IIW Annual Assembly – Dubrovnik, Croatia.
July 1st to July 4th, 2007.
Summary of Commission V Activities.
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Summary

Dr. Gerd Dobmann from Germany chairs this commission. Its 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 both 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. I will provide descriptions of the papers given and summaries of the results of the group discussions. The full texts of the papers are available by contacting the CCIIW.

July 2nd, 2007 – Commission V Meetings

- Dr. Daniel Beaufils gave an update on IIW procedural matters. The Welding in the World journal has made some improvements in the time to publication and the number of available on-line documents. He is also retiring in early 2008, and will be replaced by another person from France.
- Dr. Gerd Dobmann provided an update that the Welding in the World Journal is now requiring three reviewers for all published articles. This journal is now an official reviewed journal with the required process.
- **Presentation 1** – Annual Report for Commission V (NDT and Quality Assurance), G. Dobmann, Germany, V-1372-07.
    - No interim meetings for Commission V.
    - The average attendance for the 2006 Quebec meetings was roughly 20 people from 10 countries.
    - The joint seminar with Commissions X and XI was a success and has resulted in some collaborative work. This seminar was held last year and focussed on progress on fitness for service assessment of welded construction.
    - As a group we need to start formulating a plan on data formats to store NDT results. The different NDT techniques have different data formats to display and store the inspection results. This is true also within disciplines, as there are multiple data formats used for AUT also. In order to be able to compare results in the future, this needs to be addressed.
- **Presentation 2** – Presentation of Commission V Documents, G. Dobmann, Germany.
    - Presentation of document V-1375-07, the strategic plan for Commission V. Each commission had to prepare a strategic plan for the time period 2007 – 2012 that fits into the broad overall guidelines provided by the IIW.
    - The main goal of the plan is to "identify, create, develop and transfer best practices for sustainable development in a sustainable world".
    - More specifically, there are four categories of objectives:
        - Initiate and develop global best practices.
        - Organize the exchange of scientific and technical information and provide an environment to encourage and sustain the transfer of knowledge.
        - Oversee IIW standardization activities.
        - Encourage and support a safe and healthy and environmentally friendly world.
    - Each of these topics is discussed in some detail in the strategic plan. The IIW and the commission V chairman have asked for input from the national delegations into how to best realize the strategic plan. Input from interested Canadian people is encouraged over the next year as this plan is finalized.
    - Presentation of document V-1376-07, which is the commission V part of an IIW white paper on the state of the art and the future direction of NDT. Dr. Dobmann has written a first draft of the white paper. The main function of NDT currently is detection of flaws in structures, but he sees this focus changing in the future. He is starting to see design

engineers working with NDT engineers to design in inspection from the earliest stages. The term used for this is SHM (structural health monitoring).

- He talks about the product life cycle with NDT integrated into the process, as opposed to the way that NDT is used now for flaw detection. He sees NDT with less operator influence by using operator independent systems and analysis. He also sees embedded sensors in smart structures that provide information from high stress areas, with possible feedback into the structure to dynamically improve performance. One example that was given are fibre optic sensors embedded in aircraft wings connected through an intelligent control system with actuators that can modify a wings shape to optimize fuel efficiency for whatever conditions exist on the wing at a given moment. There is current work like this being done in Germany in the areas of bridges, airplanes, ships and windmills.
- Dr. Gerd Dobmann is asking for contributions to this white paper from the people attending the commission. I will be adding my thoughts to this white paper, which include FFS codes with actual weld flaw sizing using something like PA data merging (rather than work man ship codes that are currently being used) and engineered guided wave testing for many different complex geometries. Input from is also solicited on this.

