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Dear Reader,

Welcome to 2011, and to the premier issue of *PetroChem E-ssentials*, the new quarterly e-newsletter of PetroChem Inspection Services, a subsidiary of TÜV SÜD America!

For 30 years, PetroChem's expertise and industry reputation have been synonymous with quality, safety and efficiency. We hope that this and future issues of *PetroChem E-ssentials* will provide you with a broader understanding of our testing, inspection, and training capabilities in service and safety to the petrochemical and energy industries.

The publication of this issue of *PetroChem E-ssentials* coincides with the 2011 American Petroleum Institute (API) Inspection Summit and Expo, which begins on January 24th in Galveston, Texas. A number of PetroChem International technical experts will be sharing their latest research in papers, presentations, and workshops at this year's Summit. In this inaugural e-newsletter, we've provided a brief summary of each of the seven PetroChem Inspection Services expert presentations that are planned. Hopefully, you'll have time to attend one or more of these excellent presentations at the upcoming Summit.

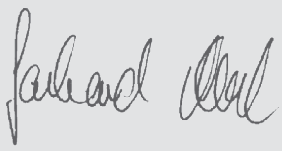
Our April 2010 acquisition of Mechanical Integrity, Inc. significantly expanded our capabilities in advanced field inspection services. In a separate article, “An Overview of Automated Ultrasonic Techniques,” we’ll discuss some of the automated ultrasonic testing technologies and inspection techniques we acquired through this acquisition that strengthen PetroChem’s position as a technical leader in inspection services.

Finally, PetroChem is pleased to announce its 2011 lineup of technical and certification courses for non-destructive testing operators. The training courses, which will be conducted out of PetroChem’s Houston, TX headquarters are being offered in conjunction with our partner, Lavender International, an internationally recognized training and consulting firm to the petrochemical industry.

Look on page 8 for the full article on course offerings for 2011, or contact us for more information on this exciting new training program.

We hope that you enjoy this first issue of *PetroChem E-ssentials*. If you have comments or suggestions on how we can improve this e-newsletter, or ideas for future topics, please let us know. Thanks!

Gerhard Abel



President
PetroChem Inspection Services

API Summit Showcases PetroChem Inspection Services Technical Experts

Technical experts from PetroChem Inspection Services will deliver several key presentations at the 2011 American Petroleum Institute (API) Inspection Summit and Expo, to be held January 24-27, at the Galveston Island Convention Center in Galveston, Texas.

The bi-annual API Inspection Summit is the premier venue for petroleum industry inspection and reliability professionals and examiners. The 2011 Summit will offer more than 120 individual technical program sessions over four days, covering topics in piping and pipelines, pressure vessels, and tank inspection. Programming on the final day of the Summit, Thursday, January 27th, will be devoted exclusively to sessions and workshops on career and skills development.

Here is a brief summary of the seven presentations being delivered by PetroChem Inspection Services professionals at this year's API Inspection Summit:

"What Lies Beneath: A Comprehensive Look at the Inspection of Buried Plant Piping"—Brant Shields, Monday, January 24th, 11:15am (Piping and Pipelines)
Corrosion at petrochemical and refining facilities has always been a major concern for piping integrity. Underground piping not only exacerbates the general external corrosion of the piping, but also makes more difficult the inspections required to ensure the safe and reliable operation of the buried segment. Recognizing the appropriate methods and tools that can be used to detect corrosion of buried piping is essential, and can result in an accurate inspection without excessive cost.

This presentation discusses various methodologies that can be used to examine different types of buried piping, including 100% buried segments, partially buried segments, cased/non-cased road crossings, and earthen dike wall crossings. Employing pre-assessments, indirect/direct inspections, and post-assessments can prove invaluable in executing an effective inspection. A comprehensive testing strategy for buried piping that applies different techniques can assist owners/users in discovering "What Lies Beneath."

"Real-Time Radiography"—David Morgan, Monday, January 24th, 4:15pm (Piping & Pipelines)
Real-time radiography is a non-destructive test method in which an image is produced electronically rather than on film, resulting in minimal lag time between the item being exposed to radiation and the resulting image. The image formed is a positive image, since the brighter parts of the image represent areas where increased levels of radiation have reached the screen.

Real-time radiography has become a relevant detection technology in today's industrial inspection industry. Real-time radiography equipment has vastly improved over the years, with the latest technologies offering easy-to-use applications that quickly provide inspectors with quality information. While there are some limitations to its use, the benefits of real-time radiography make its expanded use compatible with continued efforts to reduce inspection costs.

