U.S. Department of Transportation
Pipeline and Hazardous Materials Safety Administration

1200 New Jersey Ave, S.E.
Washington, D.C. 20590

Mr. John C. Keppel
4234 North Main Street, Unit 502
Fall River, MA 02720

JUL 07 2010

Mr. Michael L. Miozza
84 Holland Street
Fall River, MA 02720

RE: Request for Written Interpretation on the Applicability of 49 C.F.R. Part 193 to Proposed Waterfront Liquefied Natural Gas Plant in the City of Fall River, Massachusetts

Dear Mr. Keppel and Mr. Miozza:

You have asked for a written interpretation on three questions related to Weaver's Cove Energy, LLC's (Weaver's Cove or the Company) proposal to build a waterfront liquefied natural gas (LNG) plant (Fall River Plant or the Plant) in the City of Fall River, Massachusetts (Fall River). In particular, you ask whether the Company's use of the SOURCE5 source term model to calculate the flammable vapor gas dispersion exclusion zone for the onshore portion of the Fall River Plant complies with 49 C.F.R. § 193.2059. You also ask whether its use of a certain thermal radiation flux value to calculate the thermal radiation exclusion zone for that same portion of the Plant complies with 49 C.F.R. § 193.2057. Finally, you ask whether Weaver's Cove's failure to submit an Emergency Response Plan (ERP) is a violation of 49 C.F.R. Part 193.

While our regulations do not mandate the use of a particular source term model, we conclude that SOURCE5 can no longer be used to comply with our vapor gas dispersion exclusion zone requirements. We further conclude that the Company used the proper thermal radiation flux value to calculate the thermal radiation exclusion zone for the onshore portion of the Plant, and that it is not yet required to submit an ERP.

Background

In December 2003, Weaver's Cove Energy filed an application with the Federal Energy Regulatory Commission (FERC) to build the Fall River Plant.[1] In that application, the Company certified that it would comply with 49 C.F.R. Part 193 in siting, designing, constructing, operating, and maintaining the Plant. Weaver's Cove also used SOURCE5 and the thermal

[1] *Weaver's Cove Energy, LLC*, 112 FERC P 61070 (July 15, 2005) (Kelly, Comm'r, dissenting). According to the record in the FERC proceeding, Shell Oil Products US and its affiliates previously operated a petroleum terminal and oil refinery on the proposed site, and the Commonwealth of Massachusetts has designated it as appropriate for water-dependant industrial uses. *Weaver's Cove Energy, LLC*, 112 FERC P at 61527-61529.

radiation flux values specified in the NFPA 59A: Standard for the Production, Storage, and Handling of LNG, 2001 Edition (2001 NFPA 59A) to determine the dimensions of the thermal radiation and vapor gas dispersion exclusion zones for the Fall River Plant. On July 15, 2005, FERC issued an order conditionally approving the project.[2]

In January 2009, Weaver's Cove filed another application with FERC to modify the design of the Fall River Plant by replacing its shoreline marine berth and cargo transfer system with the Mount Hope Bay (MHB) Transfer System, an offshore marine berth and 4.25-mile subsea PIP LNG Transfer System. As none of your questions relate to that proposal, this letter does not address the MHB Transfer System.

Question 1

You first ask whether Weaver's Cove's use of SOURCE5 to calculate the flammable vapor gas dispersion exclusion zone for the onshore portion of the Fall River Plant complies with the requirements in 49 C.F.R. § 193.2059. Before answering that question, we will briefly examine the history of our siting requirements and discuss some recent developments in the field of consequence modeling.

In 1980, the U.S. Department of Transportation's (USDOT) Materials Transportation Bureau (MTB) issued the original federal minimum standards for siting LNG facilities.[3] Those standards required an operator or governmental authority to control the property within an "exclusion zone" to protect the public from the adverse effects of thermal radiation and flammable vapor gas dispersion in the event of an LNG release.[4] They also specified the mathematical models that had to be used in calculating the dimensions of these exclusion zones.[5]

In the case of vapor gas dispersion, our 1980 regulations incorporated the Gaussian line-source (GLS) model described in appendix B of a 1974 technical report, "Evaluation of LNG Vapor Control Methods,"[6] and prescribed the conditions that had to be followed in executing that

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[2] *Weaver's Cove Energy, LLC*, 112 FERC P at 61546-61547.

[3] *See* 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).

[4] LNG Facilities; Federal Safety Standards, Development of New Standards, 44 Fed. Reg. 8142, 8142 (February 8, 1979) (describing the hazards associated with LNG).

[5] 49 C.F.R. §§ 193.2057, 2059 (1980). Subpart B also authorized the use of alternative thermal radiation or vapor gas dispersion models that "[h]a[d] been evaluated and verified by testing at a scale, considering scaling effects, appropriate for the range of application; . . . submitted to the Director for approval, with supportive data as necessary to demonstrate validity; and . . . received approval by the Director." 49 C.F.R. §§ 193.2057(c)(2), 2059(c). The Director referenced in these requirements was the head of MTB, 49 C.F.R. § 1.3(b)(8) (1980), an entity then-organized within USDOT's Research and Special Programs Administration. 49 C.F.R. § 190.3(d) (1980) (defining Materials Transportation Bureau).

[6] 49 C.F.R. § 193.2059(c).

model. A method for determining the vaporization design rate, or source term, for input into the 1974 GLS model was one of those conditions.[7]

In February 1997, MTB's successor and our predecessor, the Research and Special Programs Administration (RSPA), replaced the 1974 GLS model with the current vapor gas dispersion model, the DEGADIS Dense Gas Dispersion Model (DEGADIS),[8] and modified our regulations to allow operators to satisfy our vaporization design rate requirements by using an "equivalent personal computer program,"[9] which led to the widespread use of SOURCE5 by the U.S. LNG industry.[10] In March 2000, RSPA also repealed our vaporization design rate requirements "to allow operators more flexibility in computing" the formation of the source term, i.e., the physical phenomena that occur immediately after an LNG release, but prior to atmospheric dispersion.[11]

There have been some significant technical studies on source term and vapor gas dispersion modeling in the past five years. Specifically, at the request of the National Fire Protection Association's (NFPA) Fire Protection Research Foundation (FPRF), the United Kingdom Health

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[7] 49 C.F.R. § 193.2059(d). As recently described by a panel of experts:

> The dispersion of releases of hazardous fluids through from loss of containment to dilution below hazardous levels can be simply considered as comprising two stages: source term formation and atmospheric dispersion. The former occurs immediately after release when the behaviour of the fluid is dominated by conditions under which the fluid was stored and the particular conditions of release. Further downstream, as the influence of the source decays, the atmosphere becomes increasingly important and controls fluid behaviour.
>
> In LNG hazard assessments these two stages are usually modelled separately by a source term model and a dispersion model. The output from the source term model, specifying the state of the fluid at that stage, is used as input to the dispersion model.

