MEETING TIME AND ATTENDANCE

The fracture mechanics subcommittee met in the morning of January 29 for approximately 4 hours. A total of 19 individuals attended the meeting. The attendance list was given to the secretary of the main committee.

DISCUSSION AND OUTCOME

1. Resolution of unresolved issues highlighted in the lists distributed by the main committee

   The subcommittee reviewed the highlighted issues relevant to
   • A.3.2e, A.3.2f, and A.3.2j and
   • A.5.1.2.

   The outcome of the subcommittee votes is in the Excel sheets forwarded to the secretary.

2. Repair welding of Annex A welds

   The subcommittee reviewed comments by Ken Lee related to repairing welds that are qualified and inspected per Annex A. Section 10 stipulates that the repair welds be evaluated per Section 9. As a result, a part of a weld circumference is evaluated per Section 9 and the rest of the circumference is evaluated per Annex A. There are concerns related to whether the repair welds have adequate levels of weld strength and toughness. Furthermore, the application of flaw interaction rules between the unrepaird and repaired portions is not clear.

   The subcommittee recognized that this is a complex issue. Members of the subcommittee will work with the repair welding TG to fill identified gaps.

3. A.3.2

   The subcommittee voted to change the first sentence under A.3.2 to “Any change in the essential variables listed below shall …,” i.e., replacing the word “specified” with the word “listed”.

4. Presentation by V. B. Raj on A.3.2f on welding consumable using composition control (Table A.1)
The table in the published version is sufficient for consumables of mechanized GMAW process. Consumables made for SAW may have additional alloying elements. The published table could be “too tight” for those consumables. Raj proposed a table that allowed greater ranges of some elements. The subcommittee debated that these ranges could be too wide and might lead to a significant change in weld performance. An alternate or additional criteria base on PCM was discussed.

The subcommittee asked Raj to analyze data in different ways and report back to the subcommittee.

5. *Charpy tests — requirements for ductile behavior*

The requirement for 50% shear area is removed in the draft 21st edition. The shear area requirement in the Errata of the 20th edition is meant to ensure ductile behavior of girth welds. However the percentage of shear area in welds is difficult to read and the value depends on the individuals making the reading. While the subcommittee voted to remove the shear area requirement, the group recognized that the required energy values in the draft 21st edition could be too low for mechanized GAMW welds to ensure ductile behavior. There is a gap left by removing the shear area requirement.

Using lateral expansion as an indicator for material ductile behavior has been proposed as possibly being a better alternative to shear area. Raj of Lincoln and Fabian of EWI presented their Charpy data with lateral expansion. The initial data looked encouraging. Reorganizing the data in different ways may help developing a criterion of lateral expansion.

A template for data analysis will be developed and circulated to the subcommittee members. Further data analysis using the template will be performed after the template is agreed by the subcommittee. This subject was discussed briefly during the main committee meeting and a request to other members was made to provide CVN with lateral expansion data. Tim Burns stated that submissions of data should be made through the Chair so that he can first sanitize the data so that it is anonymous and contains no commercial information.

6. *Appendix D ECA for High Longitudinal Strain Applications*.

Some offshore pipelines are installed by reeling. The longitudinal strains from reeling can be as high as 2%. The use of API 1104 is required for some of these pipelines, e.g., export lines. Since Appendix A cannot be used when strains are greater than 0.5%, the girth welds of these pipelines are inspected and accepted by workmanship criteria. Indications with small height but length greater than 1 or 2 inches requires repair under workmanship criteria. These indications would be acceptable when ECA is applied.

DNV-RP-F108 is the most widely used ECA option for offshore installation by reeling. However when pipelines are required to comply with API 1104, DNV-RP-F108 cannot be used. One proposal was to explore the possibility of referencing F108 with some guidance on the use of F108. Another consideration is that F108 has been criticized for being inappropriate for high strain applications because the fracture mechanics basis of this RP is an extension of BS 7910 technology (also analogous to 1104, Annex A). BS 7910 is
intended principally for stress-based applications. This topic is currently being researched by DNV to pursue upgrades to the F108 approach.

The development of strain-based ECA targeted for wider applications, such as geohazards, was discussed. While there is a general interest in the industry, such development will require significant efforts and involves scopes beyond field girth welding. For instance, testing and qualification of linepipes will necessarily be a part of strain-based ECA.¹

A number of individuals have expressed interest in working in this new area, including Yong-Yi, Tom, Doug, Bill F., Robin Gordon/Hillary, Fabian, and Craig Sloan.

This subcommittee will develop a charge for a task group of Appendix D and the initial membership of the task group.

¹ In the main committee discussion is was mentioned that depending on the scope of such an effort, the issue may be more appropriately handled by a separate API Task Group aimed at developing a dedicated RP instead of handling this topic within 1104.