U.S. Department
of Transportation

Pipeline and Hazardous Materials
Safety Administration

1200 New Jersey Ave., SE
Washington, DC 20590

JUL 16 2010

**CERTIFIED MAIL – RETURN RECEIPT REQUESTED [7009 1410 0000 2472 2674]**

Ms. Lisa M. Tonery
Fulbright & Jaworski L.L.P.
666 Fifth Avenue, 31st Floor
New York, NY 10103-3198

**RE: Request for Written Interpretation on the Applicability of 49 C.F.R. Part 193 to Proposed LNG Import Terminal in Robbinston, Maine**

Dear Ms. Tonery:

As counsel for Downeast LNG, Inc. (Downeast or the Company), you have asked for a written interpretation on two questions related to your client's proposal to build a liquefied natural gas (LNG) import terminal in the town of Robbinston, Maine (Robbinston LNG Import Terminal or the Terminal). Specifically, you have asked whether Downeast may use its alternative source term model (DLNG Source Term Model) to comply with the vapor-gas exclusion zone requirements in 49 C.F.R. § 193.2059. You have also asked whether the Company must examine the effects of jetting and flashing to comply with those same requirements.

Under the conditions described in this letter, Downeast may use the DLNG Source Term Model to calculate the vapor-gas exclusion zone for the sumps at the Robbinston LNG Import Terminal. The Company must also examine the effects of jetting and flashing in siting appropriate facilities at the Terminal, including pressurized piping or equipment, to comply with our vapor-gas dispersion exclusion zone requirements.

Question 1

The Pipeline and Hazardous Materials Safety Administration (PHMSA) issues federal safety standards for siting LNG facilities.[1] Those regulations require that an operator or governmental authority control the activities that occur within a specified distance around the facilities at an LNG plant, to protect the public from unsafe levels of thermal radiation and flammable vapor-gas dispersion in the event of an accident. Certain mathematical models and other parameters must be used to calculate the dimensions of these "exclusion zones."

In the case of vapor-gas dispersion, two different computational models are already authorized for use by regulation: (1) the DEGADIS Dense Gas Dispersion Model (DEGADIS), a model developed by the U.S. Coast Guard and Gas Research Institute (GRI) to simulate the downwind

[1] Pipeline Safety Act of 1979, Pub. L. No. 96-129, § 152, 93 Stat. 989 (1979) (currently codified at 49 U.S.C. § 60103(a)).

dispersion of dense gases in the atmosphere, and (2) FEM3A, another dispersion model designed "to account for additional cloud dilution which may be caused by the complex flow patterns induced by tank and dike structure."[2]

Downeast intends to calculate the vapor-gas dispersion exclusion zone for the Robbinston LNG Import Terminal with DEGADIS, an integral model that requires the user to input a "source term." The source term is designed to simulate the physical phenomena that occur immediately after an LNG release, but prior to atmospheric dispersion.[3]

You have asked whether the Company may use a new source term model, the DLNG Source Term Model, to perform the exclusion zone analysis for the sumps at the Terminal. You state that this new model uses conservative assumptions for the effects of pool spreading, vapor production, and vapor retention. In your opinion, that makes it suitable for use with DEGADIS under our regulations.

The source term used as the input for DEGADIS must have a suitable basis to comply with our Siting Requirements. "Otherwise, a user could select whatever source term is likely to produce the most favorable outcome, e.g., the smallest or largest possible exclusion zone, or even at random."[4] Such a result would not be consistent with the limitations of DEGADIS or our statutory obligation to protect the public from the hazards associated with an LNG plant. For these reasons, the utmost care must also be exercised in evaluating the suitability of any such model, a task that involves "making predictions, within [PHMSA's] area of special expertise."[5]

We further note that the proponent of an alternative source term model previously had to petition for, and receive, the Administrator's approval to use that model to comply with our vapor-gas dispersion exclusion zone requirements.[6] However, our predecessor agency repealed that requirement in a March 2000 final rule.[7] Consequently, the Administrator's approval is no

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[2] 49 C.F.R. § 193.2059 (2010). The Administrator may also approve the use of alternative vapor-gas dispersion models that "take into account the same physical factors and have been validated by experimental test data." 49 C.F.R. §§ 193.2057(a), 193.2059(a); 49 C.F.R. § 190.11 (2010) (authorizing the submission of petition for finding or approval with the Administrator).

[3] Ivings, et al., LNG Source Term Models for Hazard Analysis: A review of the State-of-the-Art and an Approach to Model Assessment, p. vi (Mar. 2009) (on file with PHMSA).

[4] *In the Matter of Mssrs. Keppel and Miozza*, PHMSA Interp. (July 7, 2010) (to be available at www.phmsa.dot.gov).

