

IIW Annual Assembly – Seoul, South Korea.

July 14th to 16th, 2014.

Summary of Commission V Activities.

Report written by: Eric Sjerve (IRISNDT, 780-577-4477, esjerve@irisndt.com).

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.

July 14th, 2014 – Commission V Meetings

- **Presentation 1** – Commission V Annual Report, E. Sjerve, Canada, V-1615-14.
 - Eric Sjerve gave the opening remarks and the Seoul agenda was adopted. The meetings this year will have Sub-commission VF, VE and the GWT seminar on Monday; Sub-commissions VC and VE on Tuesday; and the continuation of Sub commission VE and the joint Commission XIII seminar on Wednesday. The commission V annual report was reviewed (V-1615-14), along with the Chairman's Report (V-1611-14). There was interest within Commission V to joint the meeting being setup by Commission XII on fibre reinforced plastics for the Helsinki 2016 IIW Annual Assembly. Eric Sjerve then talked about the IIW mandate and how Commission V needs to attract young people to our work. All people attending Commission V should focus on this in the coming year.
- **Presentation 2** – Annual Report for Sub-commission VF (NDT Reliability Including Simulation of NDT Techniques), P. Calmon, France, V-1618-14.
 - Pierre Calmon gave the annual report. The main two projects that this sub-commission is involved in are simulation/validation of NDT models, and simulation assisted POD studies. It was reminded that the IIW Booklet on recommendations for the use and validation of non-destructive testing simulation is now available on the IIW Web site. An overview of modelling benchmarking was given, along with potential future benchmarking projects. Some background was given on the French National Project involving ultrasonic modelling of welds.
- **Presentation 3** – Presentation on recommended practices for the use of simulation in POD curves for UT weld inspection, P. Calmon, France, V-1630-14 and V-1645-14.
 - Pierre Calmon presented the work in this area, which has been completed in first draft in the document V-1630-14. This document is organized into four sections: review of existing documents on POD; advantages and limitations of simulation in this context; prerequisites for the use of simulation; and methodology and examples of possible applications. A review of this document was given, and Commission V members should read the document for more information. This document has been sent to experts in the area of simulation for comments, which will be incorporated as they come in. It is Pierre Calmon's intention to present a complete document in Helsinki next year.
- **Paper 1** – Phased array simulation for evaluation of weld in offshore chain, J. Lee, South Korea, V-1619-14.
 - Jeongki Lee presented a paper describing detailed simulation work using CIVA to model the phased array ultrasonic response in a chain used for offshore applications. The chains are used to anchor offshore platforms, and they are difficult to inspect properly using manual ultrasonic inspection. The defect of interest is for lack of fusion in the welds that cannot be seen visually. Information about the modeling was provided to ensure full weld inspection coverage for lack of fusion. The experimental calibration sample that will be used for field inspections was then described.

- **Presentation 4** – Annual Report for Commission VA (Radiography Based Weld Inspection Topics), U. Zscherpel, Germany, V-1620-14.
 - Uwe Zscherpel gave the annual report. A detailed overview was presented of film radiography, computed radiography and digital detector array radiography weld quality standardization to ASTM, EN and ISO. The ISO standards structure for all kinds of radiography was described and how the standards interrelate. The ASTM DICONDE standard was briefly described, along with the potential problems when transferring radiographic files between equipment vendors. A detailed description of German activities for radiographic weld inspection in nuclear plants was given, with information on how to use the BAM snail for determining the angle of incidence of the radiation with respect to the weld axis. Information was provided on the guidelines when using flat DDA's on curved welds. Lastly, a description of ISO standards dealing with RT corrosion profile radiography was provided. Commission V recommends publication of this digital catalogue and fully supports this work; note that Resolution C-V-01-13 from 2013 in Essen is the IIW resolution to publish this work.
- **Presentation 5** – Update and demo of Phase 1 of publication of the digital welding flaw catalogue, U. Zscherpel, Germany, V-1621-14.
 - Uwe Zscherpel gave a summary of the current IIW project, and the history of IIW involvement in RT reference radiographs. This project is to take the film reference radiographs and redo them into a digital format. Initial development was to use PDF format, but this was changed because of copyright issues. The current format is to have an app deployed from a tablet that gives full access to the radiographs. A demo of the app was given showing how it works. It is possible to sort the reference radiographs and to zoom in on any location on the radiograph. Each weld has a radiograph, macro sections, along with visual pictures of the inside and outside weld surfaces. The format is impressive.
- **Paper 2** – Meeting Testing Class B Standards in Europe for Weld Inspection, U. Zscherpel, Germany, V-1622-14.
 - Uwe Zscherpel gave a presentation about Class B radiographic standards in Europe, which are used for all pressured equipment in Europe. Background was given on both film radiographic and digital radiographic parameters of importance for Class B testing, with emphasis on the contrast to noise and signal to noise values. Discussion about the differences between ASME and ISO IQI requirements was provided, with a good summary graph of IQI sensitivity requirements as a function of wall thickness. Measurement of spatial resolution and recommendations of x-ray tube voltage were provided for meeting Class B requirements.
- **Presentation 6** – Guided wave testing seminar introduction, F. Bresciani, Italy, V-1623-14.
 - Francesco Bresciani gave a summary of the basics of guided wave testing (GWT) for people in the audience that are not familiar with this inspection technique. A description of the length of travel of guided waves was given, along with the field conditions that can cause their attenuation. It was stated that GWT is a screening technique that requires follow up NDT to quantify damage. Analysis of data by trained personnel is of paramount importance, as it can be difficult to correlate GWT signals with pipe damage. Some discussion about how GWT that is done on buried piping is more difficult than above ground piping, as there is not possibility to visually inspect the pipe and the signal to noise ratio is lower.
- **Presentation 7** – Update on GWT ISO standard and review of ISO comments, F. Bresciani, Italy, V-1624-14.
 - Francesco Bresciani gave a summary of the ISO standardization activities Commission V has been pursuing with GWT. Francesco formed a working group within Commission V to modify an existing Italian GWT standard on piping inspection to an ISO standard. A detailed description of the sections in this standard was provided. This standard was submitted to ISO under Route II, and after a lengthy delay it has now become DIS 18211 (draft international standard). It has been accepted in ISO TC 135 and it has been sent to the ISO member countries for comment. These comments are expected in August 2014,

