Eddyfi Technologies

Beyond current

PHMSA STRENGTHENS GAS PIPELINE ASSESSMENT REQUIREMENTS BY ADDING GUIDED WAVE ULTRASONIC TESTING AS AN ADDITIONAL ASSESSMENT METHOD

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Introduction

After several years of consultation, the Pipeline and Hazardous Material Safety Administration (PHMSA) has revised the Federal Pipeline Safety Regulations to further improve the safety of onshore gas transmission pipelines. The document was published late last year and will become effective on July 1, 2020. Many of the changes concern the use of Guided Wave Ultrasonic Testing (GWUT) for the inspection of road crossings which the organization has found to really contribute to evaluating the integrity of gas transmission pipelines. The Federal document is over 400 pages in its entirety, and the GWUT is specifically covered in Appendix F. The purpose of this article is to assist customers in accessing the relevant information, summarize the changes, and explain what it means for implementing Teletest inspections in the field in accordance with this methodology.

Background

Pipeline operators have used GWUT for several years. Previously, operators were required to submit a notification to PHMSA as an ''other technology'' assessment method in order to apply GWUT. In 2007, PHMSA developed guidelines for how it would evaluate notifications for the use of GWUT. The organization has considered these guidelines to have been effective for over nine years, and they now have confidence that operators can use GWUT to assess the integrity of short segments of pipe against corrosion threats. In this final rule, PHMSA is incorporating these guidelines into a new Appendix F, which is referenced in 49 CFR § 192.921[1]. As a result of this rule change, operators will not be obliged to notify PHMSA to use GWUT.

In the current Federal Pipeline Safety Regulations, § 192.921 requires that operators with pipelines subject to the Integrity Management (IM) rules must perform Integrity Assessments. Currently, operators can assess their pipelines using In-Line Inspection (ILI), pressure tests, direct assessments, and other technology that the operator can provide an equivalent understanding of the condition of the pipeline. PHMSA recently proposed adding three additional assessment methods to the regulations:

1. A spike hydrostatic pressure test, which is particularly well suited to addressing stress corrosion cracking and other cracking or crack-like defects;
2. Guided Wave Ultrasonic Testing (GWUT), which is particularly appropriate in cases where short segments such as road or railroad crossings are difficult to assess;
3. Excavation with direct in situ examination.

Public Consultation

There was significant public consultation regarding improving the guidelines for GWUT and Eddyfi Technologies worked with customer partners to ensure that Teletest operators were considered within the recommended changes. For example, the individual specifying manufacturers of equipment have been removed from the document, and magnetostrictive sensor technology is also now accepted.

There were some areas of the document that remained unchanged. For example, despite some objections of the claimed unnecessary complexity in the GWUT data interpretation process, PHMSA has decided to retain the requirement to use both torsional and longitudinal wave modes. They

[1] Code of Federal Regulation, Title 49. Transportation, Subtitle B. Other Regulations Relating to Transportation Chapter I. PIPELINE AND HAZARDOUS MATERIALS SAFETY ADMINISTRATION, DEPARTMENT OF TRANSPORTATION Subchapter D. PIPELINE SAFETY Part 192. TRANSPORTATION OF NATURAL AND OTHER GAS BY PIPELINE: MINIMUM FEDERAL SAFETY STANDARDS Subpart O. Gas Transmission Pipeline Integrity Management Section 192.921. How is the baseline assessment to be conducted?

considered this is a longstanding requirement in PHMSA's guidance for accepting GWUT as an allowed technology under an ''other technology'' notification.

Double-ended inspections are not always necessary to meet the new Appendix F requirements; as long as the guided wave ultrasonic test covers the entire length of the assessment as well as the ''dead zone'' where the equipment is set up.

