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

1200 New Jersey Ave., S.E.
Washington, DC 20590

AUG 10 2009

The Honorable Deborah A.P. Hersman
Chairman
National Transportation Safety Board
490 L'Enfant Plaza East, SW
Washington, DC 20594

Dear Chairman Hersman:

This letter provides an updated response and requests the National Transportation Safety Board (NTSB) close Safety Recommendation P-04-01. Safety Recommendation P-04-01 recommends the Pipeline and Hazardous Materials Safety Administration (PHMSA) ***"Remove the exemption in 49 Code of Federal Regulations 192.65 (b) that permits pipe to be placed in natural gas service after pressure testing when the pipe can not be verified to have been transported in accordance with the American Petroleum Institute's recommended practice RP 5L1."***

Natural gas transmission pipeline minimum safety requirements contained in 49 CFR Part 192 provide an exemption to the use of natural gas transmission pipe transported before November 12, 1970. The exemption requires hydrostatic testing be performed under generally more stringent conditions than other pipelines in order to verify pipe integrity.

As stated in the enclosed report, the results of PHMSA analyses indicate:

- Typically, gas pipelines are not at significant risk of failure from the pressure-cycle-induced growth of original manufacturing-related or transportation-related defects.
- PHMSA records do not contain any known incidents involving failure of steel natural gas transmission pipe from the pressure-cycle-induced growth of original manufacturing-related or transportation-related defects.
- Test pressure levels of at least 1.25 times the Maximum Allowable Operating Pressure tend to eliminate the risk of failure from pressure-cycle-induced fatigue crack growth of defects, or other failure modes, for steel pipe in natural gas service.
- Future use of vintage, thin-wall pipe, which was transported by rail is highly unlikely, due to lack of availability of line pipe manufactured before November 12, 1970.

PHMSA research and experience indicates natural gas pipelines are not at significant risk of failure from the pressure-cycle-induced growth of original manufacturing-related or transportation-related defects. Moreover, the exemption contained in 49 CFR § 192.65(b) has not been demonstrated, through natural gas accident history or other data, to warrant any changes to the current regulation. Current industry practices of pressure testing, and the existing regulation, do not expose the public to increased risk of failures due to transportation-related defects.

Based on these conclusions and on the information presented in the enclosed report, PHMSA requests the NTSB classify Safety Recommendation P-04-01 as "Closed-Acceptable Action." If you have questions, please feel free to contact me at 202-366-4433.

Sincerely,

Cynthia Douglass
Acting Deputy Administrator

Enclosure

PHMSA Review of Transportation Related Damage and Fatigue Issues with Natural Gas Transmission Line Pipe

The U.S. Department of Transportation

July 6, 2009

Response to P-04-01

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EXECUTIVE SUMMARY

On July 4, 2002, an incident occurred near Cohasset, Minnesota where a 34-inch steel crude oil pipeline ruptured, releasing approximately 6,000 barrels of product (Ref 1). The cost of this incident was reported at approximately $5.6 million, comprising of "estimated property damage, including cost of cleanup and recovery, value of lost product, and damage to the property of the pipeline operator and others".(Ref 1). National Transportation Safety Board (NTSB) conducted an investigation and reported the probable cause "was inadequate loading of the pipe for transportation that allowed a fatigue crack to initiate along the seam of the longitudinal weld during transit. After the pipe was installed, the fatigue crack grew with pressure cycle stresses until the crack reached a critical size and the pipe ruptured". In response to this incident and the investigation, NTSB submitted three recommendations to U.S. Department of Transportation (DOT) – Research and Special Programs Administration (RSPA), now the Pipeline and Hazardous Materials Safety Administration (PHMSA), including the following:

> ***(P-04-01) Remove the exemption in 49 Code of Federal Regulations 192.65 (b) that permits pipe to be placed in natural gas service after pressure testing when the pipe can not be verified to have been transported in accordance with the American Petroleum Institute's recommended practice RP 5L1.***

This report evaluates the recommendation in light of PHMSA data and relevant research. The results of PHMSA analyses indicate:

- Typically, gas pipelines are not at significant risk of failure from the pressure-cycle-induced growth of original manufacturing-related or transportation-related defects.
- PHMSA records do not contain any known incidents involving failure of steel natural gas transmission pipe from the pressure-cycle-induced growth of original manufacturing-related or transportation-related defects.
- Test pressure levels of at least 1.25 times the MAOP tend to eliminate the risk of failure from pressure-cycle-induced fatigue crack growth of defects, or other failure modes, for steel pipe in natural gas service.
- Future use of vintage, thin-wall pipe, which was transported by rail is highly unlikely, due to lack of availability of line pipe manufactured before November 12, 1970.

