June 29, 1983

Mr. George H. Lawrence
President, American Gas Association
1515 Wilson Boulevard
Arlington, VA 22209

Dear Mr. Lawrence:

I have considered the objections raised in your letters of January 31 and March 18, 1983, about matters contained in our earlier correspondence with the Energy Terminal Services Corporation (ETSC) and the ETSC Draft Guidelines.

In short, I must affirm the position Acting Associate Director Judah took in his May 28, 1982, letter to ETSC regarding proper application of the Appendix B model referenced in 49 CFR 193.2059. The reasons for my decision are in the enclosed memoranda prepared by my staff which discuss Exhibits I and II to your March 18 letter.

I am nonetheless concerned about the potential impact of §193.2059 on future changes at existing LNG plants. The current regulation was intended to account for the uncertain effects of LNG spills. As we gain more knowledge about these effects, as alternative, more appropriate safety standard might be developed for particular applications. I am hopeful that the research we have initiated (see enclosed "Response to Exhibit I") to which others may contribute will help us reach that goal.

I would be pleased to meet with you, or your representative, to discuss the ongoing research project or other aspects of this matter.

Sincerely,

Richard L. Beam
Associate Director for
Pipeline Safety Regulation
Materials Transportation Bureau

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RESPONSE TO EXHIBIT 1

Background

In its letter of May 28, 1982, to ETSC, the Materials Transportation Bureau (MTB) clarified the use of the Appendix B model that is intended by §193.2059. As discussed in the preamble to the final rule (45 FR 9195), MTB stated that the model applies only to a hypothetically continuous spill and not to a finite or 10-minute spill. A continuous spill was said to be one "that lasts at least until vapor overflows the dikes." MTB further stated that under §193.2059(d), the 10-minute spill provision is only intended for use with a modified version of the Appendix B model or another alternate mathematical model, either of which would be subject to the Director's approval. The letter explained that ETSC's insertion of a zero value in the Appendix B model to represent the vaporization overflow rate at the time of overflow was an invalid application of the model, since, among other things, it would be erroneous to conclude that after vaporization has stopped, flammable vapor would not leave the diked area.

In Exhibit I there are two major points of argument. The first point is that the 10-minute spill provision of §193.2059 may logically be used with the Appendix B model, in keeping with the plain meaning of the rule.

The second major point is that provisions in §193.2059(d) for determining vaporization rate are eliminated by the recent MTB statement "that the vaporization rate remain constant and equal to the entire spill rate as though 100% of the liquid vaporizes instantaneously." The origin of this statement is not given, but it apparently lies in the ETSC Draft Guidelines.

Continuous vs. 10-minute spill

The American Gas Association (AGA) assumes it is proper to apply the 10-minute design spill allowed by §193.2059(d) to the Appendix B model by arguing that to require the use of a continuous design spill conflicts with the plain meaning of the regulation. AGA says this meaning is indicated by (1) the opening clause of §193.2059(d), which links the criteria of paragraph (d) to the computation required by paragraph (c); (2) the minimum 10-minute spill time permitted by paragraph (d); and (3) the reference in §193.2059(d)(1)(iii) to termination of spill flow.

AGA further says that requiring a maximum rate of vapor overflow, as would result from a continuous spill with instantaneous vaporization, is an extreme position that "does not reflect reality." Alternatively, AGA proffers a volumetric expansion approach to determining the rate of vapor overflow for use with the Appendix B model where impoundment design provides excess capacity to detain vapor from a 10-minute spill.

The Appendix B model, as an acceptable existing model, was adopted for general application in determining dispersion distance under §193.2059. At the same time, other more sophisticated models were expected to be developed on the basis of new technical information. Therefore, under §193.2059(c), operators were given the alternative of using either the Appendix B model or some alternative model approved by MTB. This point is discussed in the preamble to the final rule.

The preamble to the final rule also makes clear that the Appendix B model was broadly recognized as applicable only to continuous design spills:

> "The model proposed in the NPRM [Appendix B] was also widely criticized. Its ability to provide for only continuous spills, rather than sudden spills and spills of finite duration, was viewed as a particular limitation." (p. 9195).

The need to somehow modify the Appendix B model for proper application to finite, or 10-minute spills, was also recognized. This is illustrated in the preamble to the final rule with the observations:

> "[O]ne commenter contended that it [Appendix B] could be used if the method is modified to allow for finite spills. . . . [T]he MTB believes that modifications will allow for finite spills, but even if distance is based on a continuous spill, results will not be significantly different." (p. 9195) (This closing evaluation was predicated on vapor continuing to evolve at a relatively high rate from entrained LNG, even if spillage has stopped, as would be the case with designs then existing or being contemplated).

