Guided Wave Check List

(In Groups)

This checklist of guided wave responsibilities is designed to assist inspectors in evaluating an operator's proposal for using guided wave tools as part of "Other Technology". It is not an exhaustive listing, but does highlight some issues/concerns with this technology that operators need to provide additional information to PHMSA on their intentions. For many of these issues, operators need to take a conservative approach and thus they may have to specify procedures and/or methods that they normally would not use. This is because the technology is not sufficiently advanced to provide exact measurements, so operators should be using the most conservative approaches, which need to be documented.

Under several of the items there will be an explanation as to why this item has been included in the checklist. In many cases the operators may not know what information is needed for an objective review of the notification and this checklist will help inspectors to request the additional information that is necessary to complete the review.

Operator Responsibility

1. When guided wave is being used as stand alone it requires notification to PHMSA and/or local regulators at least 180 days prior to use.
2. Information needed for casing testing (such as casing filling, casing condition, relative elevations for draining of casing water).
   Specifically for casings, operators need to determine the casing condition prior to testing and if there is anything in the annular space, such as wax, water, dirt, etc. All of these in addition to the coating can change or reduce the effectiveness of the guided wave tests.
3. Anticipated problems based on site specific factors.
   Even though the site selection may be determined by the location of the casing, operators need to provide the total length of test necessary and if multiple locations to cover the entire study area will be necessary. For example, if a 500' casing were scheduled for testing and the estimated range of the guided wave under the anticipated field conditions is 200', operators need to identify how the middle 100' of the casing is going to be evaluated (i.e. will the casing be removed at the 250' location and an additional test will be performed in both directions from that location and the results will be overlaid with the results from both ends).
4. Testing of non cased sections and possible use for calibration and validation.
   Guided wave devices send the waves in both directions. Operators can use this fact to use the non cased pipe in the opposite direction as the validation area. They need to have the guided wave contractor give them the location and sizing of any indications in that direction and then excavate them to compare the actual results to the guided wave predicted results. Doing this on both sides of the casing could be used to validate the accuracy of the equipment and to obtain an estimate of the total length that the guided wave is accurate.
5. All pipe conditions including but not limited to bends, joints, spacers, supports, contacts, adjacent metal objects, coatings (especially wire reinforced concrete), soil types and conditions.
   In order to validate the guided wave process, operators need to compare the results to known pipe physical characteristics and pipe conditions. Soils, environment, other features and defects can and will affect the length of accurate and reliable readings. All or most of these conditions need to be known before the start of the tests.
6. Defect Priorities
   Inspectors need to have operators document how they are going set defect priorities based on the results of a guided wave assessment. Since guided wave does not give exact sizes of defects, how is the operator going to set up an excavation schedule?
7. Method of defect determination for anomalies found with LRUT, i.e. x-ray, UT of pipe wall.
8. Determination of internal and external corrosion
   Guided wave technology does not differentiate between external and internal corrosion. Only by directly examining the location where the anomaly is located can it be determined if it is internal or external. Operators need to document how they are going to accomplish this, i.e. remove the pipe from the casing, remove the casing from the pipe, etc.
9. Remaining life calculation
   Guided wave tools do not give specific anomaly depth and length but rather an area that must be interpreted. Because of the lack of precision, operators should not be using a precise method of determining the remaining life of an anomaly but rather a conservative method such as B31G. Inspectors need to question operators on what method they are going to use. This is especially true of anomalies that do not have a direct examination.
10. Remediation method
11. Applied lessons learned to non covered segments as per §192.917?

12. Reassessment interval calculation per §192.939(a)(1) or §192.939(b)(1) as applicable.
    The operator needs to state how they are going to determine the reassessment interval, which can not exceed the maximum given in §192.939. Are they going to use the half life as per NACE RP 0502 or another method? We would recommend that the half life the remaining life be used since this is a conservative approach and should compensate for any measurement or tool errors.
13. Review and acceptance of results by qualified individual (NACE certification, ANST certification, P.E., etc.)
    The results from a guided wave assessment should be reviewed by qualified individuals who work for the operator. Such a review should involve quality control of the outside contractor and should be documented.
14. For pipelines subject to SCC, determination of SCC.

