MINUTES
MODEL-ASSISTED POD WORKING GROUP MEETING
JUNE 9-10, 2005
ORLANDO, FLORIDA

Attendees:

A list of attendees may be found in file 1.

Agenda:

The meeting agenda may be found in file 2.

Minutes:

This one day meeting consisted primarily of a report on action items completed during the last period. Brief abstracts of the presentations follow, with links provided to the slides presented. A few of those will be added after the posting of these minutes because of the requirement to gain organizational approvals.

Summary of Status: Thompson reviewed the past activities of the group as defined in the prospectus and the minutes of past meetings, as may be found on the MAPOD web site.

List of Empirical Studies: Irving Gray discussed the status of the report summarizing empirical POD studies. He felt that the Karta report, "Thirty Years of NDE Reliability Assessment", had done an excellent job of summarizing early work. The full 137 page report can be accessed on the Karta web site, www.karta.com.pod, and a summary appears in Materials Evaluation, Vol. 59, pp. 856-860 (2001) as authored by Ripudaman Singh. A summary of Gray's presentation may be found in the PowerPoint slide show found in file 3.

Slides 20 and 21 of that presentation show the coding categories proposed by Gray. The spread sheet in file 4 provides more details and examples of some entries. Feedback was requested on whether these are the correct categories and layout.

As part of his presentation, Gray noted that a program had been recently been initiated by David Forsyth at NRC in Canada in which NRC will be trying to apply the MAPOD approach to a problem related to the eddy current detection of cracks under fasteners. Significant cost savings are projected by Forsyth if the approach is successful.

List of Model-Based POD Studies: Jeremy Knopp, on behalf of John Aldrin, discussed the status of the report summarizing Model-Based POD Studies. The material from his presentation may be found in file 5. Possible venues for publication of that material were discussed, including the Journal of Nondestructive Evaluation and an ASTM STP. It was agreed that Aldrin and Gray would seek a common format of categories.

Ultimate Repository of MAPOD Protocols: Vincent Spanel discussed the ultimate repository for the MAPOD protocols, supported by the material in file 6. He noted that Mil Handbook 1823 is scheduled for an update soon, and that this might provide a logical vehicle. The Flight Technologies Branch, which includes Airframe Structures Group and the Propulsion Group is responsible for this update. He noted that the steps involved in an update are the following, a process that generally takes one to two years:

- Best practices (with "wiggle room" for corporate variations) provided by industry
- Draft document prepared for internal review
- Comments made affected/interested parties
- Comments adjudicated by REO
- Draft document finalized and released for official comment/coordination
- Government and Industry comment
- Adjudication of document
- Publication

A number of useful definitions were contained at the end of the presentation regarding demonstrations and validations.

There was an extended discussion, including a number of topics such as whether 1823 would be the best venue for formalizing POD protocols. Among the comments (not necessarily consensus views of the group) were:

- We should consider looking beyond the Military Handbook for an industry standard.
- The information in NDI Insight should be merged in the protocol
- A document is being developed to describe the best practices for engine NDE (Vukelich).
    - This is a couple of levels up from 1823, the latter being concerned with how to do a POD study rather than how to do an inspection

Proposed Protocol for XFN Approach: Kevin Smith presented a proposed protocol for the Transfer Function (XFN) approach. His slides may be found in file 7.

Proposed Protocol for FMA Approach: Bruce Thompson presented a proposed protocol for the Full Model-Assisted (FMA) approach. A flow chart of the proposed process may be found in file 8, including an example of how the protocol was used in the example presented by Smith at the Palm Springs meeting of the MAPOD WG. A PowerPoint document describing the protocol in more detail may be found in file 9. Among the feedback comments were the following:

- We should put as a first question, "Is a model available?"
- In any inspection, one generally uses some sort of model. It is just a question of how sophisticated that model is.
- Need to consider whether the model is robust enough to handle interactions of the effects of various parameters.

- What is the success criteria (5%, 10%, ?).
- Need guidance in validation.
- Need to move consideration of independence to an earlier point in the flow diagram.

