Program Description and Purpose

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I'd like to spend a few minutes to give a brief overview of the ARPA/AFML research program in NDE. The objectives of the program are as follows:

- To pursue advanced research in quantitative techniques for NDE
- To establish a focal point for NDE research
- To establish communication between the research community and the NDE user
- To promote the image of NDE

All these are worthwhile objectives, and certainly, the field is in a unique situation in that it needs a bootstrap from people who are exceptionally qualified, as you people all are, to give it a hand. One of the purposes of a meeting like this is to assemble an interdisciplinary group together to discuss the research that is going on.

The program topics in the ARPA/AFML program are as follows:

- Project 1: Flaw Characterization by Ultrasonic Techniques
- Project 2: Nondestructive Evaluation of Adhesive Bonded Materials and Composites
- Project 3: Nondestructive Measurement of Strength Related Properties

During the course of the meeting, you'll hear more about these. We have also selected people in keeping with our objectives, from outside the program who are doing work in parallel areas, to present the results of their work so that we can get a view, an overall view, of what is going on.

Most of our efforts in the first year have been placed in Project One. One thing we realize, of course, is that there are a number of other very important NDE techniques, x-radiography, neutron radiography and so forth. We believe, though, and I think it is the right conclusion, that it is much better to elect to put a more concentrated effort in at least one area and to try to do that comprehensively, rather than to spread ourselves too thinly and try to cover everything.

I would like to say a little bit now about our program philosophy because I think it is quite important. I have two points in using this slide (Fig. 1) which indeed is a complex slide. The first is to demonstrate a flow of logic that we think is important in the area of NDE research, and secondly, to try to place the talks that you'll hear during the next three days in perspective within that logic system.
Fig. 1. Flow diagram for generation of self-consistent materials (systems) reliability.
The principal line that we believe is important is demonstrated here by the center flow line in which one takes the sample, subjects it to nondestructive evaluation by various techniques that are appropriate, simultaneously develops by destructive techniques the failure modes and models that are characteristic of those failures, and then assembles both sets of results together into a box which we call accept/reject criteria for a material or a system or a structure. Now, I think this is one of the most important outputs that we, as research people, can develop for technology transfer to a user, because in this box is conveyed the notion that here is a set of rules and here is a set of tools that go together and are matched so that an operator can use these tools, evaluate measurements and make judgments in the context of failure models and accept/reject criteria that are meaningful. Now, this whole line of development has to be coupled to the current materials research and development world and to the disciplinary engineering world in an interdisciplinary way. We feel that insufficient coupling to these disciplines currently exists.

Now, we believe NDE research and development leading to new techniques and devices begins at the box labeled "Development of Failure Mode Data and Mechanistic Causes Thereof". After these failures are identified and characterized in terms of phenomena measurements, then these measurements themselves form the basis for a new set of NDE techniques. It is this kind of laboratory measurement, then, that must be translated into new devices that can then be brought into line as a part of the NDE arsenal. By definition, such techniques are then keyed to the specific failure problem.

There are two important feedback loops indicated in the diagram that are important also. One is the materials improvement data. From a knowledge of failure modes and phenomena that are associated with the causes of failure, one, of course, hopes to identify ways to improve the material. That becomes an important piece of information that has to be fed back and becomes part of the materials development scheme. The other piece of information that is very important, once one accepts an accept/reject criteria concept such as indicated, is the loop at the bottom labeled "NDE Adequacy Data" which feeds back into the technique box. This concept is important, for it is the only way that one can objectively determine that a technique is good enough for the purpose at hand. It's only when one develops accept/reject criteria and the rules and tools does one know that he's good enough as far as the NDE technique is concerned. I think this is an important concept in the sense that it gives us guidance in the development of new techniques and tools. As an example, the effort to increase sensitivity to smaller and smaller defects has been part of our history; yet, with appropriate accept/reject criteria, it becomes evident that sensitivity may not even be the problem.

The end product of all this, of course, is increased reliability and increased maintenance intervals. In the best of all worlds, we would all do ourselves out of a job because NDE in that world should be non-existent; but that implies total reliability, which I doubt that we'll ever achieve. I hope the diagram is a useful aid in putting it all together- in demonstrating how we couple with the materials world and the engineering world, and a way to provide a plan for the self-consistent generation of reliability.
The talks that you're going to hear during the next three days are in the areas of technique development and phenomena studies. I hope you'll understand the talks in the context of the schematic loop, be assured that they fit into a plan, and feel free at all times to discuss the work.