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).

[8] Liquefied Natural Gas Regulations—Miscellaneous Amendments, 62 Fed. Reg. 8402 (Feb. 25, 1997) (incorporating "the model described in the Gas Research Institute Report GRI-89/0242 . . ., 'LNG Vapor Dispersion Prediction with the DEGADIS Dense Gas Dispersion Model.'").

[9] 62 Fed. Reg. at 8404 (amending 49 C.F.R. § 193.2059(d)(1)(ii) to state that "[i]n determining variations in the vaporization rate due to surface contact, the time necessary to wet 100 percent of the impounding floor area shall be determined by equation C-9 in the 1974 AGA report titled "Evaluation of LNG Vapor Control Methods," or by using an equivalent personal computer program based on equation C-9 or by an alternative model which meets the requirements of §193.2057(c)(2)(ii) through (iv).").

[10] In 1991, the Gas Technology Institute released "GRI-92/0534: Spread and Vaporization of LNG," a report that described a computer program intended for the calculation of the vaporization rate of spilled LNG. The original computer program, SOURCE1, was revised several times, and the U.S. LNG industry eventually began using the final version, SOURCE5, for determining source strength inputs for DEGADIS.

[11] Pipeline Safety: Incorporation of Standard NFPA 59A in the Liquefied Natural Gas Regulations 65 Fed. Reg. 10950, 10953 (March 1, 2000). In that same final rule, we also authorized the use of another vapor gas dispersion model, FEM3A, "to account for additional cloud dilution which may be caused by the complex flow patterns induced by tank and dike structure . . ." 49 C.F.R. § 193.2059(a). As your question does not relate to FEM3A, that model is not addressed in this letter.

& Safety Executive's Health & Safety Laboratory prepared a pair of reports on these subjects. The authors of those reports, a group with expertise in consequence modeling evaluation, concluded that SOURCE5 suffers from two deficiencies—i.e., it does not accurately represent the likely effects of (1) pool spreading and the resulting flammable vapor flashing or (2) vapor accumulation within impoundments.[12] According to the FPRF report, those deficiencies could lead to an under-prediction of the distance of a vapor gas exclusion zone for an LNG plant.

Turning to your question, our siting requirements no longer specify the vaporization design rates that must be used as the input for DEGADIS. We eliminated that regulation a decade ago "to allow operators more flexibility in computing" the formation of the source term, subject to our continuing obligation to evaluate the suitability of those models based on the best available scientific and technical evidence.

In that regard, our regulations state that "[f]lammable vapor-gas dispersion distances must be determined in accordance with the model described in the Gas Research Institute report GRI-89/0242 . . . 'LNG Vapor Dispersion Prediction with the DEGADIS Dense Gas Dispersion Model.'"[13] GRI-89/042 further states that DEGADIS is subject to certain "limitations," including that it "<u>models vapor dispersion only</u>" and, by necessity, "requires the user to specify vaporization rates for liquid spills."[14]

To comply with our vapor gas exclusion zone requirements, the vaporization rates specified as the input for DEGADIS must have a credible scientific basis.[15] 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. That would not be consistent with the limitations described in GRI-89/042, as incorporated into our siting requirements by reference, or our statutory obligation to protect the public from the hazards associated with operating an LNG plant.[16]

The authors of the FPRF reports found that using SOURCE5 as the input for DEGADIS may lead to non-conservative hazard predictions. That finding, rendered by a group of experts in consequence modeling evaluation, should be given the utmost consideration, and we must respond by doing what is necessary to ensure public safety. Accordingly, we conclude that

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[12] M.J. Iving et al., <u>Evaluating Vapor Dispersion Models for Safety Analysis of LNG Facilities Research Project: Technical Report</u> 8-10 (Apr. 2007) (on file with PHMSA); Ivings, et al., <u>LNG Source Term Models for Hazard Analysis: A review of the State-of-the-Art and an Approach to Model Assessment</u> (Mar. 2009) (on file with PHMSA); *see also* National Association of State Fire Marshals, <u>Review of the LNG Vapor Dispersion Model Evaluation Protocol</u> (Jan. 2009) (on file with PHMSA); National Association of State Fire Marshals, <u>Review of the LNG Source Term Models for Hazard Analysis: A Review of the State-of-the-Art and an Approach to Model Assessment</u> (Jun. 2009) (on file with PHMSA).

[13] 49 C.F.R. § 193.2059(a).

[14] GRI Report 89/0242 at 87 (underline in original).

[15] *Id.* (further noting that the "[p]roper characterization of vaporization rates as a function of time are extremely important for specifying the proper release mode . . . and the source strength.").

[16] 49 C.F.R. §§ 60102(a), (b)(2)-(3), 60103(a).

SOURCE5 can no longer be used to determine the vapor gas exclusion zone for an LNG plant, without taking appropriate actions to address the deficiencies identified in the FRPF reports.[17]

We cannot say how this conclusion might affect any particular proceeding,[18] but note that LNG facilities must be "designed" and "constructed" in accordance with our siting requirements, and that our interpretation of what is needed to satisfy those requirements applies to any LNG facility that is not yet in existence or under construction.[19]

Question 2

You next ask whether Weaver's Cove used the proper thermal radiation flux value to calculate the dimensions of the thermal radiation exclusion zone for the onshore portion of the Fall River LNG Plant. The 2001 NFPA 59A is incorporated into our siting requirements by reference, subject to regulatory preemption in the event of conflict.[20] The former standard lists a series of thermal radiation flux values for use in calculating the dimensions of an LNG plant's thermal radiation exclusion zone,[21] and there is no similar provision in our regulations.[22] Accordingly, the Company's use of the thermal radiation flux values from the 2001 NFPA 59A complies with 49 C.F.R. § 193.2057.

Question 3

Your final question is whether Weaver's Cove has violated 49 C.F.R. Part 193 by not submitting an ERP for the Fall River LNG Plant. Our regulations do not prescribe a specific deadline for submitting an ERP,[23] and there is no such requirement in the 2001 NFPA 59A.[24] Therefore, Weaver's Cove is not yet required to submit an ERP.

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[17] We note that conservatism is critical in developing and applying an acceptable source term model. *See In the Matter of Energy Terminal Services Corporation*, PHMSA Interp. 82-05-28 (May 28, 1982) (stating that we selected the 1974 GLS model because "it appeared to predict conservative distances in comparison with other available mathematical models[,]" that "[49 C.F.R.] § 193.2059 requires use of the model as a conservative standard of protection[,]" and that a "construction of th[at] standard [which] yields a conservative result . . . is supported by the preamble to the [February 1980] final rule").

