IIW Annual Assembly – Denver, USA.
July 8th to July 11th, 2012.
Summary of Commission V Activities.
Report written by: Eric Sjerve (IRISNDT, 780-577-4477, esjerve@irisndt.com).

Summary
Dr. Philippe Benoist from France chairs this commission, but he is stepping down this year due to a change in work commitments. The commission's focus is in the areas of quality control and quality assurance of welded products, and as such it deals with NDT techniques. The IIW meetings have two main purposes: to gather together experts from around the world to discuss welding related issues, and to allow the flow of information between the member welding societies in the parent countries. The meetings with Commission V were done in the form of updates by the Sub-commission chairmen on their work during the past year, presentation of papers and group discussion on topics. Descriptions of the papers and summaries of the group discussions are given. The full texts of the papers are available by contacting the CCIIW.

July 9th, 2012 – Commission V Meetings

- **Presentation 1** – Commission V Annual Report, P. Benoist, France.
  - Benoist presented the annual report for Commission V, which was accepted. The agenda V-1518-12 for the 2012 meetings was accepted.
- **Presentation 2** – Administrative duties by Cecil Mayer, IIW CEO.
  - Mayer presided over the election of a new Chairman for Commission V, and Eric Sjerve from Canada was elected the new chairman.
  - Mayer presented an update on the journal, Welding in the World (WiW). Information was provided about the required publishing time for submission of an article and changes in the article review process. Springer has been chosen as the publisher for WiW.
- **Presentation 3** – Annual Report for Sub-commission VC (Ultrasonic Based Weld Inspection Topics), E. Sjerve, Canada.
  - Sjerve presented the annual report for Sub-commission VC, which was accepted.
  - There were four intermediate meetings: three to discuss the phased array (PAUT) calibration block project and one to discuss the Phased Array Handbook.
- **Presentation 4 –** IIW Phased array Handbook, E. Sjerve, Canada.
  - Sjerve gave a final update on the IIW Phased Array Handbook. DVS is going to publish this document in the summer of 2012 and it will be available for purchase.
  - Sjerve gave an update on the chapter structure of the Handbook with some examples from each chapter. Sjerve also acknowledged all of the contributing authors and described to their contributions. This project is complete.
- **Presentation 5** – Phased Array Calibration Block Working Group Update, E. Sjerve, Canada.
  - Sjerve presented an update on the activities of the working group charged with designing an IIW phased array calibration block. The following topics were discussed:
    - Sjerve described the working group composition, with additions from India and England in the past year.
    - Sjerve described the statement of purpose for this work and described the way virtual apertures are being used. This project is code driven, and Sjerve gave an ASME code update and Calmon gave an EN code update.
    - Sjerve gave a summary of the Indian input to the project, much of which was regarding practical issues. Updates were then given on the basic calibrations that the block must fulfil.
    - The Swedish representatives sent background on measurement system analysis as it pertains to this project, and Sjerve described this contribution.
    - The German representative sent index point migration calculations, which is the movement of the index point with sound angle.
    - Sjerve then discussed what secondary capability would be included in the calibration block. Different calibration block designs were presented, with agreement that the Doosan Babcock block was a good starting point.

- **Paper 1** – Update on Re-establishing a Facility for Absolute Calibration of Acoustic Emission Sensors per ASTM E1106, J. Fekete, USA, V-1531-12.
    - Fekete described how NIST is restarting this work after not being involved for the last ten years. Funding is coming through an infrastructure initiative in the USA. Applications are monitoring pipelines, tanks and bridges with acoustic emission (AE).
    - The goal is to do absolute calibration of AE sensors, rather than relative calibration. ASTM E1107-07 is the relevant standard.
    - Fekete described the technique that uses a large high quality forged steel block that is polished to a mirror surface. A glass capillary is then broken in a controlled fashion that generates acoustic waves that are used to calibrate the AE probe.
    - Chauveau commented that there is now a French standard allowing AE inspection of spheres to replace hydro-tests.
- **Paper 2** – Contribution of Ultrasonic Phased Array…, D. Chauveau, France, V-1528-12.
    - Chauveau described this project, which was done in collaboration with the Louvre museum in Paris. There was a Roman antique bronze figure dating to the first century BC that has been restored. This project is to use phased array to inspect welds attaching the arms, legs and head to the body, and to determine the welding process used.
    - The material was lead bronze, and Chauveau did not know an exact velocity. Inspection was possible on the legs, but not on the arms or the neck due to contoured surfaces.
    - Fusion flow welding was used, and it was possible to determine the weld bevel.
- **Presentation 6** – European Federation for NDT (EFNDT) – A Strong Voice for the NDT Profession, Peter Trampus, Hungary.
    - Trampus described this organization and how it is a voice for the NDT profession in Europe. There is currently an exchange of information between IIW and EFNDT.
    - Trampus described how EFNDT is a part of the larger organization ICNDT, which operates in four different regions (Americas, Europe, Asia – Pacific and Africa).
    - EFNDT member ship includes many of the national NDT societies in Europe. EFNDT has a mandate to promote NDT and increase NDT reliability.
- **Paper 3** – High Temperature Guided Wave Pipe Testing, E. Sjerve, Canada.
    - Sjerve gave an update on development work done in Canada on high temperature piezo-electric guided wave testing (GWT) equipment.
    - Sjerve started with a description of how guided wave testing differs from conventional bulk wave ultrasonic testing. Included in this were descriptions of: GWT wave modes, dispersion, symmetric modes, asymmetric modes, data display and limitations.
    - There was then a description of the how high temperature guided wave is done and the methodology used in this development work. Sjerve concluded by stating that this work can now be done on pipe with surface temperatures up to 400 ˚C.

