OVERVIEW OF THE NASA HIGH POWER LASER PROGRAM

Joseph G. Lundholm

NASA Headquarters

Good Morning! It is a pleasure to take part in this Second Conference on Laser Energy Conversion. I will take the liberty of speaking for the audience in stating that we all appreciate the hospitality that Dean Chapman extended to us. We also appreciate the efforts that Fred Hansen and Ken Billman have expended in setting up this conference. I am sure that we are all looking forward to two days of interesting and challenging interchange between those of you who have been busy pushing back the frontiers in the laser field since the last conference. I hope that each of you will take an active part in this conference since I believe the success of this meeting is equally dependent on the speakers and the listeners. At the wrap-up panel discussion, I suspect that Ken Billman and I may be questioning many of you to obtain your opinion on how we should proceed and where we should place our efforts during the next two years.

A number of changes in personnel have occurred in the last two years. The most significant change is that Carl Schwenk, who was slated to give this talk, was named Director of the Research Division which was established in the Office of Aeronautics and Space Technology in August 1973. At the present time, Dr. Karl Thom, one of the speakers tomorrow, and I are program managers in this division. Dr. Thom manages the photonics and energetics programs and I manage the high power laser and thermionic power conversion systems programs.

At this point, I believe it is appropriate to reiterate the overall objectives of the *NASA* High Power Laser Program, to quickly review its structure and center responsibilities, make a few comments regarding present and future funding, and last but not least, to briefly examine the possible pace of the program.

Figure 1 shows the recommendations formulated by the AD HOC Laser Advisory Committee in 1971. We still believe that high power lasers will eventually prove useful for space missions.

Figure 2 lists the program objectives. In all cases, the overall thrust of our efforts is directed at the long range transmission of high power laser beams which are then converted to propulsive thrust or electrical power.

The next two figures 3 and 4 portray the elements of the laser power transmission program. You should note that the program is structured to provide for research on each of the key areas in order to build the required technology base which must exist in order to decide the essential issues before proceeding with prototype systems development for a space mission. This approach is illustrated in figure 5. We are able to take advantage of the DOD work, especially in the area of coherent adaptive optical technology (coat) and by attending DOD major planning and review meetings and by interacting with their contractors.

Figure 6 shows the major activity that each center is focusing on. We consider ARC the lead center for laser-energy conversion, LaRC the lead center for propagation research and LeRC the lead center for systems technology and large optical arrays.

Figure 7 shows the program targets as prepared for the FY 1976 budget and RTOP cycle. I believe it is important that you recongize the time frame we indicate we are working toward. Perhaps this aspect of the program plan should be considered in the panel summary discussion tomorrow afternoon[1].

Figure 8 lists six selected program highlights that I felt would be of special interest to you. One conclusion that I draw is that in the last few years we have gotten organized and proceeded to implement selected plans. We are now about to settle down to even more serious efforts, the success of which will be the major factor in decisions that are identified as being made around 1980.

Figure 9 is a gross schedule chart. It is a chart that is more than a year old and I deliberately did not update it. The chart indicates that by the end of this calendar year we would have narrowed down our efforts to selected systems technology. It may be necessary to do some narrowing in order to provide increased funding to concepts that appear most promising; however, I foresee this as a difficult step at this stage of the program.

The funding level for FY 1976 is presently stated to be at the same level as this year. Not until congress appropriates our funds later this year will we know how we fared.

At the present time, it appears our progess has been satisfactory. What we must all remember is that the years pass rather quickly and the 1980 time period will arrive before we realize it unless we continually assess our progress against our stated goals and schedules.

Now I am ready to listen to the researchers – the people who will have to do the work that we all hope will give us a successful program.

Ken, again we wish to thank you for getting us together for this conference. I hope all of us will pitch in with enthusiasm and help make the next two days both interesting and – perhaps – even a little exciting.

Thank You.

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[1]With reference to figure 7, High Power Laser Systems Program Targets, the last item – "Complete Evaluation of Applications for High Power Laser Systems to Assess Progress, Goals, and Benefits to NASA Missions by FY 80", – could be interpreted incorrectly to mean that research and technology efforts would cease after FY 1980. Even if a NASA space mission application requiring a high power laser system has been identified and work is initiated on a prototype unit, it is presently believed that R&T efforts would continue at an appropriate funding level.