[18] *See e.g.,* 49 U.S.C. § 60104(d)(2), (e).

[19] 49 C.F.R. § 193.2005(a)-(b), 193.2051; *see* Pipeline Safety: Liquefied Natural Gas Facilities; Clarifying and Updating Safety Standards, 69 Fed. Reg. 113330, 11331-11332 (Mar. 10, 2004).

[20] 49 C.F.R. §§ 193.2013, 193.2051.

[21] 2001 NFPA 59A, 2.2.3.2.

[22] 49 C.F.R. § 193.2057.

[23] 49 C.F.R. § 193.2903.

[24] *See* Chapter 9 of 2001 NFPA 59A; *but see* 2001 NFPA 59A, 2-1.1(d) (stating that any site-specific factors that "have a bearing on the safety of plant personnel and the surrounding public" must be reviewed, and that such a review must "include an evaluation of potential incidents and safety measures incorporated in the design or operation of the facility."); Energy Policy Act of 2005, Pub. L. No. 109-58, § 311(e), 119 Stat. 94, 688 (Aug. 8, 2005) (requiring FERC to approve an ERP before authorizing construction of an LNG terminal).

Conclusions

In conclusion, SOURCE5 can no longer be used to comply with our vapor gas dispersion exclusion zone requirements, the Company used the appropriate thermal radiation flux value to determine the thermal radiation exclusion zone for the onshore portion of the Fall River LNG Plant, and it is not yet required to submit an ERP.

Sincerely,

Linda Daugherty for Jeffrey D. Wiese
Associate Administrator
for Pipeline Safety

Cc: Ms. Dianne R. Phillips
Holland & Knight
10 St. James Avenue
Boston, Massachusetts 02116

Mr. Bruce F. Kiely
Counsel for Weaver's Cove Energy, LLC
Baker Botts LLP, The Warner
1299 Pennsylvania Avenue, NW
Washington, DC 20004-2400

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April 7, 2010

John C. Keppel
4234 No. Main St. Unit 502
Fall River, MA 02720

Michael L. Miozza
84 Holland Street
Fall River, MA 02720

Jeffrey D. Wiese
Associate Administrator for Pipeline Safety
Pipeline and Hazardous Materials Safety Administration
U.S. Department of Transportation
1200 New Jersey Ave. S.E.
Washington, D.C. 20590

Dear Mr. Wiese,

We read your letter to Ms. Dianne R. Phillips, Esq. regarding the *"Application of the Siting Requirements in Subpart B of 49 C.F.R. part 193 to the Mount Hope Bay Liquefied Natural Gas Transfer System,"* with extreme interest. The letter's description, interpretation, and application of DOT's responsibilities regarding the cryogenic pipeline and the Mount Hope Bay berthing platform with associated land based facilities at Weaver's Cove provided a clear chronological review for the DOT's oversight authority.

The issues you describe related to the Hess LNG Mount Hope Bay proposal are sourced in the 2005 FERC approval of the land based facility. If FERC had <u>not</u> approved the land based facility, the issues related to the MHB berthing facility would be mute. We understand the issues described in the letter referred to above. What we do <u>not</u> understand is FERC's 2005 approval of the land based facility through 1) use of scientifically disproven vapor dispersion models, 2) use of exorbitantly high thermal radiation exposure, when compared to other national and international standards, and 3) impossibility of a viable evacuation plan for the particular area the approved land based facility is located in, given siting recommendations of the Pipeline Safety Act of 1979.

Your letter states, *"According to relevant authorities, one of the primary reasons for the PSA was to "[c]larify [the Department of Transportation's] authority to regulate the Safety of LNG* *facilities."* The vapor dispersion models FERC used in the 2005 approval were disproven in the 1987 FALCON tests and by 2000 DOT accepted FEM3A as a model that addressed complexities the older models did not; complexities that apply to the approved land based Weaver's Cove siting. Not only did FERC allow the use of the disproven models for the Weaver's Cove approval in 2005, more recently FERC has informed project proponents, such as Downeast LNG (FERC Docket No. CP07-52-000 et al.) and LNG Development Company, LLC d/b/a Oregon LNG, that those models may not be used to calculate their exclusion zones.

We have written to FERC asking them to reopen the 2005 approval of the land based facility based on 1) use of the disproven vapor dispersion models and 2) a conflict of interest in setting the NFPA thermal radiation standards used by FERC, created by a majority membership of LNG/natural gas companies, and their constituent industries in the LNG standards committee NFPA 59A.

Finally, given that the DOT opted for *"exclusion zones"* rather than the remote siting recommended in the Pipeline Safety Act of 1979, and given that the remote siting, demographic and topographic considerations in that act were recommended to ensure public safety; evacuation plan requirements for LNG facilities should include *"viability"*, not simply identification of evacuation routes. We have also written to FERC, in a separate letter, suggesting the assessment for viability of evacuation plans for proposed LNG facilities be part of the pre-filing process.

Based on the DOT letter to Ms. Phillips and the respective DOT responsibilities described, we are asking the DOT to review FERC's use of scientifically disproven vapor dispersion models and use of high thermal radiation exposure to determine the exclusion zones around the land based facility. There is testimony submitted by Dr. Harry West (deceased) and Professor Jerry Havens through the Attorney General of Massachusetts in June 2005 to FERC that validates our concerns. In the following pages we express our concerns, including supporting documentation and references for verification. We are including Dr. West's testimony with this document because it clearly delineates the issues associated with the thermal radiation exposure.

As citizens of the United States, we are asking the DOT to document its position on the calculations for vapor dispersion and thermal radiation zones around the land based Weaver's Cove facility in the 2005 FERC approval and take appropriate action based on that position. In addition, we are asking for comment on requiring viability as part of an evacuation plan. We believe a viable evacuation plan, determined prior to construction, not part of an Emergency Response Plan (ERP) after construction has started, is the only way to ensure public safety, especially given the possibility of urban sitings in residential neighborhoods, such as that in Fall River, Massachusetts.

Vapor Dispersion

FERC and Weaver's Cove LNG used a 1980s, scientifically disproven combination of consequence models, DEGADIS in combination with SOURCE5, for determining vapor dispersion zones around the approved land based Weaver's Cove facility. The Dense Gas Dispersion Model [DEGADIS] simulates the atmospheric dispersion at ground-level, area source dense gas (or aerosol) clouds released with zero momentum into the atmospheric boundary layer over flat, level terrain. The model describes the dispersion processes which accompany the ensuing gravity-driven flow and entrainment of the gas into the boundary layer (http://gcmd.nasa.gov/records/DEGADIS-Model.html). DEGADIS works on flat areas, ground or water. In 1987, DEGADIS was proven not to work in areas with uneven terrain, or with obstructions such as buildings, dikes, fences, berms, etc. by the FALCON tests. The FALCON tests also disproved the key assumption of SOURCE5, which was that gas fills diked in areas without mixing with air.