This presentation will discuss the benefits of using real-time radiography to quickly identify mechanisms such as corrosion under insulation, as well as to detect moisture inside of the insulation. The presentation will also review how the technology can be used in support of positive material identification (PMI) programs to locate and identify welds.

"Issues Regarding Ultrasonic Testing in Lieu of Radiography Testing"—Jared Williams, Tuesday, January 25th, 1:30pm (Pressure Vessels)
Many codes now permit the substitution of ultrasonic testing for radiographic testing, assuming that certain requirements are met. However, there are several issues that need to be considered when switching from radiographic testing to ultrasonic testing. Key issues include:

- *Testing accuracy:* According to the code cases, flawed blocks need to be manufactured to ensure detectability throughout the entire weld volume. This presentation evaluates the various code cases, and details the requirements for ensuring that qualification blocks fabricated for ultrasonic testing are correctly manufactured for inspection.

- *Personnel training*: There is no code requirement pertaining to the use of phased array ultrasonics beyond that of a Level II shearwave technician. This presentation highlights the importance of the specialized knowledge required to accurately perform ultrasonic examinations.

- *Costs:* This presentation evaluates the cost implications of using phase array ultrasonics in place of radiography in specific testing situations, providing a broader understanding of the costs and financial tradeoffs between the two methods.

"Computerized Radiography Imaging Review"—J.D. Woodward, Wednesday, January 26th, 10:30am (Tank Inspection)
Computerized radiography is one of the technological advances that allows contractors to collect data accurately and efficiently. However, many contractors have neither the equipment nor the training necessary to accurately review and annotate the computerized plates being radiographed in their shops and facilities. This presentation will review the techniques necessary to perform computerized radiographic inspections, and discuss methods to ensure the proper review of the data that is collected.

"Application of Field Data per the Requirements of API 653-Tank Inspection, Repair, Alteration and Construction"—John Hazel, Wednesday, January 26th, 1:30pm (Tank Inspection)
There are many damage mechanisms one might find while performing a tank inspection. But locating damage is only the beginning of the tank inspection process. The results of the inspection should be communicated in terms of the criteria specified in API 653 (if that is the standard specified for the inspection).

This presentation will discuss the three most common types of damage found in tank inspections, and the reporting issues and requirements under API 653, as follows:

- *Bottom plate corrosion:* This presentation will present the method of applying the MRT calculation to determine the recording threshold and the operating interval for this most common of reasons for tank failures.

- *Tank settlement:* This presentation will review the evaluation of tank settlement, and discuss how to determine the acceptable limits and the NDE required when this type of damage is present.

- *Shell corrosion:* This presentation will discuss where shell corrosion is most likely to occur and how it should be evaluated.

"Small Controlled Area Radiography (SCAR): Safer and More Productive RT Inspection, Nondestructive Examination"—Adam Zambrano, Wednesday, January 26th, 3:30pm (Tank Inspection)
Traditional gamma radiography has always been a cornerstone of non-destructive examination (NDE). Inspection results produced by gamma radiography have proven useful and have been relied upon for many applications, including code acceptance for weld quality and profile thickness measurement in both small- and large-scale mechanical integrity jobs. However, health and safety hazards, such as radiation doses, exposure incidents, and RT equipment malfunctions, represent well-known drawbacks to the use of traditional radiography.

Small controlled area radiography (SCAR) utilizes compact exposure devices with built-in collimation, allowing radiographic inspections to be performed more safely, and with equal if not greater levels of productivity when compared to traditional gamma exposure devices. SCAR allows for smaller restrictive barricades, eliminates the risk of flash dose to radiographic personnel, and may increase the overall productivity of radiography crews when utilized in congested areas where increased manpower is present.

This presentation will discuss the use of SCAR systems to reduce the hazards typically associated with traditional gamma radiography. The presentation will also cover the 989 exposure device, also known as the "Baby SCAR." The 989, which is the smallest SCAR-based device available for use today, represents the latest advancement in SCAR systems technology, and can make industrial radiography safer and more productive.

"Tank Inspection Overview"—John Hazel, Thursday, January 27th, 8:30-10:00am (Career Development and Skill Development)
The tank inspection market has grown steadily over the last decade. With this growth, the need for qualified inspectors and for the advanced technologies to perform accurate inspections has also grown. Continued market growth can be expected, as expanding environmental concerns drive the demand for increased tank inspections.