1 Introduction

On July 4, 2002, an incident occurred near Cohasset, Minnesota where a 34-inch steel crude oil pipeline ruptured, releasing approximately 6,000 barrels of product (Ref 1). The cost of this incident was reported to be approximately $5.6 million. The pipe was reported to have been installed in 1967, and was API 5L Grade X52 pipe, with a 0.312-inch nominal wall thickness and a double submerged arc weld (DSAW) longitudinal seam.

National Transportation Safety Board (NTSB) reported probable cause "was inadequate loading of the pipe for transportation that allowed a fatigue crack to initiate along the seam of the longitudinal weld during transit. After the pipe was installed, the fatigue crack grew with pressure cycle stresses until the crack reached a critical size and the pipe ruptured". In response to this incident and the investigation, NTSB submitted three recommendations to U.S. Department of Transportation (DOT) – Research and Special Programs Administration (RSPA), now the Pipeline and Hazardous Materials Safety Administration (PHMSA), requesting consideration.

2 Background

National Transportation Safety Board (NTSB) issued the following recommendation to the U.S. Department of Transportation (DOT) – Research and Special Programs Administration (RSPA), now the Pipeline and Hazardous Materials Safety Administration (PHMSA), on July 1, 2004:

> ***(P-04-01) Remove the exemption in 49 Code of Federal Regulations 192.65 (b) that permits pipe to be placed in natural gas service after pressure testing when the pipe can not be verified to have been transported in accordance with the American Petroleum Institute's recommended practice RP 5L1.***

49 CFR Part 192 is entitled Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards. These regulations contain 49 CFR § 192.65 (b) and the exemption in question. This exemption deals specifically with gas line pipe with a 70 to 1 diameter to wall thickness ratio or greater, which was transported by rail before November 12, 1970, and operates at or above 20 percent of the Specified Minimum Yield Strength. The exemption also requires hydrostatic testing of at least 1.25 times the MAOP for a class 1 location and at least 1.50 times the MAOP for a class 2, 3, or 4 location, for a minimum of 8 hours.

Note that hazardous liquids transportation by pipeline is regulated by 49 CFR Part 195, which does not contain the exemption language in question here, and that the incident in Cohasset, Minnesota involves a liquids pipeline, and is therefore regulated by this Code.

The pipeline associated with the incident, a crude oil pipeline owned by Enbridge Pipelines, Inc., had a calculated pressure of 526 psig at the point of rupture and a maximum operating pressure of 687 psig. The ruptured pipe had a diameter to wall thickness ratio of 109 to 1.

A full record of applicable correspondences regarding this recommendation can be found at : http://www.ntsb.gov/safetyrecs/private/QueryPage.aspx

3 Discussion

Current language in 49 CFR § 192.65 (b) allows pipe with a high diameter to wall thickness ratio, transported by rail prior to November 12, 1970, to meet alternative pressure testing criteria, in lieu of maintaining proof of transportation in accordance with API RP 5L1. It is highly improbable that pipeline operators, or their contractors, would maintain significant quantities of pre-November 12, 1970 rail transported (unverifiable to API RP 5L1) pipe in inventory, and further, that that they would use such pipe for future construction.

Steel commodity price increases over 38 years and related increases in pipe costs, trends in industry towards "lean" operation, and storage related damage/corrosion of inventoried pipe being likely over this time-period, are variables which would make the future use of this vintage of pipe for construction highly unlikely, and therefore of negligible risk. This risk is diminished further when focusing specifically on transportation related defects leading to failure, as in this discussion. Furthermore, the pressure testing, as required by 192.65 (b), is an effective line of defense against critical defects in steel natural gas transmission line pipe, and is discussed below.