- **Paper 1** – Inspection of Electrofusion Joints in Polymetric Pipes, Christoph Wiesner, UK.
  - A summary of a TWI project to inspect plastic pipes was given. Dr. Mark Lozev was in the audience and his group at EWI is working to extend the TWI results, so he also gave some updates. The welding process for these plastic pipes was a technique using heating wires that are embedded in the weld, but these techniques would also work for plate heated butt welds.
  - The flaws of interest are LOF along the fusions line, LOP (lack of penetration) for pipes that are not inserted far enough into the sleeve, voids, sand contamination and cold weld. The flaw that has been historically difficult to detect and a major cause of failure is cold weld, where there is bonding between the surfaces, but very little strength.
  - The solution was to use a phased array system with a flexible sealed water column. The inspection is then a line scan around the circumference. The LOF, LOP and sand contamination give strong signals. The edge of the HAZ gives a weak phased array signal when the data is presented in un-gated B-Scan presentation. The position of this boundary is an indirect measurement of cold bond. If there has been good heating (i.e. no cold bond), then the boundary is well into the pipe wall. If the boundary is closer to the wires (i.e. poor heating), then there is a high probability for cold weld.
- **Presentation 3** – Annual Report for Commission VA (Radiography Based Weld Inspection Topics), Uwe Ewert, Germany, V-1377-07.
  - Dr. Uwe Ewert presented the annual report for Sub-commission VA. This group is very active with standardization and harmonization of radiography documents.
  - The working group on Digital Industrial Radiology was not active over the past year. A new chairman needs to be found for this work. If there is a Canadian person with the required expertise in this area they should talk with Dr. Eric Sjerve about this excellent opportunity. This working group is focusing on new technology and standards for CR (phosphor plates), DIR (digital detector arrays) and also on DIT training.
  - The working group on film system classification has been closed.
  - The future goals of sub-commission VA are:
    - Support the development of new standards for DIR
    - Revision of EN 12062 to include digital radioscopy, computed tomography and TOFD
    - Develop a new standard on weld inspection with CR for phosphor imaging plates
    - Develop a CR counterpart to ASTM E 1032
    - Develop new standards for DIR using DDA (digital detector arrays)
  - Dr. Ewert gave a summary of the current state of standards and code development. There has been a separation of standards for carbon steel (EN ISO 5817) and aluminium (EN ISO 10042). He also gave an update on the way that the radiography codes work: EN ISO 5817 / EN ISO 10042 flow into EN 12062, EN 1435 (film), EN 13068 (radioscopy), EN 1484 (CR), EN 12517-1 (steel) and EN 12517-2 (aluminium). He then gave a similar

update for the UT codes: EN 1714 (pulse-echo), TS 14751 (TOFD), EN 1713, EN 1712 and EN 15617).

- **Paper 2** – Progress on Digital Industrial Radiology, Uwe Ewert, Germany, V-1378-07. This described the state of the art in radiology and gave a number of techniques that have made advances recently. Film replacement was discussed. CR can be used for corrosion work in Europe, but it is not able to get the spatial resolution for weld quality work by European standards. A system called HDCR (high definition CR) is being used for weld quality, which has a laser spot size of 12μm and < 40μm geometric unsharpness. This is better than the medical systems being used. Images from digital detector arrays (DDA) were given that have very high contrast sensitivity and automated defect detection. The dual energy technique was then described, which is used for baggage screening for plastics and composites. It uses two different x-ray beams, and is then able to determine the atomic number of the materials scanned by comparing the two different responses. X-ray backscatter was then described, which sends out a scanning spot of x-rays and detects the back-scattered radiation. There were some very good images given with high detail. It was commented that the absorbed radiation dose was small enough to allow use on people.