Technologies now being used in tank inspections, or which are soon expected, include phased array ultrasonic testing, alternating current field measurement (ACFM), mass spectrometer leak testing (helium leak testing), magnetic flux leakage (MFL) testing, vacuum box testing (LT/BT), visual testing (VT), magnetic particle testing (MT), and dye penetrant testing (PT). Despite the wide range of techniques already available, research continues to develop new techniques, or to adapt existing techniques to provide additional tools.

This presentation will review the requirements of applicable API standards, as well as essential information on the non-destructive testing techniques that will be increasingly used by tank inspection professionals in the future.

An Overview of Automated Ultrasonic Techniques

PetroChem Inspection Services solves real inspection challenges through the combination of state-of-the art non-destructive evaluation (NDE) technologies and skilled field service operators, technicians, and engineers. This article will review the automated ultrasonic testing (AUT) technologies and inspection techniques that make PetroChem a technical leader in inspection services.

The Technology
PetroChem employs the TD-SCAN automated ultrasonic inspection system developed by Technology Design. TD-SCAN uses non-destructive techniques, including pulse echo, corrosion mapping, phased array, and time of flight diffraction (ToFD), to evaluate piping and vessels, such as those found in the refining and petrochemical industries. TD-SCAN provides a true representation of the tested material which speeds the process of interpreting defects. Data is digitally recorded, and scans are repeatable for monitoring purposes.

TD-SCAN uses conventional and special transducers to generate sound in the test materials. These transducers are mounted to robotic crawlers, which articulate to cover large areas of vessel surface. The data collected is then displayed in color in multiple A-scan, B-scan, C-scan, and D-scan images.

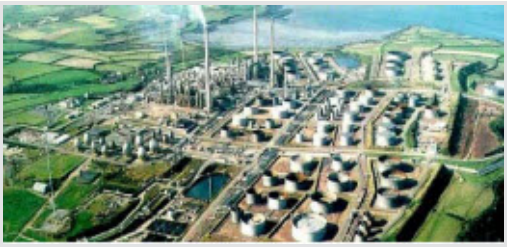


Figure 1: Corrosion mapping

The A-scan representation is the view in which the signal amplitude is shown as a vertical excursion from the horizontal sweep time trace. The B-scan and D-scan presentations are two-dimensional views of cross-sectional planes through the test object on different axis. This imaging is helpful in distinguishing mid-wall inclusions, such as laminations and blistering, from back-wall discontinuities like erosion and corrosion. The C-scan image is a two-dimensional plan view of the object. Indication of depth is color-coded to provide the image with qualities resembling a topographical map viewed from the inspecting surface.

Inspection Techniques

Pulse-Echo

Pulse-echo inspection is a process in which discontinuities are detected by the return echoes from the transmitted pulses. This is the most common ultrasonic method used, and usually consists of one or more search units acting individually to send and receive sound. There are several different ways to use pulse-echo ultrasonics, and each approach provides specific information pertaining to the test object.

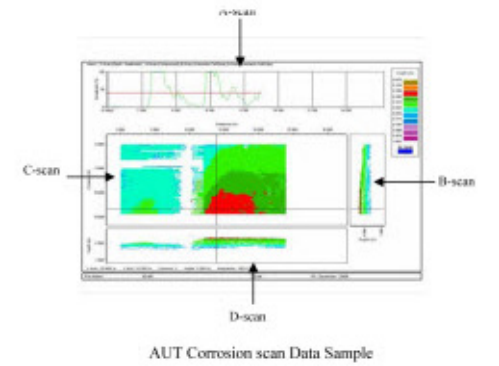


Figure 2: AUT corrosion scan data sample

Corrosion Mapping

Corrosion mapping is one of the more common inspections performed today. It provides reliable information about the remaining wall and ID geometries of equipment and piping to engineers and inspectors, who use the information to establish corrosion rates, equipment longevity, and maintenance and repair cycles.

Corrosion mapping also provides information on material integrity, such as laminar defects and blistering, which may occur due to the migration of hydrogen atoms through the material. All vessels and piping systems in the refining and petrochemical industry are subject to material degradation, and automated ultrasonic corrosion scanning can help detect where problem areas exist, or where they could exist in the future.

Using TD-SCAN, it is possible to scan up to 800 square feet of surface area each day. AUT corrosion scanning also provides digital images which can be regenerated or archived for future examination. AUT corrosion scans can also

be remapped to establish flaw extension over time, for assessments regarding fitness for service.