Part 192, Appendix F — Criteria for Conducting Integrity Assessments Using Guided Wave Ultrasonic Testing (GWUT) and associated comments regarding Teletest

Operators must apply all 18 criteria defined in the Appendix to use GWUT as an integrity assessment method. If an operator applies GWUT technology in a manner that does not conform with the guidelines of the Appendix, it would be considered ''other technology'' for the purposes of §§ 192.710, 192.921, and 192.937. GWUT in the ''Go-No Go'' mode means that all indications (wall loss anomalies) above the testing threshold [a maximum of 5% of cross sectional area (CSA) sensitivity] be directly examined, in-line tool inspected, pressure tested, or replaced prior to completing the integrity assessment on the carrier pipe.

I. Equipment and Software: Generation. The equipment and the computer software used are critical to the success of the inspection. Computer software for the inspection equipment must be reviewed and updated, as required, on an annual basis with intervals not exceeding 15 months to support sensors, enhance functionality, and resolve any technical or operational issues identified.

Teletest electronics can be calibrated yearly either through a return to base or via the Telecheck remote calibration equipment.

II. Inspection Range. The inspection range and sensitivity are set by the signal to noise (S/N) ratio but must keep the maximum threshold sensitivity at 5% CSA. A signal that has an amplitude that is at least twice the noise level can be reliably interpreted. The greater the S/ N ratio, the easier it is to identify and interpret signals from small changes. The signal-to-noise ratio is dependent on several variables such as surface roughness, coating, coating condition, associated pipe fittings (T's, elbows, flanges), soil compaction, and environment. Each of these affects the propagation of sound waves and influences the range of the test. It may be necessary to inspect from both ends of the pipeline segment to achieve a full inspection. In general, the inspection range can approach 60 to 100 feet for a 5% CSA, depending on field conditions.

The Teletest software is fully compatible with this procedure as standard. It is important that the PHMSA "linear extrapolation" CSA calculation is used within the software. This uses a linear relationship between % reflection and % cross-sectional area loss, specifically with this application in mind. -26dB is equivalent to 5% reflection of a 100% reflector.

III. Complete Pipe Inspection. To ensure that the entire pipeline segment is assessed there should be at least a 2:1 signal-to-noise ratio across the entire pipeline segment that is inspected. This may require multiple GWUT shots. Double-ended inspections are expected. These two inspections are to be overlaid to show the minimum 2:1 S/N ratio is met in the middle. If possible, show the same near or midpoint feature from both sides and show an approximate 5% distance overlap.

The Teletest software has a road crossing template contained within the software to enable this and prove coverage. The -32dB line (dashed line) is the noise line that shows the 2:1 S/N ratio and complete coverage is achieved.

IV. Sensitivity. The detection sensitivity threshold determines the ability to identify a cross-sectional change. The maximum threshold sensitivity cannot be greater than 5% of the cross-sectional area (CSA). The locations and estimated CSA of all metal loss features in excess of the detection threshold must be determined and documented. All defect indications in the ''Go-No Go'' mode above the 5% testing threshold must be directly examined, in-line inspected, pressure tested, or replaced prior to completing the integrity assessment.

Using the Teletest software, it is possible to estimate the CSA of all the metal loss features detected along the diagnostic length and report.

V. Wave Frequency. Because a single wave frequency may not detect certain defects, a minimum of three frequencies must be run for each inspection to determine the best frequency for characterizing indications. The frequencies used for the inspections must be documented and must be in the range specified by the manufacturer of the equipment.

It is typical for Teletest to collect 10 frequencies as standard and further frequencies added as required.

VI. Signal or Wave Type: Torsional and Longitudinal. Both torsional and longitudinal waves must be used, and use must be documented.

Longitudinal wavemode is easily deployable for Teletest as the equipment was designed with inspection of this wavemode in mind. It is widely available as it is contained within the Teletest Multimode module. This module is capable of collecting both Longitudinal and Torsional data in one collection, without the need for a tooling change.