July 10th, 2012 – Commission V Meetings

- **Paper 4** – Ultrasonic Phased Array for Characterization of Fatigue Cracks on Thermal Power Plants, D. Chauveau et al, France, V-1529-12.
    - Inspection of re-heater header and super heater header welds on a thermal power plant is described. These headers are prone to ID thermal fatigue cracks that propagate radially away tubes. Access is difficult and cracks will sometimes interact with each other.
    - The customer needs to know if the cracking is deeper than 20 mm for fitness for service. Tube diameter is 51 mm and header thickness is 54 mm.
    - Chauveau used CIVA to model and understand the ultrasonic signals that are possible with this configuration. Three configurations were considered: TT (shear-shear), LLL (long-long-long) and LLT (long-long-shear) modes. The modelling showed the relative amplitudes of these three signals, and they determined the LLL signal gives the strongest amplitude for cracks greater than 10 mm in depth.
    - Using the amplitude differences between the expected signals as well as crack tip diffraction, they were able to provide good results. A complicated calibration block was fabricated to allow proper calibration.

- **Presentation 7** – Update on ISO TC 44 SC 5 Work, D. Chauveau et al, France.
    - Chauveau gave an update on documents that TC 44 SC 5 (Non-destructive testing of welds) has been working on.
    - ISO 13588 deals with automated phased array testing of welds, and this standard deals with reference blocks used to set sensitivity. Chauveau states that this standard does not recommend a calibration block to use.
- **Presentation 8** – Annual Report for Commission VE (Weld Inspection Topics Based on Electric, Magnetic and Optical Methods), M. Kreutzbruck, Germany, V-1531-12.
    - Kreutzbruck gave a summary of past Sub-commission VE work, which concentrated on Magnetic Metal Memory (MMM) and micro magnetic methods. Kreutzbruck opened the floor to input on the future direction of VE.
    - He divided VE into three areas of interest: electric methods (ET), passive / active magnetic methods (an example of passive is MMM and active is MFL) and passive / active thermal methods.
    - Kreutzbruck gave information on the following topics he wants to pursue in VE:
        - GMR sensors (giant magneto-resistance sensors) for detection of magnetic fields with the goal of replacing MPI inspection in automated environments. GMR sensitivity is impressive to surface breaking flaws, and Kreutzbruck gave examples of GMR capability to detect surface breaking cracks that are as small as 10 microns deep and less than 1 mm long.
        - Active thermography for detection of surface breaking flaws. Kreutzbruck stated that there is a lack of standards in the area of active thermography as well in passive thermography. Kreutzbruck gave an update on laser activated thermography, using the same cracked sample that was used for GMR. Spatial resolution using lasers for heating is excellent, and the technique is well suited for automation.
- **Presentation 9** – IIW Guidelines on Weld Quality in Relationship…, B. Jonsson, Sweden.
    - Jonsson provided an update on the project "Weld Quality in Relationship to Fatigue Strength" that has been on-going in Commission XIII. They are writing an IIW document that will become an ISO standard on welds – both butt welds and fillet welds.
    - Dobmann is helping them by writing a chapter, and Jonsson is asking Commission V for help in writing an inspection matrix and attend their interim meeting.
- **Paper 5** – Application of the metal magnetic memory method for detection…, S. Kolokolnikov et al, Russia, V-1527-12.
    - Magnetic metal memory (MMM) functions by detecting residual stresses in welded joints as a determination of potential flaw locations. These areas are called SCZ (stress concentration zones), and sometimes correspond to micro flaws that are not detrimental to service, and in other cases correspond to macroscopic flaws. MMM can detect damage in its early stages before it grow into flaws.
    - SCZ occur after the initial material stage, and before micro-damage of microstructure. At some time in the future, these SCZ locations can develop into macroscopic cracks. MMM is quite sensitive to detection of micro-flaws compared to other NDT techniques.
    - Kreutzbruck questioned the validity of basic MMM theoretical research used as a basis for the MMM technique, and also how to calibrate the MMM technique.
- **Paper 6** – Thermographic Testing of Spot Welds, M. Kreutzbruck et al, Germany, V-1532-12.
    - Kruetzbruck gave a description of the history of spot welding, typical methods of destructive testing used and how thermographic testing can be used.
    - Kreutzbruck wants to replace destructive testing with an NDE technique that is capable of rapid spot weld inspection in a fabrication environment. The system he described uses a flash filter to heat the weld, and an IR camera that measures heat transfer.
    - They worked with a set of 75 spot welds – 25 being welded properly, 25 that do not have acceptable penetration and 25 that were contacted too long with unacceptable properties.
    - Examples of thermograms and processing algorithms are given. When processed, the three types of welds can be distinguished based on the early in time portion of the heating curve, which shows some promise for further technique development.

