06 June 2011
11 Yeager Drive
Cheektowaga, 14225

RE: Pipeline Safety Report to America /PHMSA–2011–0127

As a result of wide ranging concerns for pipeline safety, and in light of a broadcasted request for suggestions and other relevant data for an upcoming public meeting on pipeline safety, I am respectfully submitting this information for consideration relative to due-diligence precautions and planning to help ensure safety of pipelines. As a metallurgist with more than 40 years relevant experience, including employment as Metallurgist or Corporate Welding Engineer with utilities including Public Service Electric & Gas, and GPU Nuclear, and further, having taught Metallurgical subjects as Assistant Professor of Materials Science at a couple of local colleges, I have a detailed, thorough familiarity with various relevant engineering Codes and standards, and also am a member of several technical societies, including the ASTM (and ASTM Committees E-04, Metallography, and G-01, Corrosion of Metals).

Pipeline safety clearly requires a multiple path approach to provide the needed level of general confidence in utilities as well as rigorous verification of pipeline sufficiency and safety. I submit that the following areas of concern need to be addressed in some depth:

- **Utility Technical Expertise**

  As noted by the NTSB and other authorities, inspection manpower is now stretched somewhat thin. This poses an important consideration. Short of a *massive* build-up of inspection and auditing personnel, what might be done to 'get a feel' for a utility's technical expertise and their approach to gas line operations? A fairly recent article in the *Engineering News Record* regarding competence (in certain areas) of licensed professional engineers, suggested that a new, lengthier licensing exam would, among other things, more specifically identify areas of expertise. One reason for a revised exam is that engineers, and people in general, tend to be over-confident in their abilities and areas of proficiency. This was identified as *the Dunning-Kruger Effect.*

  It may be quite beneficial to have utilities which operate gas lines similarly produce some test pipeline design to standardized criteria, which would then be scrutinized and compared to design parameters that would have been developed by an expert panel commissioned by the NTSB or other appropriate agency. The comparison of the utility design to the correct 'standard' test design would be a relatively objective way of perceiving the technical competence of such utility. The standardized test design could also account for some typical difficulties which could and do arise in practice, such as pipeline support in difficult terrain. Cathodic protection could be included in the standardized test design.

Usage of such a standard test design would proactively demonstrate a utility's technical know-how, and simultaneously identify technical areas which may require bolstering. Whether such a standardized test would be applied once to any utility or be administered periodically (say, every decade or so) would be judgmental to be determined by appropriate regulators.

Further, utilities & gas pipeline operators need to demonstrate that they have a satisfactory quality program, which not only fully complies with appropriate regulations (including ANSI B31.8), but which emphasizes control of welding operations. Such quality program must detail handling of nonconformances and corrective actions. Qualified, written welding procedures which are appropriate for specific alloys and circumstances must be thoroughly developed and available to welding personnel.

- **Pipeline (Physical/Mechanical) Design**

  In addition to the Code of Federal Regulations, gas pipelines are covered in all aspects by ASME/ANSI Code B31.8, 'Gas Transmission and Distribution Piping Systems'. This engineering code has been in existence for a considerable time and, *when faithfully and rigorously implemented,* provides assurance that gas pipelines will be operational and in safe condition, to a high degree of confidence.

  Maximum Allowable Operating Pressure (MAOP) is established through the calculations specified in ANSI Code B31.8. The method of calculation is identical to that in the Code of Federal Regulations. Code calculation is the *PREFERRED* method of determining MAOP – and *NOT* merely reliance on hydrostatic testing. Additionally, elevated levels of stress (above say, 40% of SMYS) invoke additional requirements and restrictions by ANSI Code B31.8. Thus, it is prudent to utilize stress levels not above about 1/3 SMYS.

  Pipelines must have proper rating in conformance with Location Classes in regulations (ANSI B31,8).

- **Corrosion Controls**

  Although utilities (such as PG&E) employ cathodic protection (C.P.) systems throughout their pipelines, it needs to be emphasized that such C.P. systems are only good if properly maintained. Such systems can be somewhat complex, and if not adequately designed and afforded adequate maintenance, will *NOT* be providing corrosion protection as intended, thus leading to a false sense of pipeline integrity.

- **Development of Pipeline Documentation**

When a pipeline does NOT possess adequate documentation to identify the materials of construction &/or the pipe material strength, it is indeed possible to develop such necessary documentation. This documentation is necessary not only for records review, but also is needed whenever welding must be performed, whenever replacement pipe materials must be obtained, and when a pipeline must be reviewed for re-rating. Welding on a pipeline without having thorough knowledge of the materials involved, and *NOT* knowing the correct welding procedure or welding filler metal is a *Code violation,* and could conceivably lead to catastrophic consequences. Development of necessary pipe documentation involves obtaining a Certified Material Test Report (CMTR) for pipeline material. A CMTR is a certification that identifies and verifies a material by specification and grade by listing the chemical composition and mechanical properties. Sometimes metallographic data such as grain size and microstructure is also (optionally) identified on a CMTR. A standard CMTR also possesses a valid signature of attestation (and *optionally* a Notary, or even a P.E. seal). A utility can generate needed CMTRs by having *in-situ testing* done.

For the purpose of producing CMTRs, the following testing would need to be performed on questionable piping:

- ✓ Chemical analysis of the piping, by means of X-Ray Fluorescence Spectrometry (XRF). This is a *VERY* commonly used technique for accomplishing Positive Material Identification (PMI) on a wide variety of materials and product forms. It is very rapid (getting a readout in perhaps 5 to 15 seconds), easily done (in-situ) and typically should be quite accurate.