at which point Commission V must address them. Depending on the detail of the comments, this may be done in Helsinki or via e-mail ballot to Commission V delegates.

July 15th, 2014 – Commission V Meetings

- **Presentation 8** – Commission V Update, E. Sjerne, Canada.
 - Eric Sjerne presented the minutes from yesterday's meeting and notified the Commission of small changes to the agenda. There was also a discussion about how Commission V plans to work more closely with other IIW Commissions in the future. This will likely be through joint seminars, but may take other forms. There will also be efforts made to organize a structural health monitoring (SHM) seminar in Helsinki involving other IIW Commissions but lead by Commission V. Bastien Chapuis of France has volunteered to lead this, and he will be requesting support from other Commission V members to accomplish this task.
- **Presentation 9** – Guided wave testing simulation, B. Chapuis, France, V-1625-14.
 - Bastien Chapuis gave a summary of the new CIVA guided wave testing module in Version 11 of the software. A good summary of the physics of guided waves was given, along with a discussion on guided wave dispersion. Figures derived by simulation were given of particle motion for a variety of wave modes. In this version of CIVA, there is now the ability to do finite element analysis of the guided wave mode interacting with complex piping features, which gives an added capability to model real-world configurations. It was pointed out that the finite element modeling is done by the software only when needed and without the user having to specify any details. Two examples were given of simulated guided wave modes interacting with defects near geometric signals that show the power of using simulation to choose appropriate guided wave modes. It was commented that there are good commercial applications for this, especially in the SHM area.
- **Presentation 10** – Annual Report for Sub-commission VC (Ultrasonic Based Weld Inspection Topics), D. Chauveau, France, V-1626-14.
 - Daniel Chauveau gave the annual report. A short summary of the phased array (PAUT) calibration block project was given; this was the main project in this Sub-commission in the past year. A detailed summary of ultrasonic ISO standards was then provided, with good information about how the standards are used together. Summaries of the Sub-commission VC work in the areas of the PAUT IIW Booklet and the Commission XIII joint work on guidelines for weld quality in relationship to fatigue strength were given. Some measurements were provided using the M2M real-time TFM system, which is the only commercial system capable of performing this type of inspection.
- **Presentation 11** – General progress report for PAUT calibration block project, D. Chauveau, France, V-1627-14.
 - Daniel Chauveau gave a detailed presentation on this project, and he said that it is near completion. The technical work is mostly done and the calibration block design is complete, but there is still work to be done in preparing the ISO standard. First, the original justification for starting this project was given with a summary of the activities of this working group in the past year. All relevant working group documents are posted to the IIW Website for download. A summary of the draft ISO standard was then given. This standard obtained a positive vote from ISO earlier in 2014 to accept it as an ISO standard, so there is now a corresponding ISO DIS number. A detailed summary of the block design changes that were done in the last year since the Essen Assembly was given, along with the justification for these design changes. It was stated that this project is one of the first to use simulation to determine block design.
- **Presentation 12** – Anisotropy concerns for the calibration block; possible techniques to apply, D. Chauveau, France, V-1628-14.
 - Daniel Chauveau gave a presentation on the anisotropy concerns of ultrasonic calibration blocks. There was a good description of the steel making process and how this can create steels that are anisotropic for ultrasonic testing. This was followed up by measurements of the refracted angle of sound and attenuation as a function of what direction the sound was going in the steel with respect to the steel anisotropy. It was shown that there can be