Pulse-Echo Weld Inspection
Pulse-echo weld inspection uses single or multiple search units, set at specific angles, to inject sound into the test weld to search for discontinuities and defects. These angled and zero-degree search units can be mounted onto a robotic crawler, which enables the inspector to cover large areas of weld in a reliable and repeatable manner, and in less time than that required to perform the work manually.

Depending on the thickness of the test material and the angle of the search unit sound path, the crawler rasters the transducers in a perpendicular motion to the weld in order to obtain full volumetric coverage of the material with the search units. This assessment is performed simultaneously from both sides of the weld, which detects, locates, sizes, and identifies the nature of the flaw. Any defects found with AUT weld inspection are then manually checked by the certified technician to be sure of reliability.

Most vessel and piping welds can be examined with pulse-echo ultrasonics, whether they are existing, repaired, or new production. Pulse-echo is the most widely-practiced and commonly used weld inspection technique in use today. Up to 300 linear feet of weld can be inspected per day with AUT weld scanning.

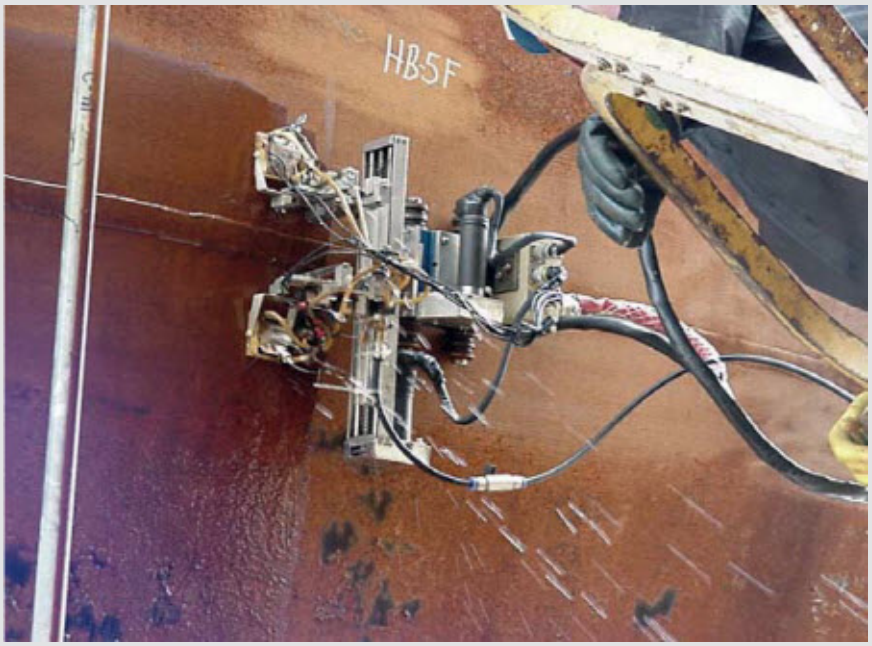


Figure 3: An example of a Crawler performing AUT weld inspection

Zoned Weld Inspection
Zoned weld inspection is another type of AUT weld inspection. The search unit (or units) is set at a specific surface distance from the weld, depending again on the thickness and angle used, and focuses the sound on a particular area of the weld. The crawler is then used to traverse the weld in a linear parallel to search for defects. Since no raster is needed, a zone weld inspection is one of the fastest AUT inspections and provides detection and flaw length information. Using AUT zone weld scanning, it is possible to inspect up to 500 linear feet of weld per day.

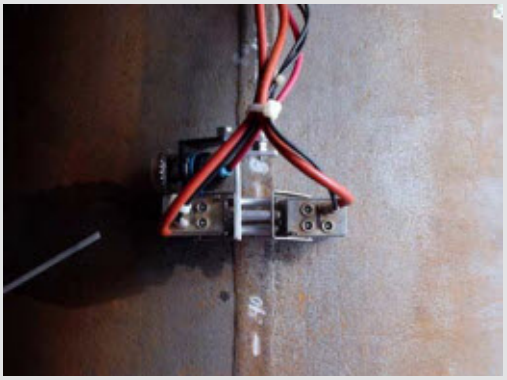


Figure 4: A manual encoded scan system for a zoned weld system

Phased Array

Phased array technology is one of the latest advances in AUT and provides many useful tools for inspection purposes. In pulse array inspection, an array of transducer elements is excited in precise timing patterns to produce specific desired effects, such as steering the beam axis or focusing the beam. This allows the user to inspect certain portions or volumes of the weld using many different beam angles and focal laws. The results may be viewed as A-scans, B-scans, or C-scans, or as sector scan images. This technique is also used in a single axis scan motion, which makes it faster than manual scanning.