In 2000, the DOT, reacting to the scientific community **rejection** of SOURCE5/DEGADIS, **accepted** the FEM3A or a combination of FEM3A with DEGADIS as the standard for determining vapor dispersion zone because it determines the *"reach"* of a flammable LNG vapor cloud for uneven terrain, dikes, berms, etc. and complex areas the DEGADIS/SOURCE5 could not accurately address.

It is important to note that a study released by the Fire Protection Research Foundation in March 2009, again confirmed the 1987 findings regarding SOURCE5. The study was funded by the energy industry and concluded that the SOURCE5 scientific basis for pool spreading *"is quite unphysical"*. Quoting the last paragraph from the study: *"Furthermore the prescription of SOURCE5 that the cloud formed in a dike should not disperse or dilute at all until pure vapor has accumulated in the dike to the level top of the wall is* ***unphysical*** *and is likely to lead to optimistic (non-conservative) hazard predictions."* Particularly troubling to us is the fact Weaver's Cove was a project sponsor and seemingly aware of the results, yet they continue to rely upon this incorrect approach in recent filings with FERC.

Professor Jerry Havens and Thomas Spicer of the Ralph E. Martin Department of Chemical Engineering at the University of Arkansas have written a paper entitled Vapor Cloud Exclusion Zone Issues for Spills into Impoundments. In that paper, the two professors identify the most accurate methodology and combination of scientific models for determining vapor cloud exclusion zones. That methodology uses FEM3A for the impoundment areas in combination with DEGADIS outside the impoundment area. In addition, the paper describes proposed changes to NFPA 59A, which require vapor cloud dispersion exclusion zones to be determined at the wind speed at which the maximum distance would occur, just as is done for thermal exclusion zones. The conclusion of the paper is that if the recommendations in the study are adopted, *"there will be important ramifications of such changes in the regulations, as the methods currently in practice can result in vapor cloud exclusion zones that are insufficient to* *protect the public, while increases in the required exclusion zones can be a determining factor in siting LNG facilities."*

Thermal Radiation

The accepted FERC standard (based on the NFPA) for public exposure to thermal radiation from an event at an LNG facility is 1600 Btu/hr/ ft^2. That is the amount of thermal radiation which causes 2nd degree burns to bare skin in 30 seconds. 1600 Btu/hr/ ft^2 is an **unreasonably high** level of exposure compared to other government standards and other industries, both domestic and international, as identified in the table below. However, it is not surprising given Congressman Edward Markey's testimony before the Subcommittee on Energy Policy, Natural Resources and Regulatory Affairs on Tuesday, June 22, 2004. Quoting Boston Deputy Fire Chief Flemming, Markey testified:

> Deputy Chief Flemming notes, for example, that the NFPA standards call for preventing *"thermal radiation flux from a fire from exceeding"* certain limits. One of these limits is 1600 Btu's per hour per square foot. He notes that *"this level of heat flux will cause 2nd degree burns in 30-40 seconds,"* that it *"will cause severe pain in 13 seconds,"* and that it will *"be fatal to 1% of the affected population in 50 seconds."* Deputy Chief Flemming notes that the Society of Fire Protection Engineers Handbook recommends a level ½ of that allowable under the NFPA standard. Finally, he notes that the NFPA Committee that made up these standards is largely comprised of representatives of the LNG industry or energy industry consultants, and that public officials – including firefighters who may have to deal with an LNG fire, are not routinely brought into discussion about what the appropriate standards should be utilized. A quick check of the NFPA website reveals that the NFPA LNG Committee has representatives from BP Amoco, Distrigas, ExxonMobil, Weaver's Cove Energy, Keyspan, the American Gas Association, the American Petroleum Institute, the American Concrete Institute, and the Steel Plate Fabricators Association.

According to Flemming's testimony, the industry is setting its own standard through the National Fire Protection Association and FERC uses that standard which is **significantly less rigorous** than comparable industries.

THERMAL RADIATION STANDARDS

Orgazinzation	Standard	Criteria
FERC	1600 Btu/hr/ft^2	FERC using NFPA standards for LNG exclusion zones
American Petroleum Institute	1500 Btu/hr/ft^2	Areas where emergency actions lasting **several minutes** may be required **by personnel with appropriate** clothing
	500 Btu/hr/ft^2	Locations where personnel are continuously exposed.
Dept. of Housing and Urban Dev.	450 Btu/hr/ft^2	Playgrounds, parks, school grounds, etc. relative to potential fire locations.
European Standards	1600 Btu/hr/ft^2	For LNG at property boundary, but **only for areas that are easily evacuated.**
	480 Btu/hr/ft^2	Areas not easily evacuated
Society of Fire Protection Engineers*	800 Btu/hr/ft^2	Public tolerance limit
Opinion of Engineers	450-500 Btu/hr/ ft^2	Many engineers believe this range is more appropriate for LNG exclusion zones.

Source: Extrapolated from LNG, A Level Headed Look at the Liquefied Natural Gas Controversy, pages 167-168. *Source: Society of Fire Protection Engineers Handbook 3rd Ed.

When questioned about the arbitrarily weak standard used by FERC because it allows 2nd degree burns in 30 seconds, a former head of the FERC LNG program said, *"You'd simply walk in another direction. Your skin ain't burnin' or anything like that. And that 1,600 assumes you're nude. You have a layer that's helping you already."* (LNG, A Level Headed Look at the Liquefied Natural Gas Controversy, page 168)

The outrage of such a response only continued in a White Paper on LNG inside the NFPA in 2005, when a fire safety professional asked for a review of the 1600 Btu/hr/ft^2 standard by the LNG Standards Committee (again, made up of LNG companies, natural gas companies, and the contracting industries that serve them). The report recognized that bare skin develops 2nd degree burns in 30 seconds with an exposure to 1600 Btu/hr/ft^2 and then justified the standard for LNG facilities by stating *"a person can safely run away to a distance of 100 m at which distance the radiant intensity will be far less and thus avoid suffering a second degree burn."* It also quoted one fire department that stated a 30 second exposure to 1600 Btu/hr/ft^2 was acceptable *"since a second degree burn is reversible if attended to promptly."* (http://www.nfpa.org/assets/files/PDF/ROP/59A-A2005-ROC.pdf)

That is an outrageous response! The high thermal radiation level used by FERC does not take into account sensitive populations, such as the elderly, the handicapped or children. It does not take into account the confusion if an event occurs in the middle of the night. It does not take into account an area such as Fall River, in which there are dead end streets and there are massive hills that abut the property of the proposed facility. It does not take into account problems that startled people may encounter in the rush to escape to a safe and protected area. The high FERC standard of 1,600 Btu/hour/ft^2 is ONLY safe provided the potential exposed population will have BOTH the opportunity and the capability to quickly take cover. Finally, in a major event, the concept of 2nd degree burns being *"reversible if attended to promptly"* is anything but responsible coming from an organization charged with setting safe standards.

