

IIW Annual Assembly – Essen, Germany.

September 12th to 14th, 2013.

Summary of Commission V Activities.

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Summary

Dr. Eric Sjerve from Canada chairs this commission. 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 Commission V meetings 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 CCIW.

September 12th, 2013 – Commission V Meetings

- **Presentation 1** – Commission V Annual Report, E. Sjerve, Canada, V-1545-13.
 - Sjerve gave the opening remarks and the Essen agenda (V-1544-13) was adopted. Possible future Commission V activities were discussed and there was interest in the following topics: approach CXI and CXIII for a future joint workshop on probability of detection for weld flaws, discuss validation of phased array UT weld testing using CIVA as a joint project with CXI, and a workshop at the 2014 Korea Annual Assembly on guided wave testing. Sjerve will also approach Prof. Gong regarding the potential for NDT as part of his SC-AIR work.
- **Presentation 2** – Annual Report for Sub-commission VA (Radiography Based Weld Inspection Topics), U. Ewert, Germany, V-1546-13.
 - Ewert presented the annual report for Sub-commission VA.
 - It was decided to keep the working group C-V-A-a dormant in case of future need.
 - An overview was presented of digital radiography standardization to ASTM, EN and ISO. BAM has done a study about the possibility of harmonization between ASME and EN standards, and for pressure vessels this is not easily possible due to more stringent European IQI standards.
- **Presentation 3** – Development of a Digital RT Welding Catalogue, U. Ewert, Germany, V-1570-13.
 - Ewert gave a history of IIW involvement in RT reference radiographs. The most recent card layout for digital radiographs was done in 2005, and a two part project to update the IIW digital reference radiographs as a digital mobile catalogue was proposed.
 - A resolution was passed to publish the IIW reference radiographs in digital format, which will be done in two phases.
- **Paper 1** – RT-Simulation for Virtual RT-Training, U. Ewert et al, Germany, V-1571-13.
 - This paper described how to use BAM RT simulation software called aRTist for digital industrial radiology training. Development of modelling software at BAM was initially used for optimization of radiological processes and measuring system performance, but due to increases in computer speed can now be used for training.
 - A live demonstration of aRTist was done.
- **Presentation 4** – Annual Report for Commission VE (Weld Inspection Topics Based on Electric, Magnetic and Optical Methods), M. Kreuzbruck, Germany, V-1548-13.
 - Kreuzbruck presented the annual report for sub-commission VE.
 - BAM is doing research in the area of magnetic inspection of crack initiation.
 - A summary of active thermography for detection of surface breaking flaws was given, and it was shown that this technique has good ability for detection of small surface breaking flaws. Standardization in active thermography was summarized, and potential areas for future IIW activities in this field were presented. Gerd Dobmann commented that there was previous CV work in this area done by a Russian scientist.

- **Paper 2** – Magnetic Detection of Surface Breaking Cracks Using GMR-Sensor Arrays, M. Kreutzbruck, Germany, V-1573-13.
 - Kreutzbruck presented a paper describing fundamental studies and POD curves using GMR sensors. POD results were given for defects with specific depths, slot widths and orientations. Future work will include determination of false alarm rates and application to welded components
- **Paper 3** – Non-destructive testing of spot welds using transient heat flows, M. Kreutzbruck et al, Germany, V-1574-13.
 - Kreutzbruck presented results for spot weld testing. Test samples were fabricated that had three characteristics: too low heat input, correct heat input and too high heat input. The goal of this work is to distinguish these types of welds using active thermography. Details were provided on the testing procedure and the statistical analysis used to distinguish between the cooling curves of the three cases.
- **Paper 4** – Determination of Mechanical Properties of Welded Joints Metals..., S. Kolokolnikov et al, Russia, V-1555-13.
 - Kolokolnikov presented results of a study measuring residual stresses in welded samples using MMM (metal magnetic memory). Details were given on how samples were prepared and the results of MMM measurements through the base material, heat affected zone and weld. Statistical curves were presented showing the correlation between SCZ increases and micro hardness.
- **Paper 5** – Detection of Local Stress Concentration Zones in Engineered Product..., S. Kolokolnikov et al, Russia, V-1554-13.
 - Kolokolnikov presented a paper that showed MMM results for several non-welded cast components such as bar stock for oil and gas applications and turbine components. Background on the MMM method and a summary of the standard GOST R 52330-2005 were also given.