- **Paper 7** – Integrity Ensuring of Main Pipelines Means of Multiple In-line Inspections, O. Steklov et al, Russia.
    - This paper described maintenance techniques currently being used on aging Russian gas pipeline systems. They are experiencing an increase of failures due to corrosion, SCC and abnormal shaped girth welds. SCC is a small percentage of the damage mechanisms present, but results in the majority of the pipeline failures indicating it is a damage mechanism not well controlled.
    - Steklov then presented a case study for a 110 km long section of pipe that has had three ILI inspection runs done. Comprehensive statistics are given on the locations and severity of defects detected with ILI.
    - Some description is then given on the ILI pigs used for inspection of these pipelines, which are manufactured by the company doing the presentation.

July 11th, 2012 – Commission V Meetings

- **Presentation 10** – Annual Report for Sub-commission VA (Radiography Based Weld Inspection Topics), U. Ewert, Germany.
    - Ewert presented the annual report for Sub-commission VA. This group is active in the area of standardization and harmonization of radiography standards, with special focus on transfer of film radiographs to digital radiographs.
    - Sub-commission VA has one working group in Digital Industrial Radiology that is chaired by Dr. Uwe Zscherpel of BAM. This group has two main focuses: Focus 1 – new techniques and standards for weld inspection, and Focus 2 – training in digital industrial radiology. Ewert is trying to recruit people to join this working group. There have been no interim meetings with the digital industrial radiology since 2007.
    - Film based catalog of reference radiographs IIW-5817-2005 was reviewed in analogy to development of ASTM reference radiographs.
    - HOIS is conducting trials with CR, DDA and gamma radiography. Most of this work is focused on the petro-chemical industry.
    - Updates on ISO / ASME / ASTM standards were given.
    - A comparison is given between ASME and ISO IQI sensitivity over ranges of thicknesses, and it was found that ISO sensitivity is slightly higher than ASME.
    - Ewert presented an equation to calculate the limits of human perception of a hole, which depends on the SNR, effective contrast, effective pixel size and a fudge factor that is called perception threshold.
    - Ewert described two CEN standards dealing with profile wall thickness measurement (EN 16407-1 and EN 16407-2) that are being transitioned to ISO standards.
- **Paper 8** – New ISO 5817 and Revision of Reference Radiographs, U. Ewert, Germany, V-1542-12.
    - Some history was given on this project that was started in 1953. The latest revision is being done by DVS and is based on ISO 5817:1992.
    - Severity of weld imperfections was distinguished by different colours and the defect type is stamped on the outside of the card. NAIT in Edmonton has the older catalog.
    - The cards are updated to include metallurgical cross sections and pictures of the weld reinforcement, which aid in interpretation of the radiographs.
- **Presentation 11** – Welding in the World Update, B. Meester, Belgium.
    - Meester gave a WiW update. The main points relevant to Commission V are: progressive increase in the quality and number of papers per issue, peer review introduced in 2008, and accepted into SCI (Science Citation Index) in 2010.
    - Once a paper is recommended for publication, there are revisions required for the paper. There is one principle reviewer and one other reviewer that recommend changes.
    - Springer was chosen to be the publisher of WiW.
    - The role of Commission V is to recommend appropriate papers for the journal: i.e. proper format, non-commercial, scientific/engineering relevance and unpublished elsewhere.

