissions to the atmosphere. It is the most effective control technology considered in the top-down review. Flare gas minimization not only reduces VOC emissions to the atmosphere, but also prevents unnecessary emissions from other contaminants. AGDC proposes to implement the flare minimization measures described in Attachment 1 – *Flare Minimization Plan* (Rev 0).

ATTACHMENT:

1 - *Flare Minimization Plan* (Rev 0 - 3043-AIR-PLN-00002)

Public

Flare Minimization Plan

May 26, 2022

3043-AIR-PLN-00002

Alaska Gasline Development Corporation
3201 C Street, Suite 201
Anchorage, Alaska 99503
T: 907-330-6300
www.alaska-lng.com

REVISION HISTORY

Rev	Date	Description	Originator	Reviewer	Approver
0	May 26, 2022	For Use	C. Humphry, B. Leininger [082 exp]	L. Haas	F. Richards
Approver Signature*					

*This signature approves the most recent version of this document.

MODIFICATION HISTORY

Rev	Section	Modification

1. INTRODUCTION

The Alaska LNG Liquefaction Plant will utilize three flare gas systems (i.e., wet, dry, and low-pressure, EUs 14 - 20) to route relief vapors from separate sections of the plant into their respective flare collection headers. The wet flare gas system (EUs 15, 17, and 19) will control waste gas streams containing a significant concentration of water and heavier compounds. The dry flare gas system (EUs 14, 16, and 18) will be used for safe disposal of dry hydrocarbons streams discharged downstream of the dehydration unit. The low-pressure BOG flare gas system (EU 20) will be used for safe disposal of intermittent, low-pressure operational release from the LNG storage and loading system and intermittent maintenance purging of inert gas from LNG carriers. These flare systems prevent the direct relief to the atmosphere of vent gases that contain VOC and GHG (in the form of CH4). The flares will emit CO, NOx, SO2, particulates, VOC, and GHG

Applicability

In accordance with Alaska Department of Environmental Conservation (ADEC) Air Quality Construction Permit No. AQ1539CPT01 Best Available Control Technology (BACT) determination, implementation of Flare Minimization Plan is required for controlling CO, NOx, SO2, particulates, VOC, and GHG emissions. The plan will apply to the following emissions units:

EU No.	Description	Fuel	Rating/Max Capacity
14	Dry Ground Flare #1	Fuel Gas/Process Gas	55,000 Mscf/hr
15	Wet Ground Flare #1	Fuel Gas/Process Gas	13,000 Mscf/hr
16	Dry Ground Flare #2	Fuel Gas/Process Gas	55,000 Mscf/hr
17	Wet Ground Flare #2	Fuel Gas/Process Gas	13,000 Mscf/hr
18	Dry Ground Flare #3	Fuel Gas/Process Gas	55,000 Mscf/hr
19	Wet Ground Flare #3	Fuel Gas/Process Gas	13,000 Mscf/hr
20	Elevated Low Pressure Flare	Fuel Gas/Process Gas	990 Mscf/hr

Purpose

Flare gas minimization techniques are commonly employed at oil and gas, refining, and petrochemical facilities. New Source Performance Standard (NSPS) Subpart Ja regulates flaring at petroleum refineries. This NSPS requires refineries to prepare and submit for review by the Administrator a Flare Gas Management Plan detailing the procedures a facility will implement to minimize flare emissions to the atmosphere.[1] Additionally, state and local air pollution control rules require preparation and implementation of Flare Gas Minimization Plans.[2] AGDC proposes to implement the following plan to minimize flaring, similar the measures employed by these federal, state, and local air pollution control standards.

[1] See 40 CFR 60.103a(a)

[2] For example, see SCAQMD Rule 1118, BAAQMD Regulation 12, Rule 11, and SJVAPCD Rule 4311.

Current Design Basis

The current flaring design basis is outlined as follows and is subject to updates during the final design process prior to construction and operations.

The flare system will be installed to protect personnel and equipment from the potential hazards created by unexpected operating excursions as well as controlled reliefs during various operations (e.g., start-up, off-spec flaring etc.) from the LNG liquefaction trains and the supporting facilities. The design and operating basis do not include routine or continuous venting of gas to flare for general service disposal purposes.

The major flaring contingencies included in the current design considered multiple scenarios/cases for the dry and wet ground flares and LP flare. The maximum flaring load cases in terms of volumetric and vapor flow rates (lbs/hour) occur with the dry flares. Those cases include the following operating events:

1. Mixed Refrigerant (MR) Compressor Blocked Outlet - blocked outlet on the MR Compressor in Train 1 + Train 2 start-up
2. Propane Compressor Blocked Outlet - blocked outlet on the Propane Compressor in Train 1 + Train 2 start-up
3. Start-up Flaring (@ 35% of Normal Flow) - assumed that during start-up, 35% of the normal flow to 1 LNG train will be routed to the Dry Flare from downstream of the Dehydration Unit
4. Governing Case for Dry Liquids - For the purpose of sizing Dry Flare KO Drum, it is assumed that it may be required to route 35% of LNG from one train to the Dry Liquid Disposal for short term.

