MEETING TIME AND ATTENDANCE

The fracture mechanics subcommittee met in the morning of January 23 for approximately 4 hours. A total of 18 individuals attended the meeting. The attendance list was given to API representative.

WORK ITEMS

1. Rules to Become a Voting Member of FM Subcommittee

Requirements to become a voting member of the subcommittee were discussed. Doug Fairchild will draft the text of the requirements and pass them to the subcommittee for review.

2. Duplicate text in Appendix A

Clauses A.3.3 and A.3.4.4 of the 21st Edition have exactly the same text, covering the qualification of multiple pipe sources. This duplication is an error. The text of Clause A.3.4.4 was moved to become Clause A.3.3. Clause A.3.4.4 should have been deleted before the publication. An erratum should be issued to remove Clause A.3.4.4.

3. Potential use of Appendix A or ECA for girth welds with high installation strains

Tom Jarvie brought this issue to the subcommittee.

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.

The option of using ECA was recognized as a real need of the industry. However, the issue cannot be addressed with a simple revision/addition to the current Appendix A. The structure and fundamentals of Appendix A were built around welds experiencing small to moderate levels of strains.

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 text on the use of F108.

A sub-group was formed to develop a path forward. The members of the subgroup are: Yong-Yi, Tom, Doug, Bill F., Robin Gordon/Hillary, and Fabian.

4. **Use of Option 3 for Land Based Pipelines**

Gery Bauman brought this issue to the subcommittee.

Option 3 was developed with the intent to primarily address certain offshore applications. The language related to the use of Option 3 is very brief. There have been two recent onshore projects in which Option 3 was used. More guidance on the use of Option 3 was thought to be beneficial to the industry and regulators.

A sub-group was formed to develop the guidance. The members of the subgroup are: Yong-Yi, R J Hammer, Bob Huntley, and Robin Gordon/Hillary.

5. **Strain-based ECA**

Strain-based ECA has been listed as a work item in the past few years. No substantive work has been done.

Doug explained that the interest in strain-based ECA has not been as strong as initially thought. The technology is complex. The scope of strain-based ECA is perhaps beyond API 1104. For instance, new test methods may have to be introduced. The work can be multi-year and drawn out.

PHMSA has recently published possible conditions for strain-based design. One new concept in the conditions is the requirements of conducting tests of production welds to verify weld properties. Some argued that such requirements can be difficult to implement.

Various options to move the work item forward were discussed. They include the production of a *strain-based ECA light* and/or wait for the outcome of some PRCI work.

6. **Use of Appendix A on post-construction integrity assessment**

The subcommittee received a request for interpretation related to the use of Appendix A for post-construction assessment. The subcommittee provided response to the request. As a separate work item, the subcommittee was tasked to develop language qualifying the use of Appendix A for post-construction assessment.

Post-construction assessment requires at least four key elements: (1) material property, (2) flaw detection and sizing, (3) applied stress or strain, and (4) calculation procedures based on fracture mechanics principles.

The subcommittee agreed with the following general statement: (1) Appendix A is principally intended for new construction, and (2) the calculation procedure in Appendix A can be used for fitness-for-service assessment provided that the necessary input data/information can be justified.
Yong-Yi was to draft text suitable to be included in the requirements/conditions of using Appendix A.

7. **Update on chemistry limits on consumables**

Ray brought this issue to the subcommittee.

Table A-1 of the 21st Edition provides ranges of chemical composition when a lot is defined by the control of chemical composition. A more suitable table was developed right before the publication of the 21st Edition, but was too late to be included in the final publication.

The updated table should be made available through an addendum.

8. **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 prior 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 GMAW welds to ensure ductile behavior. There is a gap left by removing the shear area requirement.

A number of options were proposed for consideration in the meeting of January 2013.

(1) Test Charpy specimens at two temperatures, one at room temperature and one at the minimum design temperature. The averaged value at the minimum design temperature needs to be above certain percentage of the averaged value at room temperature.

This option is now considered problematic if the minimum design temperature is very low, such as -40C.

(2) Produce full transition curves of Charpy impact energy at any one o’clock location.

The number of test specimens can be large. Multiple qualification welds may be needed for small diameter pipes.

(3) Require high energy values specifically for mechanized GMAW welds.

This option was not discussed at this meeting.

(4) Specify a minimum value of lateral expansion. Such value may depend on the strength of the weld being tested.

This option was extensively discussed. The follow actions were agreed:

(a) Jon was to check the requirements in ASME Sections III and IIX and report back to the subcommittee.

(b) Tom/EWI, Raj/Lincoln Electric, Jon/Chevron, Sebastien, and Doug/Exxon were to determine the availability of relevant data and report back to the subcommittee.
(5) Reinstate 50% share area requirement, but add retest provisions to address occasional low values.

Some argued that accurate reading can still be a problem. Others stated that they never had problems meeting the 50% shear area requirement.

9. **Requirements on cross-weld tensile tests.** The requirement for cross-weld tensile specimens not-breaking in the weld is removed in the 21st edition. Concerns were expressed at the January 2013 meeting that the removal of this requirement may lead to weld strength undermatching against the actual strength of the pipe. The undermatching welds can become the location of strain concentration in events of changing pipe support conditions, such as ground movement, subsidence, and landslide.

The rationale for removing the requirement was given in the minutes of the prior meetings. The assurance of no weld strength undermatching can only be achieved when there is a reasonable control of the upper bound of the pipe strength distribution. In the absence of such control, one of the best options is adding some language to the part of the appendix on stress analysis. Such language would highlight the potential consequence of strain concentration in the welds under certain loading scenarios.

**NEXT MEETING**

A mid-year subcommittee meeting was proposed to review the progress of the work items described above. The meeting is tentatively planned in May/June of 2014.

**ATTENDANCE RECORDS**

(The attendance record was given to Tim Burns on 01/23/2014 who would give it to the API representative at the meeting.)