Guided Wave Contractor

15. Inspection parameters to be used such as frequencies, modes, amplitudes.
16. Signal to noise ratios (at proposed frequencies and modes) and expected attenuation rates at similar locations.
    The guided wave contractor should provide the operator with some basic information such as what are acceptable signal to noise ratios and over what length the guided wave should meet minimum performance guarantees at the conditions expected to be encountered based on past experiences on similar or identical environments (pipe diameter, wall thickness, soils, coating, casings, casing filling, etc.).
17. Sensor type, spacing, location and expected range (under current conditions).
18. Single or dual sensors
19. Algorithm status such as age, updating and past performance and if/how validated.
    The latest generation of guided wave tools uses algorithms to determine corrosion on the pipe wall. Many of these algorithms cycle the unit through several wave frequencies and possibly the linear and torsional wave forms. It is important that these algorithms are validated and that the most up to date ones are used.
20. Performance guarantee and range guarantee, if any.
    The guided wave contractor should provide a guarantee and for performance, similar to ILI MFL tools, and to a minimum range for accurate readings. Many factors may make the range short, such as coating and soil conditions, casing filling, large metal objects near the pipe, pipe size and wall thickness.
21. Method of converting area of metal loss into length and depth determination.
    The guided wave tool does not report metal loss in depth and length but rather as area. The tool may have an algorithm or other method to convert this area into suspected depth and length and the method needs to be documented and explained.
22. Method to be used for calculating remaining strength and inclusion of tool tolerances
    If the operator has the guided wave contractor calculating the remaining life of anomalies found, the method used and the inclusion of tool tolerances needs to be specified and documented. A conservative method should be used specified, such as B31G and the estimated tool tolerance added to all dimensions in the calculation.
23. Anomaly classification criteria.
    How is the guided wave contractor going to classify anomalies and what approved methods are they going to use (B31G, etc.)
24. QA method to be used to validate results.
    The guided wave contractor needs to have a QA plan that documents how readings are going to validated and what methods are going to be used (such as multiple passes on the same pipe length, using different individuals to interpret results, etc.)
25. Inspection and equipment procedures with calculations, tool tolerances, and procedures
26. Defect location and tolerances on distance from sensor
27. Location and dimensions of known indications such as welds, spacers, bends, etc.
    Known indications can be used as a method of performing an "under-test" QA/QC and to validate the guided wave results. If such known features can not be discerned from the test, the entire test may be suspect as to its accuracy and validity.
28. Filters used on sensors and in the algorithm.
    The newest generation of guided wave tools uses filters to eliminate unwanted clutter and noise from the reflected wave form. The tool contractor needs to document that the tool being used has such a capability and that these filters do not detract from the tool's accuracy, except where noted or accounted.
29. Operator notified of critical defect before leaving site?
30. Preliminary Report within ? days from test completion
31. Final report within ? days from test completion

Equipment Issues

32. Equipment calibration history

As with all other electronic measurement equipment, the calibration history and calibration requirements need to be documented.

33. Test and calibration of equipment prior to first test on site. How long between calibration tests, especially prior to testing at new site?
34. Frequency of calibrations during testing
35. Tool tolerances and signal attenuation at various ODs and WTs

    Operators need to have the tool tolerances and signal attenuation at the various ODs and WTs that are being tested so that they can determine the remaining strength and the reassessment interval. Per §192, the tool tolerances must be taken into account for these determinations.

Training Issues

36. Training and qualification of field personnel for equipment, procedures and wave frequency determination
37. Training and qualification of personnel performing data interpretation for filter screening, conversion of wave signals and interpretation of signals to metal loss (pit depth and length)
38. OQ training and other certification of testing and interpretation personnel

    There are no certifications for guided wave contractor personnel but some guided wave manufactures do offer training courses on the equipment. If a contractor's personnel have been trained, this could increase the confidence of obtaining valid results. Some personnel may have other training such as NDE which could be helpful in evaluating results.
39. Testing and interpretation personnel experience on this type of inspection

    Guided wave testing has been used in petrochemical plants for determining external corrosion under insulation. In previous generations of guided wave equipment, the experience level and the type of experience were critical to a successful test. The latest generation of equipment has a computer performing many of the tests to determine the best wave form and frequencies for testing and obtaining valid results but the experience of both the testing and interpretation personnel is still very important and can affect the quality and reliability of the testing.