[5] *Baltimore Gas and Electric Company v. Natural Resources Defense Council*, 462 U.S. 87, 103 (1983); *see Wisconsin Electric Power Company v. Costle*, 715 F.2d 323, 329 (7th Cir. 1983) (upholding EPA's use of a particular dispersion model and stating that its "choice to rely on an air quality model is a policy judgment deserving great deference.").

[6] Liquefied Natural Gas Facilities; New Federal Safety Standards, 45 Fed. Reg. 9184 (Feb. 11, 1980); Liquefied Natural Gas Facilities; Reconsideration of Safety Standards for Siting, Design, and Construction, 45 Fed. Reg. 57402, 57418 (Aug. 28, 1980) (denying, in part, and granting, in part, a petition for reconsideration); *see In the Matter of Energy Terminal Services Corporation*, PHMSA Interp. 82-05-28 (May 28, 1982); *In the Matter of Mr. George H. Lawrence, President, American Gas Association*, PHMSA Interp. 83-06-29 (June 29, 1983); *see also* Liquefied Natural Gas Regulations—Miscellaneous Amendments, 62 Fed. Reg. 8402, 8404 (Feb. 25, 1997) (amending 49 C.F.R. § 193.2059(d)(1)(ii)).

[7] Pipeline Safety: Incorporation of Standard NFPA 59A in the Liquefied Natural Gas Regulations 65 Fed. Reg. 10950, 10953 (March 1, 2000).

longer an absolute prerequisite to using an alternative source term model with DEGADIS under our Siting Requirements.[8]

In our opinion, the DLNG Source Term Model can be used with DEGADIS to calculate the vapor-gas dispersion exclusion zones for the sumps at the Robbinston LNG Import Terminal. Downeast has demonstrated, through the use of a parametric analysis, that an instantaneous pool spreading scenario across these particular sump floors will produce the longest flammable vapor-gas cloud. The Company has also shown that its heat transfer methodology is appropriate. As confirmed in the documents submitted with your letter, that methodology "assum[es] perfect thermal contact between [the] pool and [the] ground, and only vertical temperature gradients in the ground," and the conduction is modeled "by the one-dimensional Fourier conduction equation in the ground, with an initial state where the ground is uniformly at ambient temperature, and assumes the boiling temperature of LNG as soon as the spreading pool reaches" the sump floor. Finally, the model conservatively assumes that none of the produced vapors is retained by the sump walls.

These conservative assumptions provide the model with a suitable basis for use in this particular application. Accordingly, we conclude that the DLNG Source Term Model can be used with DEGADIS to calculate the vapor-gas dispersion exclusion zones for the sumps at the Robbinston LNG Import Terminal.[9]

Question 2

The phenomena known as jetting and flashing can occur if pressurized piping or equipment fails. Jetting can cause released LNG to propel beyond an impoundment system, or result in fragmentation and formation of aerosols. It can also erode earthen dikes, expose equipment to cryogenic liquids, or project LNG or its vapors onto adjacent properties. Flashing is the instantaneous vaporization of released LNG due to exposure ambient pressure and temperature. Like jetting, it can cause fragmentation and formation of aerosols and project vapors onto adjacent properties. Understanding the effect of these phenomena is important to public safety, as they can create hazards (e.g., cascading failures, the loss of containment, and the instantaneous formation of a vapor-gas cloud) that are capable of affecting offsite properties and activities.

You state that Downeast has not considered jetting and flashing in siting the Robbinston LNG Import Terminal, because the "Part 193 Subpart B LNG Requirements do not speak to either flashing or jetting and flammable vapor production rate in the event of an LNG leak." You have asked PHMSA for an opinion to that effect, namely, that "[j]etting and flashing are not to be considered with respect to the exclusion zone analysis of 49 CFR Section 193.2059." Contrary to your position, we conclude that these phenomena should be considered in appropriate cases.

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[8] As in the case of Downeast, those seeking to use an alternative source term model with DEGADIS may obtain an interpretation from this agency on the suitability of such a model. 49 C.F.R. § 190.11 (2010).

[9] Our opinion on the suitability of the DLNG Source Term Model only applies to the sumps and does not address the adequacy of the exclusion zone analyses performed for any other area at the Robbinston LNG Import Terminal.

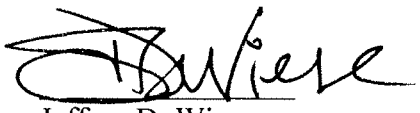
The source term model used as the input for DEGADIS must have a suitable basis to comply with our vapor-gas exclusion zone requirements. In the case of jetting and flashing, there is no dispute that a failure of pressurized piping or equipment may cause LNG to vaporize in the air. Using a source term model that ignores that effect (or any other phenomena that has a similar influence on the discharge, vaporization, or conveyance of LNG) could distort the downwind dispersion of vapor gas and compromise the integrity of an operator's exclusion zone analysis. Such a result would not ensure that the siting of an LNG facility occurs in a manner consistent with our statutory obligations. Consequently, a source term model should account for the effects of jetting and flashing in appropriate cases, including where a design-spill scenario involves a failure of pressurized piping or equipment.