Per 49 CFR § 192.65 (b), the natural gas pipe discussed herein must be tested to 1.25 times the MAOP for a class 1 location and at least 1.50 times the MAOP for a class 2, 3, or 4 location. The report by Kiefner and Maxey (Ref 2) shows that the higher the test pressure to operating pressure ratio, the smaller the maximum size of defects which potentially remain in the tested pipe. The general premise behind the pressure testing requirement is that critical defects will propagate to failure at these test pressures and defects that do not lead to failure during testing, are not a significant risk for future operational failures, by fatigue or other failure modes, when subject to the stresses inherent to natural gas transmission.

A 2004 report by Kiefner & Associates, Inc (Ref 3) reinforces this, as it concluded that typical hydrostatic testing of natural gas pipe to a minimum of 1.25 times the MAOP is adequate to screen for defects which might lead to pressure-cycle-induced fatigue crack growth to failure, within a pipe's expected lifetime. The testing involved worst-case longitudinal seam defects that would "barely survive" hydrostatic testing. Calculations of projected failure times were made using aggressive natural gas pressure cycle spectra, based on pipe MAOP. The calculated times to failure were well above typical pipe lifetimes, as long as 1.25 times the MAOP or greater hydrostatic tests were performed.

These worst-case defects were therefore below the critical size that would lead to failure, for this scenario.

Pressure cycle spectra are plots of pressure vs. time, which capture the typical variations of pressure within a natural gas or liquids pipeline over the course of a desired period of time.

Pressure cycles in natural gas transmission pipelines have significantly lower amplitudes and changes in amplitude and are much less frequent than in liquids pipelines, and therefore, cycles, and time until failure, are much longer, and not of particular concern. Liquid pressure cycling, such as in a crude oil or other hazardous liquids pipeline, is known to be much more aggressive than when transporting natural gas. This difference is mainly due to the nature of hydraulic compressibility as compared to pneumatic compressibility of natural gas. Since liquids are relatively incompressible, a large drop in pressure, such as when a pumping station shuts off, will lead to a large downstream pressure drop, as compared to a smaller drop when a natural gas compressor station shuts off. Pressure cycle spectra in a liquids pipeline tend to have higher peaks and lower valleys, which can even approach 0 psig, a phenomenon that would only occur in an evacuated natural gas pipeline. These conditions lead to the greater susceptibility of liquids pipelines to pressure-cycle-induced fatigue crack growth.

PHMSA performed numerous data queries of regulated pipeline incident reports, seeking natural gas transmission pipeline incidents attributed to fatigue, from any cause (Ref 4). The results of these queries yielded a list of candidate incidents. After consideration of the full PHMSA incident reports, only five incidents involved natural gas transmission line pipe attributing fatigue as a possible failure mode. Only three of the five incidents were possibly attributed to pressure-cycle-induced fatigue, each occurring at the toe of fillet welds where there was a branch. The other two incidents involved wind induced cyclic fatigue at girth welds. All five of the incidents involved failures which initiated within construction welds, and not within pipe seams or the pipe wall, and therefore did not involve transportation related damage to the pipe.

Several other incident reports involve valves, weld-o-lets, and other peripherals which are outside the scope of this discussion. From this research, it is concluded that PHMSA incident records are consistent with the premise that natural gas transmission piping is not susceptible to pressure-cycle-induced fatigue failure that would result in a seam failure similar to the Cohasset, Minnesota incident. Incident records also show that pipe transportation related damage does not normally result in operational fatigue failures of natural gas transmission pipe, as none of the reviewed incidents originated in the pipe or the pipe seam, nor do they implicate transportation related damage.

4 Conclusion

Natural gas transmission pipeline minimum safety requirements contained in 49 CFR Part 192, provide an exemption to use of natural gas transmission pipe, transported before

November, 12 1970. The exemption requires hydrostatic testing be performed in order to verify pipe integrity.

The July 4, 2002 incident occurred near Cohasset, Minnesota, and the subsequent NTSB accident investigation, resulted in NTSB Recommendation P-04-01:

> ***(P-04-01) Remove the exemption in 49 Code of Federal Regulations 192.65 (b) that permits pipe to be placed in natural gas service after pressure testing when the pipe can not be verified to have been transported in accordance with the American Petroleum Institute's recommended practice RP 5L1.***

The results of PHMSA analyses indicate:

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5 References

1. National Transportation Safety Board, Pipeline Accident Report NTSB/PAR-04/01, PB2004-916501, Notation 7514A, Adopted June 23, 2004, Rupture of Enbridge Pipeline and Release of Crude Oil near Cohasset, Minnesota, July 4, 2002.