Even one of the two documents submitted by ETSC for MTB review, "Analysis of Vapor Fence Effectiveness in Limiting Dispersion Hazard Zones," by Arthur D. Little, Inc., (the firm that produced the model) states: "The vapor dispersion model described in the Regulations is, unfortunately, not applicable to the dispersion from a vapor fence retaining a confined vapor volume." (p. 13). This clearly shows the model was not designed for finite spills.

In arguing the meaning of §193.2059, AGA overlooks the words in Appendix B, itself. The description of the model in Appendix B clearly implies that a design spill must be continuous, or last until saturated vapor overflow begins. Appendix B provides:

> "Liquid accumulates on the dike floor, and the evolved dense methane vapor blanket grows in thickness. As it does so, air, originally in the dike, is displaced. When the dike is full of the cold, saturated methane vapor, any further vaporization results in overflow and mixing with the prevailing wind. It is the purpose of the vapor dispersion model to estimate downwind vapor concentrations <u>after</u> vapor overflow has occurred."

This description plainly reveals that the authors of the model had a continuing process in mind. In this process, liquid from a hypothetical spill of LNG "accumulates on the dike floor" while the "vapor blanket grows in thickness". The spillage and vaporization go on until the "dike is full of cold, saturated vapor", and further vaporization results in overflow. There is no reference to spill termination. The clear implication, therefore, is that the spill and associated vaporization of liquid continue uninterrupted until vapor overflow occurs. Thus, the model was broadly recognized as a "continuous spill" model.

Furthermore, the stated purpose of the model (i.e., to estimate downwind vapor concentrations <u>after</u> vapor overflow has occurred) reinforces its conceptual character. This purpose cannot be achieved by applying the model to finite design spills that would completely vaporize before vapor overflow occurs, as ETSC has proposed to do.

AGA now argues with determination in contradiction of its earlier views. In its comments to the Notice of Proposed Rulemaking (44 FR 8142), AGA, while recommending adoption of the Appendix B model as an option in the final rules, recognized that this model is applicable only to continuous spills. It cited this limitation as a significant criticism, specifically commenting that the proposed model is only "for a continuous source." Further, AGA commented that the authors have stated in publications that the model is intended for a " spill produced by a continuous source, such as a piping failure." Comments on the notice by one of the authors of the model, Drake, also acknowledged this limitation.

The continuous spill feature of the Appendix B model was also apparent in the Notice of Proposed Rulemaking. There, in the text of a proposed §193.109 (later adopted as |193.2059), the Appendix B model was set forth without any proposed alternative, and the vaporization rate for design spills from an assumed pipe failure was specified without regard to spill termination. In addition, the continuous spill nature of the Appendix B model was recognized in open discussion at a public meeting of the Technical Pipeline Safety Standards Committee held in Cambridge, Massachusetts, June 12-15, 1979, for purposes of considering the reasonableness of the proposed rule.

MTB intended, therefore, that the Appendix B model apply only to an assumed continuous spill, and the final rule was made with full disclosure of this continuous spill limitation. Consequently, AGA's argument that a 10-minute spill may be applied to the Appendix B model is an outcome that was not contemplated when §193.2059 was developed.

AGA is correct is stating that paragraphs (d)(1)(i) and (d)(1)(iii) apply in whole or part to a time limited spill. If not Appendix B, to what models, then, do the finite spill provisions of these subdivisions apply? Although obscured by admittedly troublesome drafting, it is apparent from the record that these limited spill conditions were designed to apply to alternative models allowed by §193.2059(c). This is evident from (1) the fact that the notice did not propose the use of a finite design spill resulting from failed transfer piping, and (2) the discussion in the preamble of the final rule that alternative models or a modified Appendix B model might be used to predict dispersion from finite spills. A finite design spill of not less than 10 minutes was introduced in the final rule along with the conditional use of alternative models to permit operators to take better advantage of the risk reduction achieved when they design facilities with spill detection and rapid shutdown equipment and "over the top" transfer lines, as opposed to side or bottom penetrations.

Vapor expansion scenario

As its key proposition in connection with applying the Appendix B model to a 10-minute spill, AGA proffers an innovative concept for determining vapor overflow where there is excess detention capacity. In this concept, vapor-gas overflow rate would be based on the rate of thermal expansion of the vapor-gas. Intended for support of this concept, AGA provides graphical representations purporting to show for methane: (1) the temperature-density relationship; (2) the temperature-percent volumetric increase relationship; and (3) the percent of occupation of a detention space by vapor due to vaporization from a finite spill and subsequent thermal expansion of saturated vapor and gas as a function of time.