Consideration of jetting and flashing might also be required outside the confines of an exclusion zone analysis.[10] For example, steps must be taken to ensure that any released LNG is retained within the limits of plant property.[11] That includes "grad[ing], drain[ing], or provid[ing]" certain areas "with [an] impoundment" to reduce "the possibility of accidental spills and leaks that could endanger important structures, equipment, or adjoining property or that could reach waterways."[12] Similarly, site-specific factors that have a bearing on the safety of plant personnel or the surrounding public must be evaluated in siting an LNG facility, and appropriate responsive safety measures must be incorporated into the design or operation of that facility.[13] However, as you did not request an interpretation of these or any other provisions, we simply note in closing that an operator must demonstrate that a new LNG facility complies with our Siting Requirements.[14]

Conclusion

Downeast may use the DLNG Source Term Model to calculate the vapor-gas exclusion zone for the sumps at the Robbinston LNG Import Terminal. The Company must also examine the effects of jetting and flashing in calculating the vapor-gas dispersion exclusion zone for any appropriate LNG facilities, including pressurized piping or equipment, to comply with the Siting Requirements in Subpart B of 49 C.F.R. Part 193.

Sincerely,



Jeffrey D. Wiese
Associate Administrator
for Pipeline Safety

[10] 49 C.F.R. § 193.2051 (2010).

[11] 2001 NFPA 59A, 2.1.2.

[12] 2001 NFPA 59A, 2.2.1.2.

[13] 2001 NFPA 59A, 2.1.1(d).

[14] *See e.g.*, 5 U.S.C. § 556(d); *Schaffer v. Weast*, 546 U.S. 49, 56-57 (2005).

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May 10, 2010

MAY 11 2010

Jeffrey D. Wiese
Associate Administrator for Pipeline Safety
PMHSA
U.S. Department of Transportation
1200 New Jersey Avenue, SE
Washington, DC 20590-0001

**Re: Request for Interpretation of 49 CFR Part 193**

Dear Mr. Wiese:

Downeast LNG, Inc. (Downeast LNG) has an application pending before the Federal Energy Regulatory Commission (FERC) in Docket No. CP07-52-000 for authorization to site, construct and operate a liquefied natural gas (LNG) import terminal and associated natural gas pipeline in Washington County, Maine. In conjunction with that pending application, pursuant to 49 CFR Section 190.11(b)(1), we are requesting an interpretation of the Part 193 Subpart B LNG Facilities Federal Safety Standards Siting Requirements. Specifically, we seek a written interpretation concerning 49 CFR Section 193.2059 for the items set forth below.

**Flammable Vapor Source Term**

By way of background, in an effort to develop LNG dispersion model evaluation tools for the NFPA 59A Committee, the Fire Protection Research Foundation (FPRF) funded research on LNG spill source term modeling and, in March, 2009 its findings were included in a report entitled "LNG Source Term Models for Hazard Analysis: A Review of the State-of-the-Art and an Approach to Model Assessment". The report presented a methodology for assessing the suitability of LNG source term models used in determining pool spread and vaporization. The report concluded that the SOURCE model generally used within the LNG industry, and which was also used by Downeast LNG in its initial determination of flammable vapor dispersion Exclusion Zones, could result in under-prediction of hazard distances in some cases because it does not accurately represent:

- Pool spreading and the resulting flammable vapor "flashing", and
- Vapor accumulation within impoundments,

Downeast LNG has prepared a source term calculation that addresses these specific concerns and provides input to the DEGADIS Dense Gas Dispersion Model that is specified in 49 CFR 193.2059. A copy of the calculation (previously filed with FERC on October 30, 2009) is

attached to this letter (see Appendix 1, "*Thermal Radiation and Vapor Dispersion Calculations for Downeast LNG*") and the following summarizes how Downeast LNG has addressed the particular concerns raised by the FPRF:

***Pool Spreading and Flammable Vapor Production***

The SOURCE5 pool spreading model on land uses an adaptation of a fairly standard model for spreading on water. However, it has been known since the mid 1980s to have no justification for spreading on land[1]. In order to overcome this limitation, the approach proposed by Downeast LNG has considered a range of spreading speeds across the sump floor, including instantaneous spreading to identify the speed that generates the longest ignitable vapor cloud using DEGADIS. In its calculation filed with the FERC on October 30, 2009, Downeast LNG stated that the instantaneous spreading scenario is the most conservative since it would result in the longest ignitable vapor cloud. Downeast confirmed this assumption by parametrically varying the LNG spreading speed to calculate the rate of evaporation over time. A copy of the parametric analysis and associated findings is attached to this letter (see Appendix 2, "*Downeast LNG – Parametric Study of the Sensitivity of the Vapor Dispersion Distance to the Rate of Spreading of LNG in a Sump*").