2. John F. Kiefner and Willard A. Maxey, "The Benefits and Limitations of Hydrostatic Testing", p 3.

3. J. F. Kiefner and M. J. Rosenfeld, "Effects of Pressure Cycles on Gas Pipelines" for P-PIC and GRI Project, GRI-04/0178, Contract no.: 8749, submitted on September 17, 2004.

4. Query run June 6, 2008 (incident data from 1984 through June 6, 2008) query of tables imported from Oracle database containing PHMSA gas transmission incident reports *(See Appendix A1 for details)*

A1 Appendix A1 – Database Information and Code from Incident Report Queries

- **Microsoft (MS) Access database:** tables.mdb

  This database contains source data and results of analyses of the source data.

- **User's data source:** PHMSA's Oracle database OPS9

  *A "full" data set—*JONESE.GAS_TRANS_DETAILS*—was generated by combining the appropriate tables and or views accessible to the user in OPS9. This full data set was then imported from Oracle into the Microsoft Access as the table* JONESE_GAS_TRANS_DETAILS. *The table has 2413 rows and contains data for 2305 RPTIDs.*

- **Name of user's Oracle account:** JONESE

  The MS Access object names both lacking lowercase characters and beginning with the character string JONESE *are tables or views imported directly from JONESE's work area in the Oracle database. In other words in this case, all objects identified within MS Access as* tables *were imported from the Oracle database. Generation of the so-called* queries *was in MS Access; such querying is a process inherent to MS Access.*

- **Results of a query written in MS Access**: JONESE_GAS_TRANS_DETAILS_Query

  There are 23 rows. These rows contain data for 23 RPTIDs.

- **Results of a query written in Oracle:** JONESE.GAS_TRANS_RESULT

  This results table was imported into the MS Access database as the table JONESE_GAS_TRANS_RESULT. *The table has 26 rows and contains data for 22 RPTIDs.*

With respect to the two queries mentioned above:

1. The MS Access query was:

```
SELECT *
FROM JONESE_GAS_TRANS_DETAILS
WHERE (((JONESE_GAS_TRANS_DETAILS.COMMENTS) Like '*cycl*' Or
(JONESE_GAS_TRANS_DETAILS.COMMENTS) Like '*fatigue*')) OR
(((JONESE_GAS_TRANS_DETAILS.CAUSE) Like '*cycl*')) OR
(((JONESE_GAS_TRANS_DETAILS.CAUSE) Like '*fatigue*')) OR
(((JONESE_GAS_TRANS_DETAILS.CAUSO) Like '*cycl*')) OR
(((JONESE_GAS_TRANS_DETAILS.CAUSO) Like '*fatigue*')) OR
(((JONESE_GAS_TRANS_DETAILS.WEBFORM_CAUSE) Like '*cycl*')) OR
(((JONESE_GAS_TRANS_DETAILS.WEBFORM_CAUSE) Like '*fatigue*'))
ORDER BY JONESE_GAS_TRANS_DETAILS.RPTID;
```

2. Oracle has features specifically for text mining. The following segment of a so-called *stored query expression* was the key part of the PL/SQL code:

```
create or replace function defineFeatureOfInterest
return varchar2
is
queryDescription varchar2(4000);
begin
   queryDescription:=
      '($fatigue - (corrosion fatigue | weather fatigue | '
        || ' NEAR((no=\\not,
$indication=$evidence=$sign=$associate, $fatigue), 4)'
        || ' )*0.6 ) '
        || ' ACCUM '
        || ' ( '
        || ' ($?cyclic | $cycle) - '
        || ' (cycle oil | gasoline cycle | inspection cycle |
("B" cycle) |'
        || ' NEAR((no=\\not, $indication=$evidence=$sign,
$cycle=$cyclic), 1) | '
        || ' NEAR(($freeze=$thaw, $cycle=$cyclic), 1) | '
        || ' NEAR(($wet=$dry, $cycle=$cyclic), 1) | '
        || ' NEAR(($valve, $cycle), 5) | '
        || ' NEAR(($graph, $cycle), 3) '
        || ') *0.6 )';
   return (queryDescription);
end;
```