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- **Presentation 5** – IIW and ISO Standardization, A. Davis, USA.
 - Andrew Davis from the ISO-IIW standardization group gave an update to Commission V on IIW rules when performing ISO standardization.
- **Presentation 6** – Non-destructive Testing Stress-Strained State Test on Industrial..., S. Kolokolnikov, Russia, V-1578-13.
 - Kolokolnikov provided an update on an existing GOST Standard R 52330-2005, which is a high level document assisting users in understanding the issues related to stress / strain measurements. This standard doesn't refer to any one specific NDT technique.
 - It was proposed that this standard be forwarded to ISO for international standardization. Commission V will form a working party in Sub-commission VE (C-V-E-b) to study this proposal and report back to Commission V with a recommendation.
- **Presentation 7** – Annual Report for Sub-commission VC (Ultrasonic Based Weld Inspection Topics), D. Chauveau, France, V-1547-13.
 - Chauveau presented the annual report for sub-commission VC. The main two projects discussed in the last year were the joint project with Commission XIII on the table of NDT techniques, and the phased array calibration block project.
 - An overview was presented of EN ISO 13588, which deals with automated phased array weld inspection. This standard defers to ISO 5817 regarding quality levels.
 - A short description of ASTM E2929-13 was provided, which deals with magnetostrictive guided wave testing.
- **Presentation 8** – Phased Array Focusing Workshop Opening Remarks, D. Chauveau, France.
 - Chauveau organized this workshop and gave opening remarks about its goals. This workshop presents papers on non-conventional phased array (PAUT) focusing techniques. Some background was provided, and the workshop was put into the context of future development and industrial usage of these techniques
- **Paper 6** – Basic Principles of Phased Array Ultrasonic Testing, D. Chauveau, France, V-1582-13.
 - Chauveau presented a background paper that described standard PAUT techniques.

- An introduction of focal laws was given, along with the concept of phasing applied to phased array probe elements. Good animations were used to describe the possibility of forming different sound beams using these principles.
- **Paper 7** – FMC-TFM and Derived Imaging Techniques, P. Calmon et al, France, V-1583-13.
 - Calmon presented a paper that described FMC (full matrix capture) and TFM (total focusing method).
 - FMC was described as pulsing each individual element in a phased array probe and receiving on all elements: e.g. a 64 element phased array probe will have 64 signals for each time a single element is pulsed, generating a large amount of 64^2 wave forms.
 - The technique of TFM was then described as a signal processing algorithm that takes this large amount of data and does a summation of all time of flights for each voxel of interest within the inspection volume.
 - These techniques are advantageous compared to standard phased array in terms of their ability to provide optimal focusing and sensitivity, and good ability to handle complex geometry.
- **Paper 8** – Real-Time Non-destructive testing with Self-Adaptive Technique, P. Benoist, France, V-1559-13.
 - Benoist presented results using a technique SAUL (surface adaptive ultrasounds), which is able to rapidly adapt to complex surface geometry. Some background was given on the 2D surface adaptive probes developed by CEA and Imasonic in France, and their application to complex geometry.
 - SAUL is an advance that uses a flat phased array probe in an immersion configuration: the probe is pulsed with no delay law to image the part curvature under the probe. A modified focal law is then used to create an ultrasonic wave that is convergent on the complex surface at normal incidence.
 - An aerospace inspection was demonstrated for inspecting composite airline parts of complex geometry where SAUL is rapidly able to inspect the part in an immersion tank
- **Paper 9** – Quantitative Ultrasonic Testing of Acoustically Anisotropic Inhomogeneous..., G. Dobmann et al, Germany, V-1557-13.
 - Dobmann presented a paper that described a new technique called gradient elastic constant decent model, developed at the Fraunhofer Institute as part of a PhD thesis. This technique is used for inspection of coarse grained welds where beam skewing would normally make inspection difficult.
 - A weld model is built based on the expected grain structure of the weld, and the stiffness matrix is approximated by six parameters. Using a typical anisotropic weld with a known reflector, these six parameters are determined through iterative simulation until the inspection places the known reflector at the correct position. More rapid convergence is possible if some information is already known about the stiffness parameters
- **Paper 10** – 3D Imaging by Sampling Phased Array for Industrial Applications, G. Dobmann et al, Germany, V-1584-13.
 - Dobmann presented a paper showing advances in data display of phased array signals.
 - SPA (sampling phased array) was used for data acquisition, and a description of this technique was provided. SPA data is then acquired in successive shots to build up a volumetric inspection of the entire material. Rather than display data in RF wave forms or S-scans, the goal of this work is to display data in a format that is intuitive enough to not require an expert for analysis.
 - Many examples were presented where the data is displayed in a volumetric projection where the flaws are seen as embedded inside the material. Examples include inspection of thick walled piping, narrow gap welds, austenitic welds, cast components, etc.