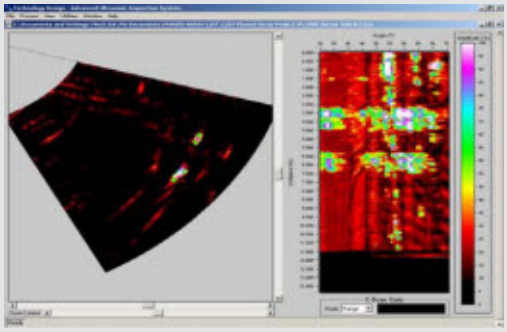


Figure 5: A phased array sector and B-scan image, showing lack of root fusion and lack of sidewall fusion

Figure 6: A phased array probe examining a half-inch weld sample in a water bath

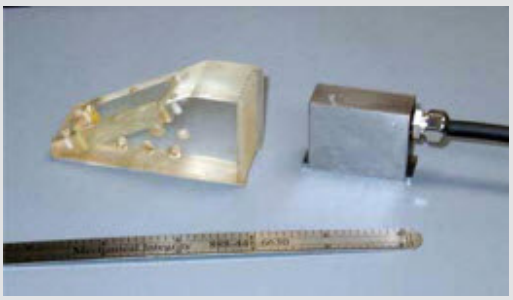


Figure 7: Samples of a phased array probe and wedge

Time of Flight Diffraction (ToFD)

Time of flight diffraction is a method for the accurate detection of flaws for weld inspection. Using two search units (one transmitter and one receiver), compression waves are injected into the test material at angles specific to the thickness range. This method introduces both the compression mode of sound as well as shear waves into the material. In most cases, full volumetric coverage can be attained. The display resembles black and white waves or lines, since each positive and negative half-wave cycle is recorded according to mode type and position gated in time.

Discontinuities are shown as breaks in the waves, or as additional waves between mode lines.
ToFD is much more sensitive than pulse-echo and is a useful tool when sizing defects in welds. The search units can also be attached to a robotic crawler, or to an encoded manual scan system, to quickly inspect welds in a single, parallel line scan motion, providing flaw detection, length, and depth. It is possible to inspect up to 500 linear feet of weld per day using AUT ToFD scanning.

Figure 8: An example of the ToFD probes on a calibration block

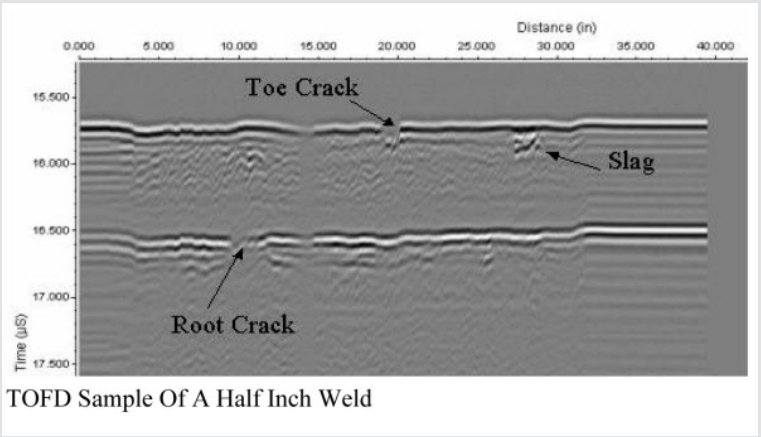


Figure 9: ToFD sample of a half-inch weld

The Scanners and Systems

Each scanning system is designed to handle day-to-day service in the most extreme petrochemical environments. The automated crawlers are fitted with coolant systems to help keep them operational at higher environmental temperatures, and have been successfully used at temperatures of up to 700 degrees Fahrenheit (371.11 degrees Celsius). Special couplant delivery systems can also be fitted to each scanner to help ensure proper sound transmission into each test piece. This provides inspectors with the ability to acquire accurate data even at the higher testing temperatures.