The Massachusetts Executive Office of Public Safety and Security wrote to FERC in February 2009 stating that after consulting with fire chiefs in the area, *"It is feared that any evacuation would result in mass chaos and create traffic jams that would bring most vehicles to a standstill. Not only would this interfere with evacuation, it would severely impair any kind of emergency response to the area of the proposed facility."* They also stated, *"It may not be possible to overcome all the safety and security implications regardless of the resources."* This would hardly provide the scenario for reversing 2nd degree burns *"if attended to promptly"* as described by the NFPA!

Viable Evacuation

FERC's sequencing of the ERP (Emergency Response Plan) is contrary to risk management principles. According to FERC's FEIS in the Weaver's Cove 2005 approval (Docket CP04-36-000), Condition 67 requires the development of an ERP including an evacuation plan **"prior to the commencement of service."** There are two problems with that. The document only says *"a plan,"* it doesn't have to be *"a viable plan"* AND the plan is to be developed during construction. Since remote siting is recommended in law as a vehicle to protect the public, assessing viable evacuation plans should be a required part of the **pre-filing process** for any facility that is not remotely sited. If FERC determined during a pre-filing process that the public could not be evacuated, then the application process should **stop**.

Currently, FERC only requires an LNG company to identify evacuation routes; they do not have to work. Again, the February 2009 comments from the Massachusetts Executive Office on Public Safety and Security are pertinent, *"It is feared that any evacuation would result in mass chaos."* Weaver's Cove has admitted through a letter to the editor of the Herald News in Fall River, that they are only required to identify evacuation routes [viability is not a part of their required responsibilities].

If the construction of the Weaver's Cove land based facility were to go ahead with Condition 67, would FERC really refuse to issue an operating permit if it were later determined the population could not be evacuated under any scenario? **The process is backwards.** Risk management principles dictate that a plan have viability, not a token gesture that is part of the current FERC regime. (*Again, see Dr. West Testimony regarding risk management and thermal radiation zones.*)

Summary:

In our conclusion to FERC, we stated:

> *"The credibility of FERC as a regulatory body of critical energy infrastructure is at stake with its approval of only the second urban siting of an LNG import regasification facility in the country. Approval of a 200,000 m^3 LNG tank on a small, 73 acre industrial parcel located in an urban area, only 1,200 feet from the nearest homes, using scientifically discredited models and industry manipulated safety criteria to determine safety zones is <u>not</u> only* ***an egregious violation of the public trust****, but a potential litigious nightmare for a federal agency.*
>
> *Standards determining thermal radiation zones should be consistent with other federal agencies, national organizations, fire safety professionals and at the very least, the American Society for Fire Prevention Engineers. Using the criteria from any of these organizations, the thermal radiation exclusion zone around the Weaver's Cove facility would be significantly larger, thereby ensuring public safety. The "run in the other direction" comments by a former FERC supervisor and the NFPA are completely irresponsible for agencies entrusted with public safety.*
>
> *LNG models that are scientifically validated for determining vapor exclusion zones should be legally required to calculate any such zones and are even more critical for a facility in a residential area!*
>
> *There are many controversial issues surrounding the 2005 FERC approval for Weaver's Cove. These are just two that need to be addressed by FERC. The approval of the Fall River siting of the land based Weaver's Cove facility needs to be reviewed and reversed in the light of the creditable information provided in this letter."*

The use of **disproven models** to delineate vapor exclusion zones and use of **comparatively high** thermal radiation exposures, to identify thermal radiation exclusion zones, compromises public safety by creating **artificially small zones** that coincidentally fit on the Weaver's Cove property. The use of vapor disproven models and high thermal radiation exposure levels are at odds with FERC's website statement that it, *"Ensures the safe operation and reliability of proposed and operating LNG terminals."* Finally, the requirement for token evacuation routes rather than real, **viable** evacuation plans are critical safety-based flaws in the 2005 approval of Weaver's Cove.

It is more than interesting that use of scientifically valid models and more rigorous thermal radiation standards **create zones that extend off of the Weaver's Cove owned property,** potentially preventing both the approval and construction of the proposed facility. It is also more than interesting, that the Pipeline Safety Act, directs consideration of *"existing and projected population and demographic characteristics of the location; existing and proposed land use near the location; and natural physical aspects of the location,"* all of which appear to be **egregiously** contrary at Weaver's Cove for an LNG import regasification facility siting, yet viable evacuation is <u>not</u> a required factor in an ERP plan.

We are respectfully requesting the Department of Transportation to document its position on the models and standards used to calculate the vapor dispersion and thermal radiation exclusion zones around the land based Weaver's Cove facility in the 2005 FERC approval. And as a responsible party in the *"safety of LNG facilities"* to not only comment on, but **require** guidelines for viable evacuation plans, not just identification of routes. This is particularly important given the topography, demographics, and location of sites, such as Weaver's Cove, in which simple identification of escape routes plainly cannot work.

We look forward to your answer at your earliest convenience.

Sincerely,

John C. Keppel

Michael L. Miozza

cc: Dianne R. Phillips, Esq.
Holland & Knight
10 St. James Avenue
Boston, Massachusetts 02116

Jeff C. Wright, Director, Office of Energy Projects
Federal Energy Regulatory Commission
888 First Street, NE
Washington, DC 20426

DIRECT TESTIMONY OF DR. HARRY H. WEST

Q. Please state your name and business address.

A. Harry H. West, Shawnee Engineers, 1829 Augusta #10, Houston, Texas 77057.

Q. What is your profession?

A. I am an independent consulting chemical engineer.

Q. Do you also maintain an academic affiliation?

A. Yes. I am an Adjunct Professor of Chemical Engineering at the Process Safety Center of the Texas A&M University

Q. Please summarize your educational background.

A. I received a BS from the Bucknell University in 1965; and a PhD from the University of Oklahoma in 1969, all in Chemical Engineering.

Q. Dr. West, do you have a particular area of specialization within chemical engineering?

A. Yes, my primary specialization is in process safety, with a particular emphasis on the analysis of safeguard systems that can avoid or mitigate the consequences of a chemical release.

Q. Do you regularly do research, publish, and speak at professional symposia on those subjects?

A. Yes. A listing of my publications and symposia presentations is included in the Resume attached to this testimony as Exhibit A.