Although a detailed review of AGA's calculation of vapor overflow rate from a finite spill has not been made, MTB has no quarrel with the apparent mechanics of the method. However, consistent with the May 28 letter and the above statements, §193.2059 does not permit application of the Appendix B model to a finite spill without qualified modification of the model and prior approval as an alternative model for use with finite spills. Therefore, in seeking approval by the Director, full substantiation of method and all pertinent data would be required per §193.2057(c)(2).

Currently, MTB knows of no research or other evidence that would adequately either: (1) support the dominance of thermal expansion for determining vapor overflow from a detention space having excess capacity, or (2) verify a determination of the heat transfer rate to saturated LNG vapor, as a function of time, needed to calculate the rate of thermal expansion and consequent vapor-gas overflow rate. In fact, such information that exists indicates that overflow from wind entrainment would have such dominance as to make overflow from thermal expansion only a secondary consideration, as prescribed in the ETSC Draft Guidelines.

If only a validated rate of thermal expansion were to be applied in determining the rate of vapor overflow where there is detention capacity in excess of the volume of saturated vapor, it appears likely that the vapor overflow rate value and consequent dispersion distance calculated from the Appendix B model would be unrealistically low. This would not be consistent with the real world conditions that both AGA and MTB seek to address. Accordingly, public safety from vapor dispersion would not be adequately served.

Also, if detention capacity is provided with sufficient volume to assure that positive buoyancy is attained, it might then be claimed that the gas would lift harmlessly into the atmosphere, and, since the Appendix B model is a gaussian model intended for application to negatively buoyant vapor, its application in establishing dispersion distance would be both unnecessary and inappropriate. With a further increase in detention capacity to be a volume equal to the fully expanded gas, a zero value for vapor overflow could be used to duplicate the fallacious position taken by ETSC. Neither of these situations or the general use of only thermal expansion would be consistent with the real world, since entrainment overflow is a reality which must be addressed.

Response to AGA's Second Major Point

MTB has not prescribed, proposed, suggested or even alluded to continuous instantaneous vaporization as a requirement. In searching for some basis for the AGA conclusion, MTB notes that instantaneous vaporization is included as a provision under section 10 of the ETSC Draft Guidelines. In this instance, the provision is strictly specific to the proposed ETSC facility and applicable only to wind tunnel simulation modeling of a finite spill of an isothermal gas. Accordingly, there is no basis for the AGA contention that MTB interprets §193.2059 to require instantaneous vaporization of 100 percent of a continuous spill.

Entrainment Research

AGA contends that vapor dispersed by eddy entrainment (scooping) before the detention space is full of vapor will always travel a shorter distance than vapor dispersed after the detention space is full of vapor. As a result, scooping is claimed to always result in reduced overall dispersion distance, because it occurs prior to the computed time for overflow from vaporization. Thus, the actual time of overflow would be extended. As a result, heat transfer and consequent vapor generation and overflow will have further diminished at the time when overflow actually occurs.

Because of the importance of this issue in validating alternatives to the Appendix B model approach to predicting dispersion distances, a brief discussion is warranted. It cannot be logically denied that when wind speed is zero or very low, and vaporization rate is still very high at the time of overflow (as would be likely with minimal detention capacity), the corresponding entrainment rate would be zero or comparatively low, with corresponding minimal effect on dispersion distance from the dominant overflow due to vaporization. As wind speed increases, or as vaporization rate at the time of overflow decreases (as the case would be with increasing detention capacity or insulation properties), dominance of vaporization overflow and associated dispersion will decrease, as the effect of entrainment overflow increases.

In the early stages of these changing conditions, entrainment overflow would still be small compared to the vaporization overflow rate, and, therefore, would not result in a dispersion distance greater than calculated from the Appendix B model, particularly when the predilution of entrainment overflow is considered. The only effect, then, would be one of conservatism (due to actual delay in the real vaporization overflow time from the calculated time and a corresponding reduction in vaporization rate) on the dispersion distance calculated from the model.

When vaporization rate becomes significantly reduced or attains a zero value, and the corresponding calculated vapor overflow rate approaches zero (as the case would be with a large detention capacity), the dispersion distance calculated from the Appendix B model would also approach zero. Dispersion from entrainment overflow would then be clearly dominant, regardless of predilution effects. At this point, the effect of entrainment overflow would be nonconservative.

In transition between these conditions, there clearly would be some boundary below which entrainment overflow has a conservative effect on calculated dispersion distance. Above that boundary, the effect would be nonconservative. AGA's premise, therefore, would be correct with respect to the first conditions described up to the boundary, but incorrect otherwise. The nonconservative effect would be correct for those conditions above the boundary (where AGA's position is incorrect) and would apply to the ETSC proposal and probably the AGA spill scenario as well.