a large effect with both angle and attenuation, which necessitates controlling the steel anisotropy. Four techniques were then described for measuring the anisotropy in steel; it will be the responsibility of the PAUT working group to decide what technique to include in the ISO standard. Lastly, the stiffness matrix was given, and then simulations of the various techniques for measuring anisotropy.

- **Presentation 12** – Guidelines on usage of phased array calibration block, E. Sjerne, Canada, V-1629-14.
 - Eric Sjerne gave a presentation on usage of the PAUT calibration block. It is the intention of the working group to publish an ISO standard that contains the standardization requirements for the calibration block, but to publish a detailed usage guide through IIW. A description of how to use the PAUT calibration block was given, and how measurements are different than for manual ultrasonic testing. Special thanks and credit was given to Ed Ginzel who provided the majority of the material on block usage.
- **Presentation 13** – Annual Report for Commission VE (Weld Inspection Topics Based on Electric, Magnetic and Optical Methods), M. Kruetzbruck, Germany, V-1631-14.
 - Marc Kruetzbruck gave the annual report. There was discussion about using GMR (giant magneto-resistive) sensors and how they are being used for magnetic flux measurements. An example was given for inspection of ICE roller bearings for surface breaking flaws. Impressive ability to detect very shallow flaws was presented, along with a POD study using EDM notches. This POD study resulted in an $a_{90/95}$ value of 16 μm . Also, a detailed study of the MMM method done at BAM was presented; this included a list of the groups in the world doing current MMM research. The basis of the MMM technique was described as the relationship between the magnetic flux, magnetic field, the stress and the strain through the magnetostrictive and Villari effects. It was stated that hysteresis is the cause of the MMM effect. There was then discussion about a number of different parameters and how they could affect MMM measurements, including: the of probes used to measure magnetic field, residual stress, part thickness, surface condition and hardness. There was then a spirited discussion in Commission V about these conclusions that was not resolved.
- **Paper 3** – Defect detection in friction stir welding by online infrared thermography, I. Kryukov, Germany, V-1633-14.
 - Igor Kryukov presented work done at the University of Kassel on infrared detection of flaws in friction stir welds. Samples were created with the following common friction stir welding defects: sound weld with no flaws, wormhole defect at the interface between the plates, lack of penetration and lack of penetration resulting in no attachment between the plates. A weld region was then chosen and temperature profiles were done during the welding process. It was shown that there are differences in the temperature profiles for these defects compared to the weld with no flaws. For the work hole flaw the temperature in the weld centre is lower, and for lack of fusion the temperature in a large area is higher. A video of a sample was shown that demonstrates this process.

July 16th, 2014 – Commission V Meetings

- **Presentation 14** – Commission V Update, E. Sjerne, Canada.
 - Eric Sjerne presented the minutes from yesterday's meeting. Marc Kruetzbruck gave a plan for moving forward with the MMM method. He will lead a working group within VE with the goal of performing round robin MMM trials. The two groups currently in this working party are the Russian group from Energodiagnostika and the German group from BAM. It is important to involve groups from other countries in this work. Daniel Chauveau and Andrew Davis then discussed the best way to proceed with the PAUT calibration block project. A vote was taken to activate this ISO standard project so that it can proceed to a vote in time to deal with ISO comments at the Helsinki Assembly; all delegates supported this resolution. Eric Sjerne informed the Commission that there will be an e-mail vote on the guided wave standard required this fall after addressing ISO comments through the DIS process.
- **Paper 4** – Analysis of defects in PIM materials using electrical based techniques, L. Quintino, Portugal, V-1632-14.