Q. Are you a registered professional engineer?

A. Yes. I am a registered professional engineer in the States of Pennsylvania and Texas.

Q. Describe your experience in LNG technology.

A. In the late 1960s, my first involvement in LNG technology was to develop a computer simulation of the LNG liquefaction process for the ChemShare Corporation, which allowed design engineers to optimize process conditions. As a member of the professional staff of University Engineers of Norman Oklahoma, I was involved in many aspects of LNG technology. In the early 1970s, I participated in the LNG safety research projects sponsored by the AGA and others, which involved LNG spills on both land and water. Experiments to evaluate the effectiveness of LNG fire control technologies were also a major project. Troubleshooting many early LNG peak shaving facilities led to numerous process developments, most notably the running film LNG vaporizer (currently used by many LNG peak-shaving facilities) and the patent on fire control of LNG tank vents.

I participated in numerous LNG safety analysis studies for proposed LNG importation terminals throughout the USA during the 1970s, including the successful projects at Cove Point, Elba Island and the Trunkline terminal in Lake Charles. For LNG liquefaction projects in the Middle East and Far East, I participated in safety analysis studies and detail design of the fire control safeguard systems.

One significant aspect of LNG safety analysis studies was the production of a document, which detailed the compliance of the proposed detail facility design to each paragraph of the NFPA 59A standard. The last such document I produced was in 2000 for the Dhabol India LNG importation terminal.

Q. What is your current focus in LNG technology?

A. I am currently updating my LNG safety text, originally prepared in the late 1970s with my partner, the late Dr. Lester Edward Brown. It is anticipated that this text will be used for a one semester academic course at the Texas A&M, Doha, Qatar campus. Notes from this text have been used in continuing education courses on LNG/LPG safety presented in the Far East for many years.

I am also involved in directing Texas A&M graduate students and visiting professors in several LNG research projects, specifically various Computational Fluid Dynamic models, design of fire control experiments, and development of updated LNG rollover mathematical models.

Q. Have you ever served as a consultant either to government standard setting agencies or to government officials working in areas bearing on LNG safety?

A. Yes. In the mid 1970's, University Engineers had a project to advise the US Coast Guard on the development of LNG regulations. As a senior consultant on this project, I visited LNG terminals in Algeria at the behest of the US Coast Guard, and subsequently co-authored the report to the Coast Guard containing recommended practices regarding LNG ship to shore transfer and dock fire fighting options.

Also in the mid 1970s , I was a member of the University Engineers technical team that provided LNG consulting services to the Federal Power Commission.

Q. For whom are you appearing in this proceeding?

A. I am appearing on behalf of a coalition of Cities in both Massachusetts and Rhode Island, each of which would be impacted directly by either the KeySpan or the Weaver's Cove proposals.

Q. When did your work for the Cities first commence?

A. I was first contacted by Garry Bliss on behalf of the Mayor of Providence, RI, in late 2004.

Q. Dr. West, when you were first contacted by representatives of the Mayor of Providence, were you told that your help was wanted in fighting the certification of the LNG proposals?

A. No, I was asked to assist the various city staff, most notably the Providence Fire Department, in evaluating the safety aspects of the Keyspan proposal.

Q. Dr. West, please summarize the conclusions that you reached following your evaluation.

A. *While working with the Providence Fire Department, I became acutely aware of* the deficiencies in the FERC safety analysis. During my review of the Keyspan draft environmental impact statements (DEIS), I had numerous technical discussions with Dr. Jerry Havens. My analysis of the LNG safety aspects of the Keyspan DEIS concurred with Dr Havens review. My testimony herein will focus on several issues that complement and perhaps expand some of the concepts detailed by Dr. Havens.

Q. Was your work subsequently expanded to include the Weaver's Cove proposal?

A. It was. The analysis that follows, and the judgments I offer, apply equally to the Weaver's Cove and KeySpan proposals.

Q. You mentioned your concurrence with the views being offered by Dr. Havens in this proceeding. Please explain what you mean by that concurrence.

A. As Dr. Havens was in the process of preparing his testimony, he wanted to test his analysis and judgments in a "peer" review fashion. He asked that I undertake a critical review of his work. I did, and following that review I told Dr. Havens that I was in total agreement with the views and judgments expressed in the testimony that he is sponsoring.

Q. Dr. West, will you explain the concerns that you have regarding the failure of the FERC LNG safety analysis?

A. The issues which I will present herein are:

- Inadequacy of the thermal hazard exclusion zone analysis
- Lack of consideration of modern concepts of Process Safety
- Inadequate consequence modeling
- Potential use of high expansion foams systems to reduce the thermal hazard exclusion zone estimates for LNG terminal impoundment areas.

Q. How are the criteria for thermal radiation hazard exclusion zones inadequate?

A. Quantification of the LNG pool fire hazard exclusion zone involves calculating the distance from the fire at which thermal radiation levels are hazardous to people and equipment. NFPA59A and the DOT 49CFR193 use the same basic concept to define the thermal hazard exclusion zone (minimum separation distance) from LNG impoundment areas to the nearest edge of the LNG facility's property line or the nearest point of assembly where the thermal flux is 1,600 BTUs/Hr-Ft^2 (5 kW/m^2).

This level of thermal hazard is far too high to provide for the congressional intent in the Pipeline Safety Act of 1979 (codified as 49 CFR part 193), which was "protection of persons and property near an LNG facility from thermal radiation caused by ignition of a major spill of LNG"

Q. What is the impact on people from a thermal radiation level of 1,600 BTUs/ hr-ft^2. (5 kW/m^2)

A. A 2004 report prepared by ABSG Consulting Inc. for the FERC provides a literature review documenting the effects of thermal radiation on both people and structures. An excerpt from ABSG report table 2.6 is reproduced below to emphasize the impact of exposure time on injury level to people at the thermal flux of 1600 Btu/hr-ft^2 (5 kW/m^2).

Effects on People for 1,600 BTU/hr/ft^2 (5 kW/m^2) Thermal Radiation

Effect	Exposure Time (seconds)	Data Source
Severe pain	13	Burn injury criteria from the Federal Emergency Management Agency (FEMA, 1990)
First-degree burns	20	5 kW/m^2 for 20 seconds corresponds to a thermal dose of 100 kJ/m^2
Second-degree burns	30	5 kW/m^2 for 30 seconds corresponds to a thermal dose of 150 kJ/m^2
	40	FEMA, 1990
Third-degree burns (1% fatality)	50	50 seconds corresponds to a thermal dose of 250 kJ/m^2
72% probability of first-degree burns	40	TNO (1992) probit equation

From the above table, it is obvious that the level of 1,600 BTU/hr/ft^2 (5 kW/m^2) is only protective provided that the potentially exposed population will have both opportunity and capability to quickly take cover. It may also be protective to workers or emergency personnel who are wearing protective clothing This high thermal radiation level does not take into account sensitive populations, such as the elderly, handicapped or children. It also does not account for problems that startled people may encounter in the rush to escape to a protected area. Further, it does not appear to take into account the extended duration that the thermal flux from an LNG fire is likely to last.