- ✓ The mechanical properties (tensile strength, yield strength, ductility & hardness) need to be determined. Although it may be impractical to obtain all strength values, it will likely be quite adequate to obtain the (ultimate) tensile strength and hardness. Various portable, nondestructive instruments are readily available for in-situ hardness testing. Such instruments are extremely portable, quick and adequately accurate. The tensile strength of steels bears a close relationship to steel hardness. Thus, if hardness is measured, a quick calculation will also provide the ultimate tensile strength of the steel.

- ✓ *IF* it would be desired to also include metallographic data such as grain size (of the piping material) on a CMTR, this also can be obtained in-situ, without extreme difficulty – although a bit more involved than other tests. The pipe microstructure and grain size can be obtained by metallographically polishing a spot on the subject piping and then employing a portable metallograph (metallurgical microscope) to photograph the prepared spot. Alternately, the surface microstructural features may be captured by polishing a spot and applying 'replication' materials to get a replica of the surface. This replica can then be analyzed for microstructure and grain size at a metallurgical laboratory. Metallographic replication is relatively quick, taking probably less than 30 minutes to obtain a surface replica.

A CMTR would also identify pipe dimensions. So in addition to the aforementioned testing, pipe diameter and pipe wall thickness would then also be stated. Pipe wall thickness is easily and accurately obtained by means of an ultrasonic meter. Many types are readily available and can be inexpensive. Needless to say, to perform any of the abovementioned actions it would be necessary to expose sections of buried pipeline.

- **Pipeline Fabrication, and Repair**

As stated, ANSI Code B31.8 covers gas pipelines, and dictates requirements for welding operations, for both initial installations and repairs. Several considerations relative to welding are of particular importance:

- ✓ What (qualified) welding procedures (WPSs) should be used. A qualified WPS *MUST* list essential variables such as material type & grade, material thickness, weld filler metal, preheat, et cetera. Welding heat input is of particular importance. As stated previously, if the piping material & grade are *NOT* known with certainty, then it would be a violation of any engineering Code, and potentially dangerous, to do welding without knowing appropriate data and using a correct WPS.
- ✓ Will post-weld heat treat (PWHT) /stress relief be performed on welds? Would appropriate PWHT equipment and PWHT procedures be readily available?
- ✓ As observed in the San Bruno failed pipe spool, weld joint geometry is eminently important to successful welding. To make any girth welds on such piping, weld end preparations (weld joint geometry) need to be machined on pipe ends. It would be quite inadvisable to attempt to generate weld preps manually, by using a torch or hand (angle) grinder.
- ✓ All welding inspection needs to be performed by an American Welding Society Certified Welding Inspector (AWS CWI).

- **Pipeline Inspection & Evaluation**

As stated above, all inspection of welds on initial installations and on repairs needs to be performed by an American Welding Society Certified Welding Inspector (AWS CWI). Obviously, piping which is already in-service also requires inspections and evaluation. It has been made very clear that hydrostatic testing and ‘pigging’ need to be utilized for in-service inspections. However, it must be recognized that hydrotesting cannot provide absolute assurance of piping &/or weld soundness. It is a fact that hydrostatic testing can indeed be successfully performed with the presence of an existing flaw which is nearly critical size. This author has seen at least a couple of instances of piping flaws which caused failure after being put back into service some period *AFTER* hydrotesting. In one instance, a large diameter, heavy wall pipe under high pressure failed some time after hydrostatic testing, and in failure analysis it was found that the failed girth weld possessed something less than 25% sound cross section prior to failure – but the pipe spool still passed hydrotesting. Note that this failure was a pressure (power) pipe governed by ANSI Code B31.1 (located at an electric generating station).

Other rigorous in-service test methods need to be implemented, rather than reliance on 'direct assessment'. The intent of direct assessment, utilizing 'CIPS' (Close Interval Potential Survey) is largely to ensure that a cathodic protection system is operational and adequate. It is *NOT* able to provide meaningful data on weld defects and similar anomalies.

- **Real-Time Monitoring of HCA Pipelines**

  A positive action to monitor pipelines would be to install Acoustic Emission (AE) sensors on pipelines (at least in selected, sensitive locations). Such sensors are utilized in various applications, even including helicopter rotors to monitor the helicopter blades for crack initiation. Various refineries and several utilities now employ Acoustic Emission monitoring. The University of Minnesota had performed a detailed study of the usage of AE monitoring of various infrastructure, in 1999. It was definitively found that Acoustic Emission monitoring is a very effective method (technically, and cost-effectiveness) of continuous monitoring, to ensure structural integrity. Acoustic emission is NOT an especially new test/inspection technique. This author has used acoustic emission sensors to monitor heat treatment on a large diameter pipe spool over thirty years ago, verifying freedom from any active flaws, at PSE&G (New Jersey). Acoustic emission can be a very effective, sensitive inspection & monitoring technique (if used properly). It will even identify active 'indications' which are *sub-surface and/or on a pipe I.D..* And by this point in time, it can also be used for remote monitoring – *and NO NEED to dig up a pipe to check for crack initiation!*

The aforementioned are *NOT* to be considered a comprehensive solution to pipeline integrity, but simply necessary considerations within a larger scope as defined by regulators and technical authorities.

Best regards,

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