- HIGH-POWER LASERS WILL BE IMPORTANT TO NASA
  - NEED FOCUS FOR HIGH ENERGY LASER R&D AND APPLICATIONS STUDIES WITHIN NASA
  - NEED MAJOR EFFORT IN R&D PROGRAMS AND APPLICATIONS STUDIES
  - BOTH SPACE-BASED AND GROUND-BASED LASERS FOR POSSIBLE NASA APPLICATIONS
- DIRECT LINK TO DOD ACTIVITIES ON HIGH ENERGY LASERS IS CRUCIAL

Figure 1.– Recommendations (from Ad Hoc Laser Advisory Committee).

- EVALUATE TECHNICAL PROBLEMS OF CLOSED-LOOP CO_2 LASER SYSTEM. CONTINUE RESEARCH THROUGH FY 76
- INVESTIGATE POTENTIAL NEW LASER CONCEPTS THROUGH FY 76
- GENERATE AND INVESTIGATE NOVEL MEANS TO CONVERT LASER BEAMS INTO THRUST OR ELECTRICITY WITH AN EFFICIENCY GREATER THAN 50% THROUGH FY 76-79
- ESTABLISH LIMITS FOR TRANSMITTING LASER BEAMS THROUGH ATMOSPHERE UNDER ALL CONDITIONS BY FY 77
- COMPLETE EVALUATION OF APPLICATIONS FOR HIGH POWER LASER SYSTEMS TO ASSESS PROGRESS, GOALS, AND BENEFITS TO NASA MISSIONS BY FY 80

Figure 2.– High power laser systems technology.

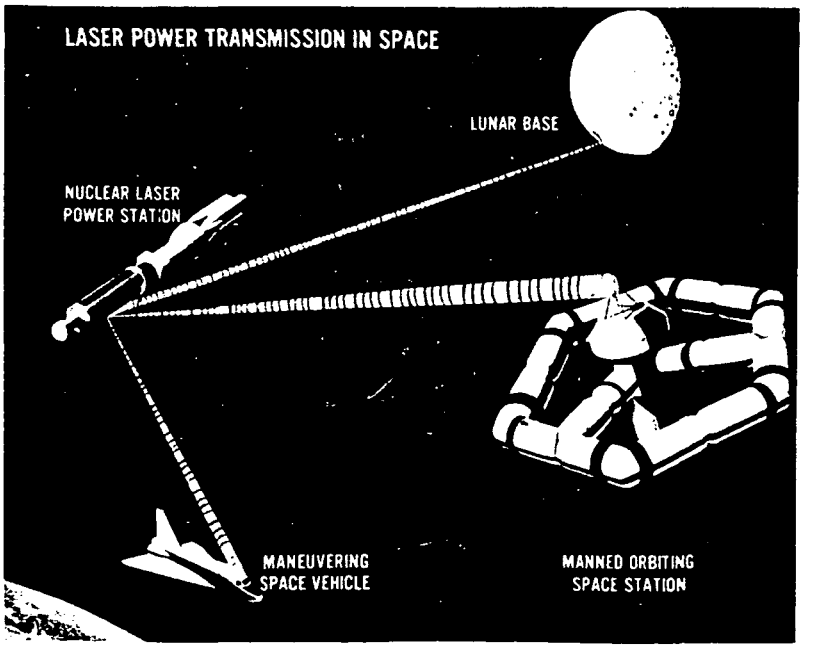

Figure 3.– Laser power transmission in space.

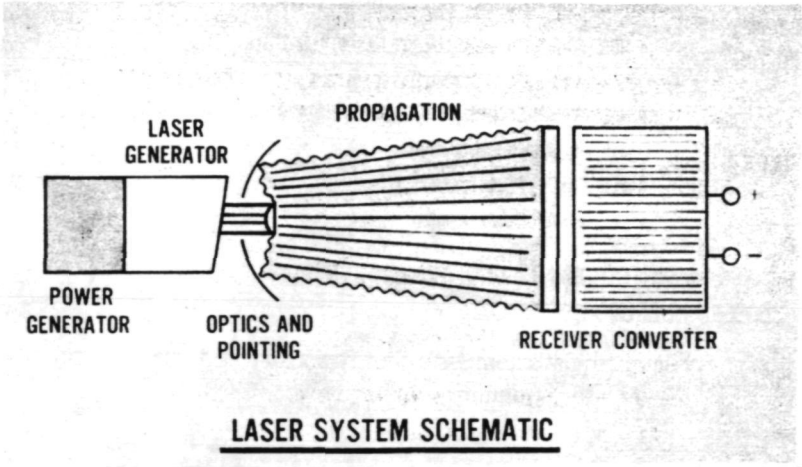

Figure 4.– Elements of laser power transmission system.