MTB believes that excess vapor detention capacity, with dispersion distance reliably predicted by wind tunnel simulation testing, could significantly reduce required dispersion distance Such a method could take into account, turbulence from tanks, detention fences, and other obstructions, with their potential variety of configurations and orientations. Thus, it could become the single best technique in providing for safe modification of existing facilities and in minimizing dispersion distance requirements and associated cost at new facilities.

However, it must be demonstrated that wind tunnel modeling is in fact a viable predictive technique for determining dispersion distances, with particular consideration of scaling effects. Accordingly, validation by verification testing and correlative analytical evaluation is needed. Unfortunately, relatively little pertinent correlative research has been performed to date.

Normally, the cost burden of such research should be the obligation of those who will benefit most. However, the wind tunnel approach appears to have the potential for broad application in the interest of both safety and reduction in cost of regulation. Therefore, MTB has joined with other organizations to co-sponsor field trials on the effect of obstructions in the flow stream of a dense gas cloud from a sudden spill.

Of greater significance, MTB has proposed and is sponsoring a more comprehensive research program on entrainment dispersion. Field trials, will be performed in Great Britian [sic] under the auspices of the British Health and Safety Executive, with the U.K. National Maritime Institute serving as prime contractor. It is not intended to be a parametric study of obstruction by fenced enclosure configuration or of spill conditions. Rather, the principal objective of this program is to develop well documented data from field trials on heavy gas dispersion for correlation with, and subsequent evaluation of, wind tunnel simulation test predictability.

Dispersion will be from a noninstantaneous, finite spill with eddy entrainment from a typical fenced enclosure having excess capacity and including wake turbulence from a tank-like structure. The fence and spill rate will be as representative as possible of conditions at a typical new or existing LNG facility which might adopt a detention space concept to reduce dispersion zone requirements, as set forth in current MTB standards.

Based on the limited research to date, it appears that dispersion distance could be safely reduced by a significant amount, thereby raising the likelihood that the detention concept and prediction by wind tunnel simulation would be broadly adopted. However, while MTB is providing substantial financial support, co-sponsors are needed to assure completion of the full range of field trials and wind tunnel testing, post test data evaluation, and wind tunnel test correlative analysis.

RESPONSE TO EXHIBIT II

In his May 28 letter to Bakerjian, Acting Associate Director Judah ruled that applying the Appendix B model referenced in §193.2059(c) to the minimum 10-minute design spill allowed by §193.2059(d) would be invalid in the case of excess vapor-containment capacity. He further stated that the model in Appendix B may be applied only to an assumed continuous spill. The basis for these statements was said to rest on a reading of Appendix B, itself, and the rulemaking record, namely the preamble to the final rule.

In its March 18, 1983, petition, the AGA contests this ruling on procedural grounds, arguing that it amounts to substantive rulemaking for which prior notice and comment are required by the Administrative Procedure Act. Inasmuch as the Act exempts “interpretive rules” from this procedural requirement, the correctness of AGA’s contention depends on whether the ruling is “substantive” or “interpretive.”

Although the distinction between substantive and interpretive rules is often gray, the courts generally hold that the former create laws while the latter clarify or explain existing laws. Such clarifications or explanations are needed when language in a regulation or statute is ambiguous or subject to more than one construction. Thus, “a ruling which changes the unmistakable meaning of a regulation is not an interpretation.” Gibson Wine Co. V. Snyder, 194 F.2d 329 (1952). The distinction in regard to Judah’s ruling, therefore, turns on whether §193.2059 permits reasonable doubt about the proper application of the Appendix B model to a 10-minute design spill where there is excess vapor-containment capacity.

To support its contention that Judah engaged in substantive rulemaking, AGA argues that the ruling was “[i]n direct opposition to the language of the regulation,” referring to the words of §193.2059(d). But, it is precisely the meaning of the regulation that is at issue, and in making its case, AGA does not fully consider the language of Appendix B, which is incorporated by reference in §193.2059. In his May 28 letter, Judah acknowledged the prima facie construction that AGA now propounds. Yet he pointed to the language of Appendix B, the record of the proceeding, as well as other authorities to show that the Appendix B model is not “conceptually suitable” to predict downwind vapor dispersion from a finite (10-minute) spill, and would yield a technically inconsistent and unsafe result. Given this reasoning, which AGA has not satisfactorily explained away, application of the Appendix B model to 10-minute spill conditions is not unmistakably intended by §193.2059. Thus, Judah’s administrative reading of the rule was wholly appropriate, desirable, and within the realm of reason. Accordingly, the May 28 ruling was interpretive and not procedurally defective under the Administrative Procedure Act.