Review of Totem Pole Issues November 2007 (1 of 2)

- System calibration (Rummel, Forsyth, Goldfine)
  - done
- Probe characterization (ISU, Gray, Patton, Broz, EWI)
  - Know how to do it, need to document
- Model validation (Knopp, Vukelich, ISU, Gray, Todorov)
  - need to document a validation protocol
  - there are many scattered case studies, collect them
- XFN validation (Smith, Hugo, Patton, ISU, Annis)
  - need to document a validation protocol

Review of Totem Pole Issues November 2007 (2 of 2)

- Specimen design (Goldfine, Forsyth, Brausch, Annis, Spencer, Moore)
  - Specific to each new problem
- Cracks versus notches (AMMTIAC, Thompson, Lindgren, Hugo, NRC)
  - ASNT Spring 2008
- Number of specimens (Spencer, Annis)
  - TBD
- Noise (Goldfine, Annis, Spencer)
  - Current activities within AF
- How do you know you are right??? (Malas, Vukelich, Thompson, Knopp)
  - TBD

System Calibration

- AF study by Brausch et al. shows that the variability within ET probes and instrumentation off the shelf within AF depots is negligible (presented at ASNT Fall 2007).
- The AF general NDI instructions, TO -33B-1-2 is being modified to add additional calibration steps to ensure that instrumentation is within the desired capability.
- Master gauging
  - There is an AF practice, we need to find this.
  - Kevin Smith: did some work including master gauging, found it difficult to set narrow limits on instruments
  - Engine OEMs use master gauging.
  - Question: what about structures OEMs?
    - No. None that we are aware of.
- Pros and cons of 3pt cal
  - 3pt. Cal not strictly necessary for detection, but is necessary for quantification of size
  - Idea of daily cal. Is to ensure that our combination of instrumentation achieves the ahat vs a that was originally planned
- Air cal possible now in limited instrumentation, this may expand

Probe/System Characterization

- PURPOSE:
  - To ensure that when performing a POD study, we characterize the instrumentation so that the input parameters for a model are known and are correct.
  - Fields not simply amplitudes
- UT: DONE by ETC already.
  - Lisa B to put on MAPOD website
- ET: ongoing efforts at ISU/CNDE.
  - Jeremy Knopp has also done this, and will write up the generic protocol. He will consult with the ISU/CNDE people. (status?) Jeremy see QNDE papers by Moulder
  - Leads to specs for probe requirements.

Model Validation

- 1. How to do validation?
  - Validate within the range of interest vs. experimental data.
- 1.1 calibrate on reference object, show you get good results on other objects.
  - Extend from some measured results.
- 1.2 absolute prediction
- 2. Is software (X) validated?
  - AF study (Knopp, Aldrin) did some validation of ET model in their recent work.
  - Thompson, Aldrin to provide refs to validation work for UT models done under ETC
  - Requirements for validation are defined by requirements on POD accuracy?

XFN validation

- How to validate in absence of POD?
  - As we collect more data and experience, may be able to define transfer function generic to a collection of problems.
  - Assumptions are made in the process, need to validate we are operating within assumptions, and/or output not sensitive to assumptions.
  - Would be nice to predict POD from XFN before knowing the answer, then look at answer from 1823-style experiment.
  - The AANC-presented work at this conference may allow this?
  - Lindgren will follow up on this, consult with FAA whether they are able to fund.
- Current AF work will validate this (see Lindgren slide this meeting).
- Smith has presented work already.

Specimen Designs

- Collect the designs (thoughts and lessons learned) used in the works reported herein.
- Residual stress issues are important
  - i.e. cold worked holes, shot peened, service use, …
  - Need to collect ongoing efforts (AUS, USAF, etc.)
- AUS, UK, CA, USA

Cracks vs Notches

- USAF project underway
  - What we know and have evidence for, what we do not know
  - Consider how to present this.
  - Session at ASNT Spring 2008
    - Send your abstracts to Lindgren
    - Review paper on the topic (Lindgren, Forsyth)
  - Can use existing C-130 notch specimens at AFRL to predict crack POD.
  - When we get cracked rainbow fitting, then can validate.
  - Also generate cracks in lab in same components.

Number of Specimens

- How to design the specimen set to support XFN and FMA.
  - Number, crack sizes, etc.
  - At this time, no activity in this area. (AUS?)
  - Relation to confidence in transfer function, samples to be used for validation of XFN, FMA.
  - How much for a POD study, 1823 style?
  - Existing work by AUS, new 1823 code for confidence bounds.
  - Some work done by Meeker in support of the seeded defect engine disk work. Bruce to check if something exists written on this topic.
  - Assessment of false call rate? How to handle this?

Noise

- Some work is in new 1823 code on characterizing noise distributions.
  - Continued effort on this topic is planned.
    - AF funding Annis to continue
    - Some Navy work ongoing, Goldfine to provide Navy POC
  - Noise distributions from data, effect on false call/decision threshold.
    - Historical body of work from IA State CNDE

How Do You Know You are Right?

- What is actual engineering requirement for being “right”
  - Still conservative, but how close?
  - “gold standard”: MIL-HDBK-1823 study on hardware from in-service aircraft containing cracks that developed in service.
  - Strictly speaking, validation of methodology (XFN/FMA methodology) does not require in-service hardware with in-service cracks. BUT there are other reasons to do so.