- **Presentation 12** – Annual Report for Commission VF (NDT Reliability Including Simulation of NDT Techniques), P. Benoist, France, V-1536-12.
    - Benoist presented the Annual report for sub-commission VF. There were multiple meetings and organized initiatives across a number of countries.
    - The first part of this work involved simulation. The document V-1496-11 on guidelines for simulation proposed by Calmon last year has been accepted. We took a recommendation to publish this as an IIW Booklet.
    - There is also activity in the area of international database and benchmarking. The main objectives for the coming year are building a database across different modelling software packages to assess modelling and benchmarking. There are IP issues with some of the organizations giving data to this project.
    - The second part is in the area of objectives for POD supported by simulation. Work in this area requires a frame work to start standardization. There are existing standards in military aerospace in the USA.
    - Benoist gave an update on the Picasso project, which brings together many research organizations in the area of airplane engine reliability.
    - Benoist retired as chairman of Sub-commission VF and Pierre calmon was elected as the next chairman.
- **Paper 9** – Method to Calculate Ultrasonic Wave Velocity by Using Chemical Composition of Austenitic Stainless Steels, T. Yoshimoto atal, Japan, V-1523-12.
    - It can be difficult to determine the ultrasonic velocity of some types of stainless steel, unless they are the common ones. Equations are given for calculation of longitudinal and shear wave velocities based on fundamental parameters.
    - Yoshimoto then gives a theoretical basis for calculation of the independent parameters in the velocity equations based on chemical composition of the steel and known parameters.
    - Their estimate of longitudinal wave velocity was in the range of +0.5% to – 2% compared to experimental values. The shear wave estimate was of similar accuracy. It is unclear if this is accurate enough for the purposes of this paper.
- **Paper 10** – Validation of Ultrasonic NDT Models Implemented in the CIVA Simulation Software, G. Calmon et al, France, V-1526-12.
    - This is a follow up on the document presented in Chennai on use of simulation in NDT. The ultrasonic module of the CIVA software package was used.
    - There have been many comparisons between experimental data and CIVA modelling to validate modelling work. This work is a more systematic validation campaign where the level of accuracy of CIVA compared to experimental work is better quantified.
    - Calmon worked through a number of configurations: echoes from SDH, corner echoes from notches, etc. They spend much time making sure that the inputs to CIVA were correct: ultrasonic velocity, isotropy of the steel, characterization of ultrasonic equipment and specific measurements on wedge dimensions. Better understanding of experimental uncertainty was also done, which resulted in an experimental uncertainty of ±2 dB.
    - The results from SDH (side drilled holes) give good agreement, and include the addition of the creeping wave that circles the SDH. Results are presented for SDH of different diameters, all showing excellent agreement. There are also excellent results with multiple SDH at different depths, except when the SDH were close to the probe in the near field. CIVA uses some simplifying assumptions that in the near field.
    - Calmon then presented results for notches of a variety of depths. Agreement is excellent, except in cases of notches of small height with lower frequency probes. CIVA uses the Kirchoff model, which has issues when wavelength and notch height are comparable.
    - A short update was given on a TOFD comparison to experimental data.
    - All results presented are available on the Extende Web site.
- **Paper 11** – Recent Evolutions of the Simulated POD…, P. Calmon et al, France, V-1525-12.
    - Calmon presented an update on the approach of using simulation to support POD studies. There is an increase in using simulation to reduce the cost and to increase the reliability of round robin trials. The improvement in reliability is due to being able to simulate the POD of actual defects, rather than the notches, which are often used for these trials.

- Details of the approach are given, along with an electron beam weld inspection example. Porosity is the main defect that needed to be detected, and phased array was used for inspection with a beam focussed at the depth of interest.
- The Berens approach is used in CIVA for estimating POD curves. Calmon has done statistical analysis on this assumption, and it is robust for this application.
- There have been good results with simulation reproducing actual POD trials with nothing more than experimental data as input parameters. There is a strong effort in NDT to use more simulation to determine POD for certain defects.