- Luisa Quintino gave a summary of a European project to fabricate improved magnets for energy generation through tidal technology. This material sinters a mixture of Somaloy power and high density polyethylene into a magnetic material. The concern is the consistency of the mixture and the uniformity of the generated magnetic field. Three techniques were used to measure the material conductivity: two point resistance measurement, four point resistance measurement and eddy current measurements. Summaries of these measurement techniques were given, and it was shown that the electrical resistance correlates to visually identified flaws. Magnetic measurements were also presented. It is early in this project, and future work will include making a decision on what measurement technique to use and on acceptance criteria.
- **Paper 5** – Surface defect detection using bacterial suspensions. L. Quintino, Portugal, V-1634-14.
 - Luisa Quintino gave a paper on using a bacterial suspension to detect small surface flaws. In micro fabrication, it is necessary to detect very small flaws as they can be detrimental to service. This method uses bacteria in the size range of 1 μm that are not dangerous for human health in the same manner as a liquid penetrant is used; it is applied, the excess is removed and then what remains is seen at surface breaking defects. The bacteria are aided in mobility with application of magnetic and electric fields. Results were given, and it is unclear if application of a magnetic field or electric field is better. It was commented that high sensitivity liquid penetrant techniques can achieve similar sensitivity to the bacterial results.
- **Presentation 15** – Microwave inspection of HDPE butt welds, M. Kreutzbruck, Germany, V-1635-14.
 - Marc Kruetzbruck gave a summary presentation of several techniques that can be used for inspection of HDPE. First, a summary of microwave techniques was given. An explanation of the physics of this inspection method was provided, and then many images of weld inspections were given. It was shown that microwave inspection is sensitive to common HDPE butt weld flaws. Standardization is beginning in this area, but there are not yet acceptance standards due to unresolved questions about what methods should be used and how they should be applied. A summary of air coupled ultrasound inspection was then given using new sensors developed at BAM. It was shown that these sensors give better signal to noise ratios than conventional sensors, and an example was given from an aerospace application.

Joint Session Between Commissions V and XIII

- **Paper 6** – Non-Destructive measurement of weld toe radius using Weld Impression Analysis, Laser Scanning Profiling and Structured Light Projection methods, E. Harati, Sweden, V-1639-14.
 - Ebrahim Harati gave a summary of three different techniques for measuring the weld toe: weld impression, laser triangulation and structured light. Summaries of all three techniques were given. It was shown that all three techniques are capable of measurements at an accuracy sufficient for this application; a table was given showing a more detailed comparison of the techniques. There was some discussion about how modelling of the radius of curvature of the weld toe should be done.
- **Paper 7** – Mobile X-ray tomographic inspection of welded austenitic pipes in nuclear power plants, U. Zscherpel, Germany, V-1636-14.
 - Uwe Zscherpel gave a summary of a RT topographic technique possible for measuring crack depths. These techniques use moving x-ray sources and digital detector arrays; by moving the x-ray source transversely across the weld it is possible to be incident on the crack at angle that is optimum for detection. The data is then deconvoluted to give a detailed depth profile through the weld. Examples were given from cracked samples, and then nuclear applications in Germany and Switzerland.
- **Paper 8** – Assessment of quality effects on the fatigue life of laser and laser hybrid welded specimens, C. Robert, Germany, V-1640-14.
 - Christopher Robert gave a presentation on fatigue lifetimes of laser welded transverse stiffeners. A total of 173 samples were welded at thicknesses of 4 mm and 10 mm. Fatigue testing results and finite element analysis results were presented. A correlation with FAT classes and a comparison to literature were given.

- **Paper 9** – Ultrasonic modelling of austenitic welds, P. Calmon, France, V-1637-14.
 - Pierre Calmon gave a presentation about a French project to model ultrasonic propagation through anisotropic stainless steel welds. First, a summary of basic ultrasonic inspection and modeling principles was given. It was shown that full numerical models can be used to calculate the sound path and response from defects for highly anisotropic and course grained structures. Examples were given from a number of experimental configurations.
- **Paper 10** – Fitness for Service assessment of defected welded structural details by experimental evaluation of the fatigue resistance S-N curve, S. Chiara, Italy, V-1641-14.
 - Servetto Chiara gave fitness for service assessments by performing fatigue testing on representative samples from both bridge and ship structures. Three different methodologies were compared for fatigue assessment: effective notch stress method, fracture mechanism method and peak stress method. Detailed results of how these three techniques perform were given. It is noted that there were weld flaws in both sets of samples, and these did not affect fatigue resistance.
- **Paper 11** – Assessment of welded joints before and after heat treatment based on MMM, S. Kolokolnikov, Russia, V-1638-14.
 - Sergey Kolokolnikov gave a summary of MMM as applied to heat treated samples. The results were done on two pipe samples: 159 mm diameter by 6 mm thick, and 108 mm diameter by 6 mm thick. Results were presented on both samples for the as welded, after high temperature tempering and after normalization. These results showed a significant reduction in the magnetic field intensity and the magnetic field gradients after both high temperature tempering and after normalization.