PetroChem Inspection Services Announces NDT Training Program

PetroChem Inspection Services, in cooperation with Lavender International Non-Destructive Testing USA, is pleased to announce the courses for its 2011 training and certification program for non-destructive testing (NDT) operators, to be conducted onsite at PetroChem Inspection's Houston, TX headquarters.

Our 2011 training program includes the following courses:

ToFD (10 days, including exam: $3,450)
This course meets the general requirements for Level 2 training and certification to the ISO 9712, EN 473, and SNT-TC-1A certification schemes. A comprehensive course syllabus is available upon request (see below). To be eligible for both the course and the exam, prospective students must hold a relevant Level 2 manual UT certification for weld testing using angle beam probes.

Phased Array (12 days, including exam: $3,950)
This course also meets the general requirements for Level 2 training and certification to the ISO 9712, EN 473, and SNT-TC-1A certification schemes. A comprehensive course syllabus is available upon request (see below). To be eligible for both the course and the exam, prospective students must hold a relevant Level 2 manual UT certification for weld testing using angle beam probes.

Advanced TomoView Online Data Acquisition and Analysis (5 days: $1,750)
This course is for those interested in applying advanced phased array software applications driving instruments in slave mode. Participants will practice generating different focal laws using TomoView software, and produce specific software layouts including polar views. In addition, data acquisition set-ups will be produced to combine phased array and ToFD enabling a comprehensive one-scan approach, suitable for efficient and reliable inspections.

TomoView Offline Analysis Software (2 days: $750)
This course is intended for those using Omniscan instruments, and for those holding Level 3 certification wanting to view Omniscan data offline using the Olympus TomoView full analysis software. The course can be supplemented by the "Detection, Characterization & Sizing" course (see below), which advances skills developed in this course to encompass full analysis principles.

Detection, Characterization & Sizing (2 days: $750)
This course offers further training to complement that of the "TomoView Offline Analysis Software" course (see above). It is intended for those using phased array technologies who want to improve the precision of their detection, characterisation and sizing skills, and become more confident in using TomoView for critical offline data analysis.

Manual UT Course: Butt Welds in Plate PCN Category 3.1 (for those with at least 5 years experience, 5 days, including PCN exam: $1,495)
This course will refresh operators on applicable general and specific theory, and also brush up manual UT skills including sensitivity calibration, scanning, detection, flaw characterisation and sizing technique. PCN Manual UT Category 3.1 Butt Welds in Plate exam follows directly after the training. Prospective students must hold a minimum of manual UT butt welds in plate category 3.1, and have at least five or more years of experience to attend this course.

Manual UT Course: Butt Welds in Plate PCN Category 3.1 (for those with less than 5 years experience, 10 days, including PCN exam: $2,795)
This course provides the requisite training for Level 2 UT certification for those with a minimum of 12 months documented work experience. The course follows the PCN manual UT syllabus, covering UT theory, calibration,

sensitivity, equipment checks, plate lamination and corrosion scanning, weld scanning, defect detection, and characterization and sizing. The 80 hour course will be taught over 8 days, followed by two days for the PCN exam.

The above courses will be conducted on the following dates in 2011:

- **ToFD**— February 2 - February 11
- **Phased-Array**—February 14 - February 25
- **Advanced TomoView**—February 28 - March 4
- **Manual UT Course** (for those with 5 or more years experience)—March 27 - 31
- **Manual UL Course** (for those with less than 5 years experience)—March 29 - April 8
- **ToFD**—May 24 - June 2
- **Phased-Array**—June 14 - June 25
- **TomoView Offline Analysis Software**—June 27 - 28
- **Detection, Characterization & Sizin**g—June 29 - 30
- **ToFD**—September 28 - October 7
- **Phased-Array**—October 12 - October 23
- **Phased-Array**—November 28 - December 9
- **ToFD**—December 12 - 21

The instructor for our 2011 training program is Tim Armitt, Technical Director of Lavender International, and a Level 3 instructor and consultant. With more than 20 years of NDT experience, Tim specializes in ultrasonic testing, and has developed a wide range of training programs covering NDT in the petrochemical industry. Tim has obtained ASNT Level 3 qualifications in UT, MT, PT, ET and VT, and is also a PCN Level 3 in eight separate categories.

Additional information about the PetroChem 2011 training program is available at http://lavender-ndt.co.uk/usa/usa.html. For questions about the program, or to register, contact Michelle Chapman at 281-913-9064, or michelle@lavender-ndt.com, or Nicola Dodsley at nicola@lavender-ndt.com.