As the pool spreads, it cools the ground below it. Initially (at least) by far the dominant mode of heat transfer to a cryogenic pool spilt on land is conduction from the solid ground below. As the pool spreads over the area of the sump, the ground beneath it will cool very rapidly, and the heat flux into the pool will decrease with time. The FPRF report found the SOURCE5 method of quantifying the rate of evaporation unclear based on an edition of the TNO Yellow Book which had long been superseded. In the method proposed by Downeast LNG, the heat transfer to the spreading confined pool has been calculated assuming perfect thermal contact between pool and ground, and only vertical temperature gradients in the ground. The conduction has been modeled by the one-dimensional Fourier conduction equation in the ground, with an initial state where the ground is uniformly at ambient temperature, and assumes the boiling temperature of LNG as soon as the spreading pool reaches it. This is considered a good model in the early stages of the spill when rates of evaporation are high according to the FPRF report.

***Flammable Vapor Retention***

The SOURCE5 model defines the source of vapor to be precisely zero until the liquid depth, plus the depth of vaporized (but undiluted) LNG, becomes equal to the height of the dike wall. This is not credible if there is any wind at all. Furthermore, air entrainment and mixing during the evaporation process will also dilute the LNG vapors. For these reasons, the calculation prepared by Downeast LNG does not take credit for any vapor retention or hold-up within the sump. This approach results in an earlier release of vapors at a time when the rate of evaporation

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1 Model Assessment Report on SOURCE5 Version 5 revision 1. LNG Source Term Models for Hazard Analysis: a Review of the State-of-the-Art and an Approach to Model Assessment, *Final Report,*" Prepared by: Dr D.M. Webber, Dr S.E. Gant, Dr M.J. Ivings and S.F. Jagger, Health & Safety Laboratory, March 2009.

is at its highest and higher than the rate of evaporation when the vapors begin to spill out of retention in the SOURCE5 model. In reality, sump walls do provide some degree of vapor retention and hold-up. Therefore, the method used by Downeast LNG results in a rate of vapor formation that is larger than would be expected in reality.[2]

**Jetting and Flashing**

In the Draft Environmental Impact Statement (DEIS) issued by FERC for the Downeast LNG project in May 2009, FERC included a condition that requires Downeast LNG to "examine provisions to minimize any effects from flashing or jetting on the downward dispersion distance of vapor from a release from pressurized piping at the LNG terminal."[3]

The previously referenced FPRF study considered jetting and flashing and its report states that a leak from a pressurized pipeline may lead initially to jetting of the liquid, and if the jet is unobstructed, a large fraction of the LNG may vaporize in the air before the liquid rains out and forms a pool. The FPRF report also states that the nature of the jet, and hence the amount of vaporization from the jet, will depend upon the ambient temperature, the pressure and temperature of the LNG, the initial velocity of the liquid, the orifice size and shape, the fluid trajectory, atomization of the liquid spray, and the entrainment rate of fresh air.

Notably, since the Part 193 Subpart B LNG Siting Requirements do not speak to either flashing or jetting and flammable vapor production rate in the event of an LNG leak the Downeast LNG application did not specifically address the considerations in its design.

**Request for Interpretation of 49 CFR Part 193**

Downeast LNG is requesting an interpretation that:

(1) Use of the foregoing methodology as summarized above and described in greater detail in Appendices 1 and 2 is consistent and in compliance with 49 CFR Section 193.2059; and

(2) Jetting and flashing are not to be considered with respect to the exclusion zone analysis of 49 CFR Section 193.2059.

Downeast LNG respectfully requests that the above-requested guidance be provided at the earliest date possible so that the Downeast LNG project may move forward in the FERC

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2 See p. 14 Model Assessment Report on SOURCE5 Version 5 revision 1, Ref. No. *CE5/04 MAR/HSL/SOUR*, Version 4 February 2009, in Appendix A of "LNG Source Term Models for Hazard Analysis: a Review of the State-of-the-Art and an Approach to Model Assessment, *Final Report*," Prepared by: Dr D.M. Webber, Dr S.E. Gant, Dr M.J. Ivings and S.F. Jagger, Health & Safety Laboratory, March 2009

3 See Downeast LNG DEIS Condition 40 (May 2009).

permitting process. To that end, please feel free to contact the undersigned with any questions concerning the foregoing.

Respectfully submitted,

Lisa M. Tonery
*Attorney for Downeast LNG, Inc.*

Attachments

cc: Charles Helm
Keith Coyle
Terry Turpin
Dean Girdis
Arthur Ransome
Harri Kytomaa