EG&G
ENERGY MEASUREMENTS

INTER-OFFICE MEMORANDUM

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To: Distribution 30 October 1989

From: Tom Tunnell TWT

Subject: TRIP REPORT :
AIL WORKSHOP IN KIEV, USSR, OCTOBER 1989

I. SUMMARY

A. Name of Traveler

Thomas Williamson Tunnell, Scientific Specialist, 505-667-9519, EG&G/LAO, 31 October 1989.

B. Dates

Original

5 October leave residence in Tesuque, NM and arrive 6 October in Kiev via Albuquerque, (6 October) Paris, and Moscow. While in Kiev, I was to stay at the Hotel Rus. Leave Kiev on 13 October and arrive in Paris via Moscow. Spend night in Paris at the Airport Holiday Inn and on 14 October resume travel back to Tesuque via New York City and Albuquerque.

Modified

Due to problem with Soviet visa, I stayed in Paris from 6 October to 9 October before travelling on to Kiev via Moscow on 9 October. I spent these three nights in Paris at the Hotel Cervantes.

C. Purpose of Trip

To present a paper at the Workshop on Artificially Ionized Layers (AIL) in the Atmosphere that was held in conjunction with the International Workshop on Nonlinear and Turbulent Processes in Physics, Ukranian

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Academy of Sciences.

D. Abstract

Due to a problem with my Soviet visa, I was three days late in arriving in Kiev. I presented our report which described our technique of inferring electron temperature in a microwave induced plasma. The greatest controversy of the workshop concerned NO production connected with the formation of the AIL. It is estimated that in its lifetime, a single NO molecule will destroy 10^5 ozone molecules.

II. Comprehensive and Detailed Report

A. Purpose

The primary purpose of the my trip to Kiev was to present a paper entitled "Analysis of Nitrogen Light Emission from AIL Breakdown" at the AIL workshop. The AIL concept is to produce an ionized layer in the atmosphere from which radio frequency waves can be reflected. (In the United States, this concept is called the Artificially Ionized Mirror, AIM. Most of the AIM research in the United States is funded by the Air Force Geophysical Laboratory, AFGL, in Boston. The AIM research at EG&G/LAO is funded by the US Department of Energy.) The workshop provided for the transfer of unclassified technology between the US and the USSR, who are reportedly years, if not decades, ahead of the US in this area of research.

B. Summary of Activities

The AIL workshop was a subset of the larger International Workshop on Nonlinear and Turbulent Processes in Physics. Both workshops started on Monday, 9 October. Workshop partcipants attended the opening talks of the larger workshop in the morning. That afternoon, introduction and overview talks on AIL research were presented in the first session of the AIL

workshop. The AIL workshop was cohosted by Dr. A. Gurevich (USSR) and Dr. T. Armstrong (US). (Because of the alteration in my schedule, I was not able to attend the first day's sessions.)

The next three days (10 to 12 October) were filled with detailed reports on specific topics in AIL research. Discussions following the reports generally ran over the allocated time so that a few talks were delayed until Friday morning for those that could attend.

Late Tuesday afternoon, one session was devoted to discussing a possible full-scale experiment to produce an AIL in the atmosphere. The radio telescope at Arecibo in Puerto Rico was identified as the prime location for the experiment. An informal invitation was extended to the Soviets to participate in the experiment. The cost of this experiment was estimated at 5 million dollars, to be split evenly between the Americans and the Soviets. If the Soviets participate, they will contribute klystrons to supplement the Arecibo telescope.

The greatest controversy of the workshop concerned NO production connected with the formation of the AIL. It is estimated that in its lifetime, a single NO molecule will destroy 10^5 ozone molecules. Thus, AIL formation could significantly degrade the ozone layer and have an undesirable impact on the Earth's environment. However, the NO^- molecule is expected to be much less destructive to the ozone layer. The balancing between NO^- and NO is an important environmental concern. This balancing depends on the complete chemical picture. Some detailed calculations were presented that claimed AIL formation may even enhance the ozone layer. It was agreed that the chemical predictions remain controversial, as they are too sensitive to pressure, temperature, and collision rates to generalize.

C. Traveler's Role

I presented my report, "Analysis of Nitrogen Light Emission from AIL Breakdown," on Wednesday morning. The analysis technique is based on a scaling law that is derived from a fluid description of the microwave-induced breakdown region. The purpose of the technique is to infer electron temperature as a function of time based on the analysis of the nitrogen light emission from the breakdown region. The primary criticism of the tech-

nique was that because it is based on the fluid description, it assumes a Maxwellian distribution for the electrons. The assumption of a Maxwellian distribution is not always valid. Others pointed out that at present this technique is the only diagnostic tool available to experimentalists. Analyzing light from different molecules was suggested as one means of testing the technique. A. Gurevich also suggested that, for application to full-scale experiments in the atmosphere, the effect of stimulated emissions be included.

D. Recommendations

The interest in knowing the electron temperature is driven by the desire to know the electron collision rates. If the analysis technique characterizes temperature so that reliable collision rates can be inferred, then the technique is a useful diagnostic tool. The new guidance issued by Admiral Watkins, Secretary of the US Department of Energy (DOE), underscores the usefulness of such a diagnostic tool. This new guidance states that safety and environmental concerns now have priority over production concerns. While most AIL research in the US is funded by AFGL, all DOE contractors (such as EG&G/EM) must adhere to this guidance. It would be desirable to couple the inferred temperature with the complex chemistry codes at Los Alamos National Laboratory (LANL) so that in a full-scale experiment, NO production could be estimated during the course of the experiment.

E. General Energy Posture of Countries Visited

The information exchanged at the workshop was not relevant to the energy posture of the USSR. Personal observations of dark hallways, very dim car lights, and poorly lit streets are all there is to report.

III. Appendix

A. Full Intinerary

5 October-Leave Tesuque in personal car 06:30
Arrive Albuquerque Airport 08:00

5 October-Leave Albuquerque on TWA flight 810 09:00
Arrive Paris/Charles DeGaulle 6 October 06:55

6 October-Leave Charles DeGaulle Airport via taxi 09:00
Arrive downtown Paris 09:30
Locate Hotel Cervantes 14:00

9 October-Leave Hotel Cervantes via taxi 09:00
Arrive Kiev/Borispol 22:25

9 October-Leave Kiev/Borispol via van (supplied by workshop) 23:00
Arrive Hotel Rus and check in 24:00

10 October - 13 October-Attend workshop while staying at Hotel Rus

13 October-Leave Hotel Rus via taxi (supplied by workshop) 06:30
Arrive Paris/Charles DeGaulle 19:10

13 October-Leave Paris/Charles DeGaulle via hotel van 19:45
Arrive Paris/Airport Holiday Inn and check in 20:00

14 October-Leave Paris/Airport Holiday Inn via hotel van 08:30
Arrive Paris/Charles DeGaulle 08:45

14 October-Leave Paris/Charles DeGaulle on TWA flight 819 11:00
Arrive Albuquerque 21:15

14 October-Leave Albuquerque in personal car 21:45

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