

*Advanced air launched missile propulsion study*

This Air Force Rocket Propulsion Laboratory (AFRPL) study evaluated the performance of advanced solid, liquid and air-augmented propulsion systems against well defined missile survivability criteria in order to allow a clear impartial comparison. The most striking result was the great increase in low level, high mach number capability which might be attained with air augmented systems. The detailed design studies performed revealed definite areas within the materials, propellants, thrust chamber assembly, pressurization and expulsion technologies which possessed the most significant growth potential. The ultimate worth of this study can be measured in the positive manner in which it has aided the AFRPL in pointing defense contractors toward the major significant problems in the air launched propulsion field and the fact that propulsion requirements from this study have been used directly in defining and implementing present AFRPL exploratory development contracts in the air augmented rocket and prepackaged liquid, solid and hybrid rocket areas.

*Oxygen concentrator*

In 1964 the Air Force Flight Dynamics Laboratory undertook an effort to fabricate and test an oxygen concentrator module which produces pure oxygen using air taken from the ambient atmosphere. This system combined with a carbon-dioxide and water vapor removal unit and recirculation system could replace the high pressure gas storage system presently employed in Air Force Aircraft.

The feasibility of the oxygen concentrator concept has been demonstrated to the point where it is currently undergoing engineering development.

*Bandwidth expansion by redundant transmissions*

Under this effort, undertaken by the Rome Air Development Center, an experimental spread spectrum anti-jam communications system, using frequency redundancy, was designed; and the breadboard was completed and tested. A theoretical evaluation of the system was compared to the experimental results. The main object of this experimentation was to determine whether or not significant loss would occur through implementation of the Bandwidth Expansion by Redundant Transmissions (BERT) technique.

This effort has provided a significant technique for improvement of stored reference, spread spectrum systems, and has reduced the theory to practice. The technique now is available for incorporation into prototype equipments where system constraints would indicate a benefit by utilization of this bandwidth expansion system.

Mr. DADDARIO. Do you have any estimate that you could provide for the record as to how you believe time and money has been saved as a result of this? Do you make any estimate of that?

Dr. MACARTHUR. I would like to think about that a little further.

Mr. DADDARIO. If it would be a difficult thing to do, is your overall judgment that it has saved considerable time?

Dr. MACARTHUR. That is right. We have ideas and products that have come out that normally wouldn't have come out or if they did it would be at least 2 years later.

There is another thing that we shouldn't overlook and that is that it is a very useful tool to attract scientific talent. If a scientist knows, that if he has an idea and that he can go to work on it tomorrow rather than waiting for 18 months while it goes through the many echelons of review and approval of the Department of Defense, the Bureau of the Budget and Congress is a very important factor in attracting him. A lot of our scientists like to feel that if they have a good idea they can get to work on it right away.

Mr. DADDARIO. During the course of these hearings it has been the judgment of all of the witnesses that it adds immeasurably to the quality of these laboratories. Whatever the percentage is, this discretionary authority allows the whole laboratory to operate more effi-