AF NDI POD Study: Robert Lewis presented the results of a recent Air Force NDI POD Study, as documented in file 10. This study, which showed that the POD being achieved in the field is significantly less than desired, stimulated considerable discussion. Included as a part of the presentation was the description of a set of modular samples that would be available for future studies

Among the questions posed/points made asked in the discussion were the following:

- Would this data support ROC analysis as a function of size?
- The number of variables that can be controlled in such a test is always limited by time and cost.
- There appears to be a very complex relationship to the age/experience/education of the inspector.
- An important feature was the presence of two administrators who observed at a distance to ensure that data was correctly entered.
- It was observed that inspectors do not always follow the procedures; they sometimes follow practices that come from a lot of sources.

Discussion of Sandia Samples and Associated Data: Mike Bode presented a description of samples available at Sandia and of the data associated with them, using the slides found in file 11. These were associated with two experiments; the Eddy Current Inspection Relative Experiment (ECIRE, designed to simulate a Boeing lap splice joint on a B737) and the Inner Layer Crack Experiment (ILC, designed to simulate a joint on a later model B737). As noted in the Palm Springs meeting of the MAPOD WG, these experiments each developed a number of samples whose construction can not be revealed since that would compromise their future utility. However there are also demonstration plates in each case (2 for ECIRE and 1 for ILC) which could be used for this purpose and discussions of those samples were included.

As a part of the discussions, it was asked how accurately such parameters as conductivity and bond thickness need to be known to apply the model. Thompson indicated that these should initially be measured carefully but then sensitivity studies should be done to determine how accurately they ultimately need to be known. It is quite possible that this process would indicate that only approximate values are needed for a number of parameters.

Discussion of POD Data Accessible at UDRI: Annis provided a summary of POD data accessible at UDRI, as reproduced in file 12. He noted that more detailed information could be obtained from Dave Stubbs of UDRI.

In the context of the discussion, Paul Swindell described a program underway at the FAA Technical Center aimed at the study of wide spread fatigue damage. This program has the goal of validating load and fatigue models, but the program affords the opportunity to also validate NDE models. NDE measurements currently being made as a part of this study include eddy current, visual, mid-frequency eddy current with pencil probes, low-frequency eddy current, phased array ultrasonics, self-nulling eddy currents, and MWM. It was asked whether appropriate data was being gathered to support model validation.

Short presentations scheduled to be given by Irving Gray (*Demonstration of X-ray POD Models*) and Bruce Thompson (*Establishing small flaw limits: an example of MAPOD*) were deferred to a future meeting in light of time constraints and the need for an in-depth discussion of next steps.

Action Items: During the meeting, a number of action items were adopted to guide future activities of the MAPOD WG. There were the following:

- Provide critique to Irving Gray of proposed categories and format for the review of empirical POD studies: All by August 1.
- Provide feedback to Aldrin regarding format of the review of model-based POD studies: All by August 1
- Provide feedback to Smith regarding protocol for XFN protocol: All by August 1.
- Provide feedback to Thompson regarding protocol for FMA protocol: All by August 1.
- If any of the above feedback needs clarification/adjudication, appoint a sub-team to assist: Thompson, as needed.
- Complete list of empirical POD studies: I. Gray by November 1
- Complete list of model-based POD studies: Aldrin by November 1
- Provide next iteration of XFN protocol: Smith by September 22
- Provide next iteration of FMA protocol: Thompson by September 22
- Invite David Forsyth to provide an update of his program at the next meeting: Thompson
- Send out a draft of a protocol as an example: Vincent Spanel
- Obtain more information about the load and fatigue studies tests being conducted at the FAA Technical Center with the goal of identifying what would need to be done to use this as a Test Bed for validation studies: Mike Bode
- Identify other possible demonstrations and explore possible funding opportunities with FAA/NASA (Knopp, Malas, Thompson, Brasche)
- Prepare a briefing explaining how to interpret the POD curve (Annis)
- Take stock of progress: All at QNDE
- Prepare a synopsis of the Fall ASNT Reliability meeting for the MAPOD web site (Malas and Cargill)

Other Open Questions: Issues needing further thought and discussion but not associated with specific action items, follow:

- Discuss what would be required to get more industry POD data in the public domain.
- Discuss what would be a "Gold Standard" POD process and then identify the strengths and weaknesses of the various approaches as measured against this standard.
- Discuss characteristics/metrics for high performance inspectors.

Next Meeting: It was agreed that the MAPOD WG would next meet after the ATA NDT Forum, to be held in Orlando. The time established was Thursday afternoon, September 22, 2005 and Friday morning, September 23, 2005.