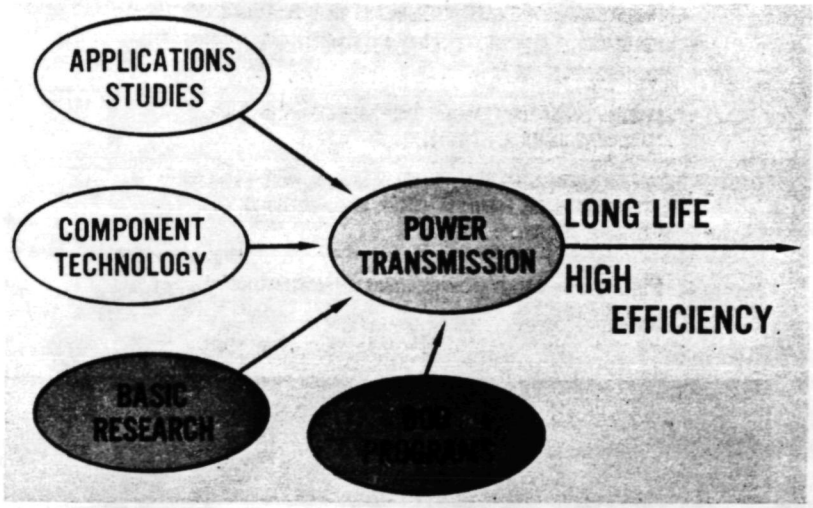

Figure 5.– Program perspective.

AMES RESEARCH CENTER
- NEW LASER CONCEPTS
- CONVERTER RESEARCH

LANGLEY RESEARCH CENTER
- PROPAGATION RESEARCH

LEWIS RESEARCH CENTER
- LASER SYSTEM TECHNOLOGY
- CONVERTER TECHNOLOGY
- NEW LASER CONCEPTS
- LARGE OPTICAL SYSTEMS TECHNOLOGY

JET PROPULSION LABORATORY
- NEW LASER CONCEPTS
- CONVERTER RESEARCH

Figure 6.– Center roles NASA high power laser systems program.

PROGRAM OBJECTIVE

THE TRANSMISSION OF HIGH POWER LASER BEAMS OVER LONG DISTANCES AND CONVERSION TO THRUST OR ELECTRICITY

- EVALUATE POTENTIAL OF HIGH POWER LASERS FOR NASA MISSIONS AND APPLICATIONS
  - PROVIDE TECHNOLOGY BASE NEEDED TO MAKE THIS EVALUATION
- DEMONSTRATE POTENTIAL UTILITY OF HIGH POWER LASERS FOR SELECTED APPLICATIONS

Figure 7.– High power laser systems program targets as listed in FY 76 (program and specific objectives document).

- LERC PILOT LASER LOOP EXPECTED TO BE OPERATING IN FEW MONTHS
- STUDY CONTRACTS ON 30 METER SPACE BASED AND 5-6 METER GROUND BASED ADAPTIVE OPTICAL ARRAYS INITIATED BY LERC
- COPPER LASER TECHNOLOGY ADVANCED BY RUSSELL OF JPL
- NUCLEAR-PUMPED LASER OPERATED AT LASL
- PULSED HIGH PRESSURE OPERATION OF CO_2 LASER PROVIDES BROADENING OF LASER LINES – PERMITS TUNING LASER "OFF" ATMOSPHERIC ABSORPTION LINES FOR IMPROVED ATMOSPHERIC TRANSMISSION PROPOSED BY HESS AND SEALS OF LARC
- SECOND CONFERENCE ON LASER-ENERGY CONVERSION AT ARC

Figure 8.– Selected high power laser systems program high-lights.

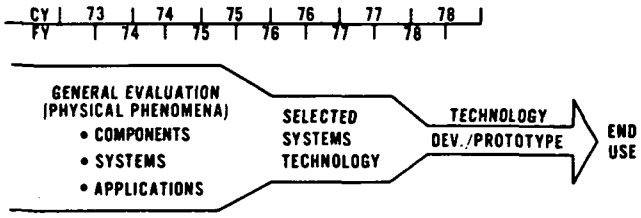

Figure 9.– Laser power system research and technology general schedule.