Q. Could you describe the protective clothing that could serve to protect workers or emergency personnel?

A. The protective equipment typically used by Fire Service personnel during rescue operations from burning buildings includes heat reflective and insulative clothing.

Q. Could residents in the immediate vicinity of an LNG terminal be issued similar clothing?

A. This is not a practicable solution to the problem of inadequate protection for a number of reasons. Workers and emergency personnel can be trained to don the protective clothing quickly, and correctly. Given the large number of residents living in proximity to the proposed Weaver's Cove site, the difficulties of providing adequate training would be enormous. Further, children, the elderly, and the disabled simply cannot respond as quickly and as completely as can workers and emergency personnel. Further, children grow; ensuring properly fitting protective clothing would be an administrative task of enormous complexity and certain of failure.

Q. Are there any regulations, standards or recommended practices that provide for exclusion zones or minimum separation distances with lower thermal radiation limits that better provide protection for the public.

A. Yes. There are several well known standards that recommend lower thermal radiation levels for the protection of people.

US Department of Housing and Urban Development

The Department of Housing and Urban Development (HUD) has established thermal radiation flux levels of 31.5 kW/m^2 (10,000 $Btu/hr\text{-}ft^2$) for buildings and 1.4 kW/m^2 (450 $Btu/hr\text{-}ft^2$) for people as guides in determining an "Acceptable Separation Distance" (ASD) between a fire consuming combustible liquids or gases and nearby structures and people. These HUD rules are codified in 24 CFR Part 51, Subpart C (paragraph 51.203) Safety standards. The following discussion from the preamble to the final HUD rule, 49 Fed.Reg. 5100 (February 10, 1984), helps to put the seriousness of this issue into context:

People in outdoor areas exposed to a thermal radiation level of approximately 1,500 BTU/ft^2- hr will suffer intolerable pain after 15 seconds. Longer exposure causes blistering, permanent skin damage, and even death. Since it is assumed that children and the elderly could not take refuge behind walls or run away from the thermal effect of the fire within the 15 seconds before skin blistering occurs, unprotected (outdoor) areas, such a playgrounds, parks, yards, school grounds, etc., must be placed at such a distance from potential fire locations so that the radiation flux level is well below 1500 BTU/ft^2- hr. An acceptable flux level, particularly for elderly people and children, is 450 BTU/ft^2- hr. The skin can be exposed to this degree of thermal radiation for a prolonged period of time with no serious detrimental effect. The effects at this exposure would be the same as a bad sunburn. Therefore, the standard for areas in which there will be people in exposed settings (e.g., outdoor recreation areas such as playgrounds and parks) will not exceed 450 BTU/hr. sq. ft. Areas covered also include open space ancillary to residential structures, such as yard areas and vehicle parking areas. An excerpt from this HUD standard is contained in Exhibit B herein. Note that the HUD rules specifically mention LNG as one of the hazardous materials that is subject to the acceptable separation distance rule.

SFPE Handbook of Fire Protection Engineering

The Society of Fire Protection Engineers Handbook of Fire Protection Engineering 2nd Edition recommends a level of 800 Btu/hr-ft^2 (2.5 kW/m^2) as a public tolerance limit for exposure to radiant heat (see page 2-114).

European LNG Regulations

The European LNG rule, EN 1473:1997, defines the maximum allowable incident thermal radiation flux at the LNG property boundary as 5 kW/m^2 for urban areas. However, the European code defines a lower allowable thermal radiation level as 1.5 kW/m^2 for "critical areas". Examples of critical areas noted in EN 1473 are areas which are difficult to evacuate on short notice. Therefore, the European LNG rules require review of the areas that may be impacted by a major LNG fire To emphasize the difference between US and European LNG codes, consider the example of a stadium adjacent to the LNG facility. The NFPA thermal hazard exclusion zone, defined as "1600 Btu/hr/ft^2 (5000 W/m^2) at the nearest point located outside the owner's property line that, at the time of plant siting, is used for outdoor assembly by groups of 50 or more persons for a fire over an impounding area." The EN 1473 regulation specifically defines a stadium as a critical area, and therefore the European standard would be 480 Btu/hr/ft^2 (1.5 kW/m^2) while the U.S. standard for this same area would be 1600 Btu/hr/ft^2 (5 kW/m^2). Thus, the US thermal exclusion zone rules are considerably less than their European counterpart.

<u>The World Bank</u>

In the 1988 World Bank manual, "Techniques for Assessing Industrial Hazards", the level of incident thermal radiation flux which causes no discomfort is listed as 1.6 kW/m^2. While this value is not a specific limit for site planning, it means that the site evaluation should review the adjacent areas out to this limit to see if special populations or critical facilities are impacted.

<u>Thermal Radiation Recommendations in API 521</u>

The American Petroleum Institute recommended practice 521 suggests permissible exposure to the thermal radiation from flares listed in the table below.

Permissible Thermal Radiation Exposure for Flares from API 521 (1997)

Thermal Hazard		Adjacent area considerations for determination of the acceptable separation distance
BTU/hr-ft^2	kW/m^2	
500	1.6	at any location where personnel are continuously exposed
1,500	4.7	areas where emergency actions lasting several minutes may be required by personnel without shielding but with appropriate clothing

It is inconceivable that the permissible exposure to the public outside the facility property line should be any less than the permissible exposure to personnel inside the plant.

Q Would you extend the consideration of a lower thermal radiation hazard limit to the LNG tanker route.

A. Yes. Two recent government sponsored reports provided estimates of the distance to the 5 kW/m^2 (1600 BTU/hr-ft^2) thermal flux level following an LNG release from an LNG tanker. The FERC revision of the ABSG report (table 4) estimates the distance to the 5 kW/m^2 thermal flux level as 5008 ft. Using the common point source approximation that incident thermal flux is proportional to the inverse square root of the target distance translates into about 1100 ft or almost 2 miles to the 1.5 kW/m^2 flux level.

The December 2004 Sandia report , titled "Guidance on Risk Analysis and Safety Implications of a Large Liquefied Natural Gas (LNG) Spill Over Water," estimates the distance to the 5 kW/m^2 thermal flux level as about 2000 meters (6560 ft) following an LNG release from an LNG tanker. Since Sandia used a zero wind speed in their analysis, the estimated thermal hazard impact distance using the DOT requirement of the largest local wind speed over 5% of the time would be expected to be an even greater distance. Nevertheless, again using the common point source approximation that incident thermal flux is proportional to the inverse square root of the target distance to the 1.5 kW/m^2 thermal flux level translates into over 21000 ft or almost 4 miles.

