Westinghouse Advanced Turbine Systems Program and the AGTSR

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Good morning. It is difficult to be the last speaker and have to repeat the same sentiments as the others expressed, but I'll try to put a Westinghouse spin on the discussion.

The AGTSR consortium is a successful partnership of government, industry, and universities. And this partnership benefits all the partners. Industry likes it because the research is focused on projects and technologies that are the most important to industry. The universities benefit because they have the leading edge on the research and problems of U.S. industry. And the AGTSR also provides opportunities for universities to train engineers to understand the technologies that will give them the most useful command of the ATS industry. DOE and the government also benefits because they channeled tax payers' funds into research that will benefit U.S. industry and will result in more skilled jobs and the hiring of experts in gas turbines and associated equipment.

Over the last few years, the AGTSR has organized very successful workshops in the following areas: combustion, heat transfer, materials, sensors, and controls. And these workshops provide an excellent way for industry to review research with participating universities. At the same time, universities can focus their research in areas that are relevant to industry. I attended one heat transfer workshop a couple of years ago. Industrial representatives voiced their ideas of where research should be focused. And I am very happy to report that in this year's proposals, more that 90 percent of them were for research on issues that industry thought very important.

I shall briefly describe successes that were carried out at the universities through the AGTSR and government funding. Westinghouse collaborated with Professor Santavicca of Pennsylvania State University in the development of a fiber optic probe to measure fuel/air mixedness, and combustion product species and concentration. This probe will be very useful in measuring the fuel/air ratios for cold flow tests and fired tests. We have been using it in our testing.

Using very lean premixed combustors to achieve single digit NO_X emissions causes problems in combustion instabilities, combustion noise, and hence high vibratory stresses in the combustion system as well as in the downstream equipment turbine blades and vanes. To counteract these instabilities, we collaborated with Dr. Zinn in the development of an active combustion-noise control system. This system is composed of a sensor that picks up the combustion instabilities, a processor that provides feedback to the generator, and finally, a fuel

valve and a controller. If you have a fuel valve and a bypass fuel line that is modulated, then this counteracts the effects of combustion instabilities. This system was successfully demonstrated in small scale tests in our Westinghouse Science and Technology Center in Pittsburgh.

Dr. Desai at the University of Central Florida worked on the compatibility of turbine materials with steam cooling, which is of considerable interest to Westinghouse because we are using steam cooling on our ATS engine. The results of his research give us insight on the effect of steam on materials that we will be using in our ATS engine.

Professor J.C. Han of Texas A&M University provided results on the effects of thermal barrier coating (TBC) spallation on hot-side airfoil heat transfer. This gave us the opportunity to revise mitigation plans to counteract the effect of TBC spallation on airfoils, vanes, and blades in the ATS engine.

Professor Gellan of the University of Connecticut is working with strength and stress measurement of bond coatings. This has already been mentioned today. This research will be useful in coating modeling efforts and will result in improved coating systems. Recent work proposed by Professor Lee of Case Western will be of considerable interest to Westinghouse. The research will be providing substrate, test samples, and an opportunity to direct this work in areas of interest to industry.

The third issue of AGTSR is the ongoing industrial intern program. Westinghouse is very much in favor of the program. To date, we have had six interns who worked on combustion, heat transfer, materials, and computational fluid dynamics (CFD) development. All six of them have been excellent workers, showing an excellent ability to learn. We hope to see more such high quality candidates next year.