July 3rd, 2007 – Commission V Meetings

- **Presentation 4** – Annual Report for Commission VC (Ultrasonic Based Weld Inspection Topics), E. Sjerve, Canada, V-1379-07.
    - Dr. Sjerve presented the Annual report for sub-commission VC. There were four interim meetings of this group.
    - The Handbook of Austenitic Weld Inspection is now with the publishing house. There are a number of pictures in the document that need to be improved, which should be done soon and allow publishing.
    - The IIW block project is coming to a conclusion. The German committee has decided to recommend that any parties that are concerned with the quality of their IIW blocks should send them to either BAM or DZFP for testing, as the chosen test procedure is not simple and requires specialized equipment. Notes will be published in international journals soon to let the NDT community know. New block do not have the anisotropy problem.
    - The strategic direction the sub-commission VC was discussed. The consensus in the group was that standardization of phased arrays would be the next topic after the Handbook for Phased Arrays is complete. This Handbook will lead in well to standardization activities for phased array.
    - There are a number of phased array standardization topics that were discussed: phased array calibration block, phased array terminology, determining acceptable phased array system performance and calibration. There is a group at CEA in France that has been working on these issues for several years. IIW and this French group will start working together so that there is no duplication of work in this area.
    - The Handbook for Phased Array Inspection is now in an early draft format, V-1380-07. The basic philosophy behind the Handbook was described and then a description was given to the group regarding the states of the various contributions. The chapters are as follows:
        - Chapter 1 – Scope
        - Chapter 2 – Physics of Phased Arrays
        - Chapter 3 – Phased Array Probe Manufacture
        - Chapter 4 – Scanning Patterns and Views
        - Chapter 5 – Codes and Calibration
        - Chapter 6 – Modelling
        - Chapter 7 – Weld Inspection Applications – New Fabrication

        - Chapter 8 – Weld Inspection Applications – In-Service
        - Chapter 9 – Non-Weld Related Phased Array Applications
        - Glossary of Terms
    - It was decided to add two application notes – one on phased array inspection of plastic pipe welds and one on phased array focal law compensation for sound fields impinging on uneven surfaces.
    - It was also decided to introduce technical editors who have not been associated with the Handbook to date to provide technical, terminology and consistency editing. Both Tom Siewert of NIST in the USA and Philippe Benoist of CEA in France have agreed to do this.
    - It is hoped that this Handbook can be presented at the next IIW assembly in Austria for approval by the commission.
- **Paper 3** – Inline Non-Destructive Inspection of Pipelines by Ultrasonics, G. Dobmann, Germany, V-1381-07. This paper gives details about a number of advanced ILI tools. ILI suppliers need to be able to supply specifications for detection of 7 flaws: pinholes, pitting, general (isolated), axial slotting, circumferential slotting, axial grooving and circumferential grooving. Several new tools have been introduced by Rosen; CDP MFL tool for corrosion detection using very high magnetic fields, and EMAT tool RoCD using guided waves for coating and SCC detection (capable of working on gas pipelines). GE introduced a tool called Ultrascan duo that is the first tool to incorporate phased array technology. They can combine crack detection and corrosion in the same ILI pig by using a specially designed sensor carrier with both corrosion and crack detection transducers. Detailed specifications for these tools and data representations are given.
- **Paper 4** – Wall Thickness Measurement for Pipeline Inspection, G. Dobmann, Germany, V-1382-07. Describing a development project to design an ILI tool that contains EMAT technology. Standard technology for ILI pigs either uses piezo-electric sensors for generation of ultrasound or MFL in for detection of wall loss. The EMAT sensors (magnetostrictive arrangement) use a horizontal magnetic field to reduce the wear on the coil, as it is not magnetically attracted to the surface. Data is presented in terms of optimising the EMAT sensors for producing ultrasound. The technological question is what to do if there is internal corrosion at the location of the EMAT sensor – there will be a large reduction in the EMAT signal not giving a wall thickness measurement. They were able to take ET lift off measurements and EMAT thickness measurements at the same time using the same sensors. Can also use the EMAT coil in the passive mode as an MFL sensor. This gives a very good data fusion application with the ILI technology.