VII. Distance Amplitude Correction (DAC) Curve and Weld Calibration. The distance amplitude correction curve accounts for coating, pipe diameter, pipe wall and environmental conditions at the assessment location. The DAC curve must be set for each inspection as part of establishing the effective range of a GWUT inspection. DAC curves provide a means for evaluating the cross-sectional area change of reflections at various distances in the test range by assessing signal to noise ratio. A DAC curve is a means of taking apparent attenuation into account along the time base of a test signal. It is a line of equal sensitivity along the trace which allows the amplitudes of signals at different axial distances from the collar to be compared.

This is standard for Teletest.

VIII. Dead Zone. The dead zone is the area adjacent to the collar in which the transmitted signal blinds the received signal, making it impossible to obtain reliable results. Because the entire line must be inspected, inspection procedures must account for the dead zone by requiring the movement of the collar for additional inspections. An alternate method of obtaining valid readings in the dead zone is to use B-Scan ultrasonic equipment and visual examination of the external surface. The length of the dead zone and the near field for each inspection must be documented.

The Dead Zone is clearly displayed on the Teletest software and if the dead zone needs to be included in the inspection, it can be inspected by using conventional UT or moving the position of the tool beyond the dead zone.

IX. Near Field Effects. The near field is the region beyond the dead zone where the receiving amplifiers are increasing in power before the wave is properly established. Because the entire line must be inspected, inspection procedures must account for the near field by requiring the movement of the collar for additional inspections. An alternate method of obtaining valid readings in the near field is to use B-Scan ultrasonic equipment and visual examination of the external surface. The length of the dead zone and the near field for each inspection must be documented.

In the case of Teletest, the near field effects are usually smaller than the dead zone and this area can be covered using the method described previously.

X. Coating Type. Coatings can have the effect of attenuating the signal. Their thickness and condition are the primary factors that affect the rate of signal attenuation. Due to their variability, coatings make it difficult to predict the effective inspection distance. Several coating types may affect the GWUT results to the point that they may reduce the expected inspection distance. For example, concrete coated pipe may be problematic when well bonded due to the attenuation effects. If an inspection is done and the required sensitivity is not achieved for the entire length of the pipe, then another type of assessment method must be utilized.

XI. End Seal. When assessing cased carrier pipe with GWUT, operators must remove the end seal from the casing at each GWUT test location to facilitate visual inspection. Operators must remove debris and water from the casing at the end seals. Any corrosion material observed must be removed, collected, and reviewed by the operator's corrosion technician. The end seal does not interfere with the accuracy of the GWUT inspection but may have a dampening effect on the range.

XII. Weld Calibration to set DAC Curve. Accessible welds, along or outside the pipeline segment to be inspected, must be used to set the DAC curve. A weld or welds in the access hole (secondary area) may be used if welds along the pipeline segment are not accessible. In order to use these welds in the secondary area, sufficient distance must be allowed to account for the dead zone and near field. There must not be a weld between the transducer collar and the calibration weld. A conservative estimate of the predicted amplitude for the weld is 25% CSA (cross sectional area) and can be used if welds are not accessible.

Calibrations (setting of the DAC curve) should be on pipe with similar properties such as wall thickness and coating. If the actual weld cap height is different from the assumed weld cap height, the estimated CSA may be inaccurate and adjustments to the DAC curve may be required. Alternative means of calibration can be used if justified by a documented engineering analysis and evaluation.

Teletest uses the standard 25% CSA for welds, but it is also possible to input cap heights if required.

XIII. Validation of Operator Training. Pipeline operators must require all guided wave service providers to have equipment-specific training and experience for all GWUT Equipment Operators which includes training for:

a) Equipment operation,

b) field data collection, and

c) data interpretation on cased and buried pipe.

Only individuals who have been qualified by the manufacturer or an independently assessed evaluation procedure similar to ISO 9712 (Sections: 5 Responsibilities; 6 Levels of Qualification; 7 Eligibility; and 10 Certification), as specified above, may operate the equipment. A senior-level GWUT equipment operator with pipeline specific experience must provide onsite oversight of the inspection and approve the final reports. A senior-level GWUT equipment operator must have additional training and experience, including training specific to cased and buried pipe, with a quality control program which that conforms to Section 12 of ASME B31.8S (for availability, see § 192.7).