Q. What are your specific recommendations regarding thermal exclusion zones?

A. The clear intent of Congress to protect people from a major LNG release requires the consideration of a lower thermal hazard criteria (such as the 1.5 kW/m^2 value used by the Europeans or the 1.4 kW/m^2 value used by HUD) for areas adjacent to the facility and along the LNG tanker route which are inhabited by sensitive populations or critical facilities.

Therefore, FERC should consider the areas that may be subjected to the 1.5 kW/m^2 thermal radiation flux level following a major LNG spill, either from an LNG terminal or an LNG tanker.

Q. Can you illustrate the errors that FERC and some of the LNG industry use to justify refusing to consider the lower public thermal hazard zone.

A. Yes. Recently the NFPA 59A committee rejected a proposal by the member representing the views of the fire service to reduce the target thermal radiation flux values to be in agreement with modern fire service ideas[ ].

The reasons that the NFPA 59A committee advances in defense of this decision are preposterous. The following quotes are taken from the NFPA 59A white paper (59A-05-ROC) defending the decision to reject the thermal flux reduction proposal.

"such a level and duration are acceptable since a second degree burn is reversible if attended to promptly"

"... in a 30 second exposure a person can safely run away to a distance of 100 m at which distance the radiant intensity will be far less and thus avoid suffering a second degree burn"

Modern safety analysis would not define burn injuries as acceptable. The argument that the public can run away fast enough to avoid injury is equally ridiculous as it does not consider the elderly, children, or the handicapped.

To illustrate how preposterous the above NFPA 59A white paper statements are, consider that the same white paper noted *that "NFPA 59A Standard stipulates 5 kW/m^2 (1,600 Btu/hr ft^2) as a safe level of exposure at a property line that can be built upon next to a LNG storage facility"*

Clearly the 5 kW/m^2 (1600 BTU/hr-ft^2) thermal flux level can not be considered a "safe level of exposure".

The NFPA 59A white paper further states, *"... most regulations, worldwide, stipulate a level of 5 kW/m^2 as the acceptable level (for the purposes of facility design and location) for public exposure to thermal radiation hazards from a liquid hydrocarbon pool fire"*. The information on the HUD regulations, European LNG rules and the World Bank recommendations presented previously herein show that this statement is erroneous.

Although NFPA 59A continues to reject modern safety concepts, the FERC must employ the most current safety ideas in order to fulfill their duty to protect the public.

Q. Does FERC apply the widely accepted principles of Process Safety in it's deliberations and requirements?

A. No. The world wide process industry has embraced the process safety management concepts, such as the principles documented by the American Institute of Chemical Engineers. OSHA's Process Safety Management regulations in 29CFR 1910.119 are a prime example of this concept. However, OSHA does not have authority over LNG facilities, only because of the federal government mandate that OSHA regulation is precluded if another federal agency has safety regulations in place. Unfortunately this deference leaves outdated safety regulations, such as the DOT LNG safety regulations in 49CFR193, in full force. Other federal agencies with authority over segments of the process industry, such as the US Mineral Management Services rules over the offshore petroleum industry, have embraced process safety management concepts.

EPA, in 40 CFR68, expanded the process safety regulations to include impacts of hazardous chemicals outside the facility fence line.

Q. How would consideration of process safety management to proposed LNG facilities help accomplish the goal of public safety?

A. A safety management system that included formal hazard analysis would permit continuing technical review of the level of safety within the LNG facility.

A recent technical paper by ABSG (a FERC contractor) detailed the need for LNG facilities to be subjected to the safety management system concepts inherent in process safety. A copy of this paper is contained in the Exhibit C .

FERC contracted with IoMosaic Corporation in September 2004 to evaluate the cryogenic design review process and inspection program by which the FERC staff reviews proposed projects and ensures the continued operational reliability and safety of each jurisdictional LNG import terminal and peak shaving facility. See FERC solicitation number FERC04C40490. The scope of this project included:

An evaluation of the engineering and design information required of an applicant to file in its application under Title18, Code of Federal Regulations Part 380.12 in Resource Report 13; and the subsequent review criteria used by the staff to determine reliable and safe operations, and the adequacy of company operating and maintenance practices;

A review of the staff's application of the design spill criteria used to establish thermal radiation and flammable vapor exclusion zones at LNG facilities

An assessment of whether there are additional safety features or plant components that should be examined during inspections and/or application reviews;

An assessment of international construction, operation, and maintenance standards and/or regulations, e.g., in Japan or Europe, that offer better protection and/or operating and maintenance measures/standards.

An evaluation of the Cryogenic Design and Inspection Manual prepared during the design review of proposed facilities and subsequently used to evaluate facility operation; including whether there are additional facets of plant operations, maintenance procedures, or procedures that should be examined.

Even though the contract deliverable report was submitted in late January 2005, FERC has never released the report. As a frequent contributor to the process safety literature, it has been expected that IoMosaic would include process safety management recommendations in their report to FERC. The importance of this report is that it covers some of the concerns that have been raised herein.

Q. Why do you believe that FERC safety analysis uses inappropriate consequence models?

A. Dr. Havens has detailed the FERC's incorrect use of the plug flow vapor hold-up model for the evaluation of vapor dispersion exclusion zone evaluations. For the case of vapor dispersion exclusion zone evaluations for the process areas impoundment areas, FERC has opted to use the old NFPA definition rather than the previous DOT 193 *"§Sec. 193.2059* requirements. The result is that the "design LNG spill" in the FERC analysis is significantly less than the equivalent "design LNG spill" which would result from the previous DOT 193 *"§Sec. 193.2059* requirements, with the ultimate effect that the FERC vapor dispersion exclusion zone estimates are too small. The appendix to Dr Zinn's paper *presented at the recent* LNG *safety sessions of the American* Institute *of* Chemical Engineers conference details this FERC error. A copy of the Zinn detail discussion is Exhibit D.

Q. Dr. West, if the Commission were to accept your concerns and challenges, would it not have to reach the conclusion that it is not possible to certificate any LNG project?

A. Absolutely not. However, in the post 9/11 world it is prudent to insure the public against severe consequence events. This translates into locating LNG facilities at

a sufficient distance from the adjacent public to insure that catastrophic events will not compromise their safety.

UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

Weaver's Cove Energy, L.L.C. and Mill River Pipeline, L.L. C.)	Docket Nos. CP04-36-000, CP04-41-000, CP04-42-000, and CP04-43-000

DECLARATION OF WITNESS

I, Harry West, declare under penalty of perjury that the statements contained in the Prepared Direct Testimony of Harry West on behalf of the City of Fall River and the Attorney General of the Commonwealth of Massachusetts in this proceeding are true and correct to the best of my knowledge, information, and belief.

Executed on this 3rd day of June, 2005.

Harry West