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- **Paper 11** – Guide Wave Testing: A Review of Acceptance Standardization..., P. Mudge, UK, V-1572-13.
 - Mudge presented a paper describing current GWT (guided wave testing) standardization activities, including standards in UNI, IIW, BSI and ASTM. A GWT overview was

- presented, including a discussion of wave modes, frequency regime and the sensitivity to cross sectional wall loss.
- Future GWT directions were described, such as further improvement of POD for narrow deep axially oriented flaws, quantitative flaw depth measurement, GWT tomography and inspection of other geometries (e.g. rail and plate).
 - **Paper 12** – Phased Array Inspection System for Butt Fusion..., E. Assuncao et al, Portugal, V-1558-13.
 - Assuncao gave a paper on a European funded project called PepPak, to develop a commercial capability for inspection of butt fusion and electrofusion welds in polyethylene piping. The goal of this project was to develop a phased array inspection technique, determine critical flaw sizes and to produce a prototype system for this inspection.
 - Project methodology was given and results were presented on detection of artificially machined flaws. Commercialization of this technique is being done through M2M and will be available for purchase. Possible future work may be development of acceptance standards.
 - **Presentation 9** – Phased Array Calibration Block Working Group Update C-V-C-b, D. Chauveau et al, France, V-1577-13.
 - Calmon, Chauveau and Sjerne presented a project update. There were five interim meetings of this working group, and changes to group composition in the last year were given.
 - Initial work on developing an calibration block design has been finished, and this design was shown to the commission. Anisotropy has been a problem with current IIW blocks, so a proposal was presented on ensuring acceptable anisotropy in future blocks.
 - Future work involves modelling the block design using the modelling matrix. Comments were received and will be incorporated into this project. All relevant project documents are on the IIW Web site
 - **Presentation 10** – Update on Development of Table of NDT Techniques Joint Work with Commission XIII, D. Chauveau, France, V-1576-13.
 - Chauveau provided an update on this joint work with Commission XIII. This document is an IIW document describing guidelines on weld quality in relation to fatigue strength. Commission V was asked to contribute a table recommending NDT techniques for detect specific weld flaws.
 - It was decided that Commission XIII should give a paper at the next assembly describing the whole document.
 - **Presentation 11** – Annual Report for Commission VF (NDT Reliability Including Simulation of NDT Techniques), P. Calmon, France, V-1549-13.
 - Calmon presented the annual report for sub-commission VF. The main two projects that this sub-commission is involved in are simulation/validation of NDT techniques, and simulation assisted POD studies. It was shown that using simulation for POD studies improves the reliability of the study and lowers the overall cost.
 - The IIW Booklet, Recommendations for the Use and Validation of Non-destructive Testing Simulation IIW-2363-13 is now available through the IIW Web site.
 - Activities of the sub-commission during the past year were described. It was proposed to collect data from well characterized welds to build up a database that can be used for determining the of validity of existing models.
 - **Presentation 12** – Proposal for Writing a Best Practice Document for the use of..., P. Calmon, France, V-1579-13.
 - Calmon presented an argument for the need to write a best practices document for the use of simulation for generation of POD curves for NDT inspection. It was proposed to begin with ultrasonic testing of welds, and then likely progress to other inspection methods.
 - Using a relatively small amount of data from real sample blocks, simulation can be used to cost effectively fill in much of the required data to produce accurate POD curves. The objectives, methodology, time lines and group composition were discussed.
 - There was support in Commission V for this activity, and a working group in VF will be formed.

- **Paper 13** – Experimental Validations of Ultrasound Phased Array Simulation with CIVA, P. Calmon et al, France, V-1580-13.
 - Calmon presented a paper describing detailed validation work comparing CIVA modeling results to experimental phased array for determining simulation accuracy. This work was done with three phased array probe configurations on three calibration blocks.
 - Care was taken to ensure that the probe signal was consistent with the experimental waveform, and then this simulated probe signal was used for all subsequent work. Results were presented that were in excellent agreement with experiment. The only deviation was when comparing the ratio of shear vertical to longitudinal wave amplitudes.
- **Paper 14** – Simulation Support POD Curves for Automated Ultrasonic Testing, P. Calmon et al, France, V-1581-13.
 - Chapuis presented results using simulation for determining POD curves for pipe line girth weld testing.
 - The setup of this inspection was described, and is typical of this inspection using the zone discrimination technique. A simulated calibration scan was shown with signals in all of the zones using a standard Z-calibration block.
 - Detailed simulation results, including POD curves, were provided for a bevel fill zone, including an analysis of signal variations for misalignment of the probe and temperature variation. It was shown that minor misalignment resulted in the adjacent channel detecting the calibration reflector.