Eddyfi Technologies provides training and certification that is compliant with ISO9712. All CSWIP Level 1 and 2 training cover the topics necessary.

XIV. Training and Experience Minimums for Senior Level GWUT Equipment Operators:

- Equipment Manufacturer's minimum qualification for equipment operation and data collection with specific endorsements for casings and buried pipe
- Training, qualification and experience in testing procedures and frequency determination
- Training, qualification, and experience in conversion of guided wave data into pipe features and estimated metal loss (estimated cross sectional area loss and circumferential extent)
- Equipment Manufacturer's minimum qualification with specific endorsements for data interpretation of anomaly features for pipe within casings and buried pipe.

XV. Equipment: Traceable from vendor to inspection company. An operator must maintain documentation of the version of the GWUT software used and the serial number of the other equipment such as collars, cables, etc., in the report.

The Teletest equipment is fully serialized on most components used.

XVI. Calibration Onsite. The GWUT equipment must be calibrated for performance in accordance with the manufacturer's requirements and specifications, including the frequency of calibrations. A diagnostic check and system check must be performed on-site each time the equipment is relocated to a different casing or pipeline segment. If on-site diagnostics show a discrepancy with the manufacturer's requirements and specifications, testing must cease until the equipment can be restored to manufacturer's specifications.

XVII. Use on Shorted Casings (direct or electrolytic). GWUT may not be used to assess shorted casings. GWUT operators must have operations and maintenance procedures to address the effect of shorted casings on the GWUT signal. The equipment operator must clear any evidence of interference, other than some slight dampening of the GWUT signal from the shorted casing, according to their operating and maintenance procedures. All shorted casings found while conducting GWUT inspections must be addressed by the operator's standard operating procedures.

XVIII. Direct examination of all indications above the detection sensitivity threshold. The use of GWUT in the ''Go-No Go'' mode requires that all indications (wall loss anomalies) above the testing threshold (5% of CSA sensitivity) be directly examined (or replaced) prior to completing the integrity assessment on the cased carrier pipe or other GWUT application. If this cannot be accomplished, then alternative methods of assessment (such as hydrostatic pressure tests or ILI) must be utilized.

XIV. Timing of direct examination of all indications above the detection sensitivity threshold. Operators must either replace or conduct direct examinations of all indications identified above the detection sensitivity threshold according to the table below. Operators must conduct leak surveys and reduce operating pressure as specified until the pipe is replaced or direct examinations are completed.

GWUT criterion	Operating pressure less than or equal to 30% SMYS	Operating pressure over 30 and less than or equal to 50% SMYS	Operating pressure over 50% SMYS
Over the detection sensitivity threshold (maximum of 5% CSA).	Replace or direct examination within 12 months, and instrumented leak survey once every 30 calendar days.	Replace or direct examination within 6 months, instrumented leak survey once every 30 calendar days, and maintain MAOP below the operating pressure at time of discovery.	Replace or direct examination within 6 months, instrumented leak survey once every 30 calendar days, and reduce MAOP to 80% of operating pressure at time of discovery.

Summary

Due to the success of using GWUT for evaluating the integrity of gas transmission lines over the last decade, PHMSA has recently made a substantial concession to how this technology can be deployed. This will make it simpler for pipeline operators to specify the use of Teletest for the inspection of short segments of pipe such as road or railroad crossings which are difficult to assess. The pipeline operators will now be able to test using Teletest without notifying the regulator as long as they apply all 18 criteria defined in Appendix F. Teletest is fully compliant with these new rules and we are available to support our customers with implementing these changes if necessary.

If an operator applies GWUT technology in a manner that does not conform with all the guidelines in Appendix F, it will then have to be considered “other technology” and permission will need to be sought from PHMSA as previously.