July 4th, 2007 – Commission V Meetings

- **Presentation 5** – Annual Report for Commission VE (Weld Inspection Topics Based on Electric, Magnetic and Optical Methods), G. Dobmann, Germany, V-1383-07.
    - One interim meeting held. The details of the MMM work will be presented as part of the other presentations.
    - The MMM Training book was discussed, V-1347-06. There are over 1000 inspectors in Russia that are educated with this document. The linguistic revision is being edited at this point, but it is not complete. It was resolved to put forth the MMM Training Book for publication as an IIW Training Handbook.
- **Presentation 6** – Report to the IV MMM Conference 2007, Sergey Kolokolnikov, Russia, V-1384-07.
    - Every two years there is a MMM conference in Moscow. There were over 100 people in attendance.
    - Topics considered were: industrial experiences of MMM, criteria for residual life assessment, non-intrusive inspection of underground pipelines and MMM standards. Special consideration was given to harmonization of Russian MMM standards with their current application to join the World Trade Organization.
- **Presentation 7** – Stress Testing is a New NDT Kind…, Sergey Kolokolnikov, Russia, V-1385-07.
    - There are a large number of methods for stress testing, both non-destructive and destructive governed by a number of standards.

- Dr. Dubov published a book to detail the basis for a physical theory for the strain failure process. They have also developed an 80-hour training program with formal examinations to instruct technicians in performing stress testing using MMM.
- This training document is forwarded to the IIW for publication in Welding of the World. It was also suggested by Dubov to form a working group within Commission V to deal with stress-strain measurements. The response was that the MMM group needs to participate with the existing European projects to standardize stress testing measurements. The MMM method needs to be put in this context and compared to other methods that are used for these measuring stress. It was also suggested to submit the MMM book for a critical physics review to a well known magnetic physics expert. It was pointed out that there are a number of other commissions within IIW that are working in these areas.

- **Presentation 8** – Quality Assessment of Welded Joints by the MMM…, Sergey Kolokolnikov, Russia, V-1346-06 R2.
  - Compares the MMM technique to other NDT methods. Last year, there was a comparison of MMM to radiography. This is an extension of this work.
  - MMM detects SCZ (stress concentration zones) that are areas of future flaw growth. Some discussion of the scanners used for MMM was covered.
  - A comparison between MMM and NDT techniques was given for a series of flaw types over a number of industries. The comparison between the methods looks good, but it does not include any provision for false MMM calls (this could be expected to be significant), there is not completeness in terms of varying flaw size/position, or is the data summarized in terms of a confidence level for the comparison. It was suggested by the group to include this data and then republish the work.
- **Paper 5** – Magnetic NDT Technology for Characterizing Materials – a State of the Art Survey, G. Dobmann, Germany, V-1386-07. Provides some background to MT development history at the IIW, and a description of the 1988 IIW MT Handbook. Describes an application that was developed at DZFP in which an automated MT system uses machine vision to find cracks. There are several GMR examples provided. Also deals with micro magnetic systems and their industrial applications.
- **Presentation 9** – Annual Report for Commission VF (Weld Defects and Their Significance), J. Zirnhelt, Canada, V-1387-07.
  - Report given by Dr. Dobmann as John Zirnhelt did not attend the meetings.
  - John Zirnhelt is starting to formulate a plan to deal with localization (i.e. POD) and sizing accuracy of permissible flaws. He is planning to get a meeting together in Berlin this fall to get experts together to discuss these issues.
- **Paper 6** – Presentation of the Software PVRisk, G. Dobmann, Germany, V-1388-07. This software was developed at the DZFP. The concept behind the program is that the fracture mechanical calculations are fairly well known, but the inputs need to be well measured. These are the yield strength, fracture toughness and the geometry of the flaw. We know that the metallurgical properties, the POD and the defect sizing are not absolute values, but are probabilistic. This software treats this problem in a statistical way and uses Monte Carlo simulations to determine the risk for failure. This gives the calculation of the effect of flaws on equipment in a more realistic manner that takes into account the statistical nature in their values. The output is then a probability of failure for the component with the associated flaw.