The design basis for maximum governing case for the dry flares is for the vapor flow rate associated with a blocked outlet on the Propane Compressor in Train 1 + Train 2 start-up at 35% of normal flow.

Wet Flare governing cases are as follows:

5. Vapor Flow Rate (from both volumetric flow and radiation point of view): Control Valve Failure in HP Fuel Gas System.
6. Liquid Flow Rate: 30 minutes of liquid accumulation in the Wet Flare KO Drum at peak condensate production rate.

LP flare governing cases as follows:

7. Vapor flow rate (from both volumetric flow and radiation point of view): BOG Compressor Failure during Loading Mode.
8. Liquid flow rate: 30 minutes accumulation of condensed liquids in the LP Flare KO Drum when C5+ vents from Condensate Storage and Loading are co-incident with another cryogenic load.

Operability and Maintainability Requirements

Planned maintenance shutdowns (turnarounds) will be scheduled and coordinated across Project facilities (e.g., GTP, Mainline, LNG Plant) to maximize overall Project availability.

Piping, valving, and equipment will be designed to allow safe and effective isolations when making the necessary preparations for maintenance work. Vents and drains will be provided that allow for safe and effective depressurizing, draining, and purging of equipment.

Facilities will be designed to minimize the risk of upset conditions, and will also include the means of safe, easy, and quick mitigation or recovery should an upset condition occur (e.g., the ability to recover quickly from unplanned compressor trip).

Operating procedures will be developed during the construction phase of the project.

Flare Minimization Procedures

A. Pilot and Purge Gas Optimization

The only continuous combustion at the flares is from pilot and purge gases. Pilot and purge gas emissions can be substantial if the flows are not optimized. AGDC proposes to work with the flare manufacturers to optimize these continuous flows. Purge gas flows shall be minimized to the extent feasible to prevent oxygen intrusion into the flare gas system. AGDC will confirm the settings for pilot and purge gases upon start-up, and as needed to prevent oxygen intrusion in the flare gas system.

B. Start-up and Shutdown Flaring

The process of starting up and shutting down equipment for turnaround and other maintenance activities will require the facility to de-pressure equipment to the flare. The volume of gases flared can be reduced through proper planning and consolidation of activities requiring start-ups and shutdowns. To the extent feasible, AGDC will consolidate maintenance events to reduce the volume and duration of flaring activities. Flaring during major facility maintenance activities or turnarounds will be planned so that flaring durations and volumes are minimized.

C. Intermittent Flaring from Maintenance and Other Operations

During operations, it will be necessary to flare process gas to reduce the operating pressure on equipment. To the extent feasible, AGDC will minimize gas volumes by isolating and depressurizing process areas subject to maintenance operation, and redirect/recover gases to the operating process prior to blowing down the equipment to the flare.

D. Plant Imbalances

Occasionally, the facility will be subject to fuel gas and other production imbalances. These conditions will require the temporary flaring of fuel, natural gas, and/or LNG. AGDC proposes to minimize these imbalances by slowing production rates and making other adjustments necessary to reduce the duration of these transient conditions.

E. Unplanned Flaring

Unplanned flaring can occur from process upsets and emergency conditions. AGDC will prepare and follow operating procedures for specific unplanned events, including possible equipment malfunctions. These procedures will incorporate flare minimization techniques to address duration and volume of gases flared. To further reduce flaring from unplanned events, AGDC proposes to implement the following procedure for all unplanned events resulting in the combustion of 500,000 scfd or more of gas in any 24-hour period. The threshold for implementing this procedure is based on NSPS Subpart Ja requirements.

1. AGDC will conduct a Root Cause Analysis (RCA) and Corrective Action Analysis (CAA) for the event. The RCA and CAA will be conducted no later than 45-days after the discharge to the flare occurs. The RCA will evaluate the circumstances and causes for the flaring and the CAA will identify the procedural and equipment changes that will be made to minimize and/or avoid the event in the future.
2. Appropriate corrective actions identified in the CAA shall be implemented within the 45-days of the event. If certain corrective actions cannot be completed within the 45-day period, AGDC shall develop and implement a schedule to complete the corrective action(s) as soon as possible. If AGDC concludes that specific corrective actions should not be implemented, AGDC shall record as part of the CAA the reasons why such action(s) do not need to be taken.
3. AGDC shall document all RCAs and CAAs and retain them for a period of five-years. Records of RCAs and CAAs shall be made available to ADEC upon request.

An RCA and/or CAA will not be prepared for flaring caused by fuel gas/process gas imbalances, planned start-ups, shutdowns, or due to planned de-pressuring of equipment for maintenance or other process conditions. During planned events, including start-up and shutdown, AGDC is required to minimize flaring emissions to the extent feasible as described above in this plan.