

## Phased Array Inspection of Coke Drums

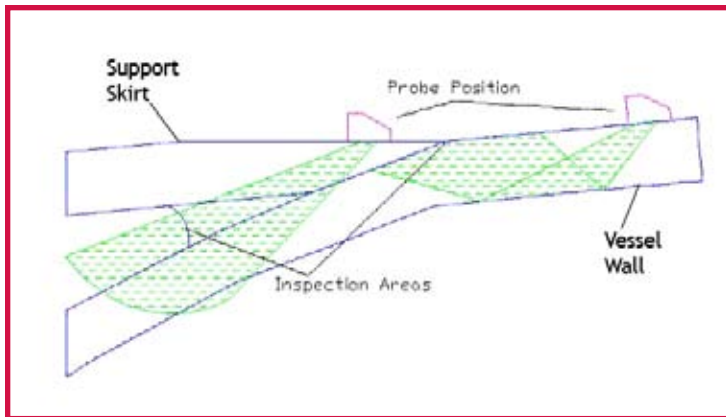
### *Current Condition*

Industry typically inspects the head to skirt welds of coke drums using Magnetic Particle testing and conventional Shear Wave methods. Typically, the indications found in this type of vessel are fatigue cracks that often result from the thermal fatiguing of the structure.

Magnetic Particle testing reveals indications on the outside diameter (OD) of the structure. Shear Wave inspection reveals indications on the inner diameter (ID) and also provides some level of sizing on the OD. However, it is difficult and costly to record the data and accurately track the growth of these indications. Additionally, shear wave inspections require scanning in the parallel and perpendicular directions to the weld. There has been a need to make this inspection quicker and more dependable, while providing the owner/operators with recordable visual data.

### *Phased Array Recommendation*

MISTRAS' Advanced NDT group was requested to provide alternate inspection techniques that would allow for a quicker inspection method while also providing the client with recordable data that could reliably track the growth rate of the indications and estimate more accurately the life of the structure or weld. Phased



*Scan setup for section of the coke drum head to skirt weld transition. Scan direction is perpendicular to the plane of the drawing.*



*Typical Coke drum inspections are difficult and costly. MISTRAS recommends Phased Array for a more rapid inspection method that delivers dependable, recordable visual data.*

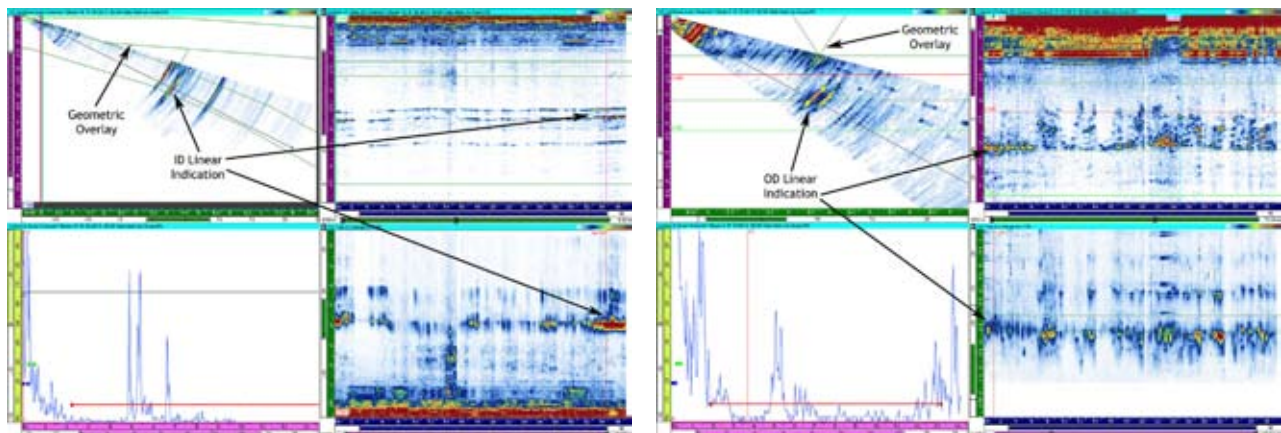
Array inspection was suggested. It has the advantages of electronic steering and focusing of the beam. This, in turn, provides for a larger area of inspection with much less rastering of the probe and greater accuracy of defect sizing. The inspection data is recordable in a secured file format.

Finally, Advanced Tomoview software allows for post processing of the data like CAD drawing superimposition on the UT signal/image, etc. This increases the probability of detection.

## Results

The inspection scanned the entire weld area of the 14 ft. diameter drum in two scans. The inspection and analysis of the results was completed in 7 hours. The phased array analysis could not find any significant ID indications throughout the transition. Geometric indications were found on the ID. This was clearly verified by superimposing the geometry of the profile onto the ultrasonic image. Typical indications on the OD were fatigue cracks which were found by magnetic particle testing (MPT). The Phased Array method was used to size these different indications based on the imaging and pattern recognition methods. Fatigue indications are typically tight cracks and it is important to identify the start of the indication correctly. The advanced imaging system of the Phased Array software allowed us to do just that, and hence, size the cracks more accurately.

Fatigue crack indications were found all around the vessel by MPT and the results were verified with the use of Phased Array scanning. The first image on the left shows a typical ID linear indication. It appears in the region of the transition, which is a stress concentration region. These indications are isolated events on a rather consistent set of geometry echoes that appear on the C-scans. The second image is a fatigue crack on the outside diameter (OD) of the specimen. It is known to be a fatigue crack because of



*Typical responses from the different indications in the head-skirt weld region and the transition zones.*

the thermal stresses that these structures are subject to. The C-scan shows a consistent occurrence of these indications around the length of the weld. These indications cannot be geometric because the OD is known to have no specific geometric indicators like a weld cap or transition.

The accurate sizing of the height and length of the indications made it possible for plant personnel to evaluate the remaining life of the vessel and to maximize safety as well as minimize downtime.

Let MISTRAS Services Division customize a coke drum inspection for you. Please contact your local MISTRAS office or the company's Corporate Headquarters in Princeton, NJ or feel free emailing us at [sales.services@mistrasgroup.com](mailto:sales.services@mistrasgroup.com). We also invite you to visit our web site at [www.mistrasgroup.com](http://www.mistrasgroup.com).

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