T110--28568

NOTICE
This report was prepared as an account of work sponsored by the United States Government. Neither the United States nor the United States Department of Energy, nor any of their employees, nor any of their contractors, subcontractors, or their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness or usefulness of any information, apparatus, product or process disclosed, or represents that its use would not infringe privately owned rights.

ADVANCED THERMIONIC ENERGY CONVERSION

ERDA CONTRACT EY-76-C-02-2263

NASA CONTRACT NAS3-20303

JOINT HIGHLIGHTS AND STATUS REPORT

NOVEMBER, DECEMBER 1977

PREPARED BY
RASOR ASSOCIATES, INCORPORATED
253 HUMBOLDT COURT
SUNNYVALE, CALIFORNIA 94086

MASTER

This report contains the results of the
point of view to the publication of
determination of the actual status
used in the future.

6/6/78 cke

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

EAB

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency Thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.

During December Rasor Associates moved its facility from 420 Persian Drive in Sunnyvale to a modern new facility located at 253 Humboldt Court, Sunnyvale. The new facility has been specifically designed to accommodate the needs of the thermionic program. It includes a separate test area for the High Current Converter Test Facility, with separate outside access and sound insulation to minimize its impact on the rest of the program. Separate fabrication room and clean room areas with HEP filtered air supplies have been provided to upgrade quality control during converter fabrication. A city independent recirculatory water system is available for converter fabrication and testing, to minimize water use and achieve independence from city supplies. Individual electric power circuits have been provided for each test stand or fabrication processing station.

The move from the old to the new building, combined with the holiday season, resulted in a significantly reduced direct effort on the thermionic programs during this reporting period. This loss will be made up quickly with the increased efficiency which will be realized in the new facility.

It should be noted that the task numbering system has been changed for FY 1978 to match the task numbers used in the DOE Thermionic Energy Conversion Program Plan, as shown in Table 1.

Task 3 - Converter Electrode Technology

1320 - Negative Ion Effects (L.K. Hansen)

The negative ion data acquired to date have been obtained with both the research converter and the quadrupole negative ion test station. To provide these data the research converter was operated in a regime where the negative ion created space charge effects may have influenced the converter I-V curves. Quadrupole data has been obtained in a space charge limited mode, where, as described last month, the negative ions apparently come from the electrode surfaces. The quadrupole experiment has also been operated in an ignited mode, with increased negative ion production. To permit better reduction of the experimental data, an analysis has been started of converter operating characteristics in the low-pressure, space-charge-dominated mode and the ignited mode.

TABLE 1

DOE TASK STRUCTURE BREAKDOWN

<u>#</u>	<u>Old Task Strcuture</u>	<u>#</u>	<u>New Task Structure</u>
1210	Converter Performance Calculations	Task 1	Basic Converter Characterization (1100) 1110 Converter Performance Calculations
1310	Interelectrode Loss Characterization	Task 2	Converter Plasma Technology (1200) 1210 Interelectrode Loss Characterization
1100	Electrode Surface Characterization	Task 3	Converter Electrode Technology (1300) 1310 Electrode Surface Characterization 1320 Negative Ion Effects
1120	Negative Ion Effects		
1320	Converter Performance Evaluation	Task 4	Advanced Converter Technology (1400) 1410 Converter Performance Evaluation 1420 Converter Structure
1410	Converter Structure		
1900	Converter Configuration Technology	Task 5	Advanced Converter Development (1500)
-----	No Comparable Task-----	Task 6	Hot Shell Development
1700	System Analysis	Task 7	Systems Analysis
1500	Program Management	Task 8	Program Management

Task 4 - Advanced Converter Technology

1410 - Converter Performance Evaluation

Work on this task during this period has concentrated on moving the existing test stations, and doing long lead time work on methods of reducing adverse negative ion effects.

Negative Ion Converter Test (M.L. Manda) - The negative ion experiment has shown that partial pressures of hydrogen less than 10^{-5} torr may be important in the generation of both cesium and hydrogen and/or CsH^- negative ions. For this reason, the most attractive approach to reducing adverse negative ion effects is to remove hydrogen from the converters.

A survey of the literature indicates that previous attempts to control the hydrogen impurity level in operating cesium converters has had little success. Typical control schemes included the use of various getters, diffusion windows, and cesium stills. The failure of these schemes can probably be attributed to two reasons. First, in those experiments utilizing cesium stills, contaminants were probably gettered by the cesium in the condenser section of the still, then transported back to the evaporator section in the liquid cesium, and re-evaporated. Second, in those experiments using active getters, the partial pressure of the hydrogen contaminants above the getters may have been high enough to cause significant reductions in converter performance by negative ion formation. Thus to achieve improved performance, better cesium distillation and gas gettering schemes must be used.

An experiment to accomplish this has been planned for the July-August-September time period. The standard converter configuration will be used for the converter. Both electrodes will be CVD W(110) on molybdenum substrates. The operating range of the emitter will be 1600-2000°K at 5-10 A/cm². The collector will operate in the 850-1150°K range.

To insure clean cesiation and operation of the device, the cesium will be distilled through a high temperature (> 800°K) section of titanium to remove contaminant gases. To minimize gettering by the cesium only a small amount of cesium will be used. During operation of the diode, a

palladium window open to the belljar will be heated to permit hydrogen to diffuse out from inside the converter.

Because of communication between the inside and outside of the converter through the palladium window, special efforts will be made to reduce the hydrogen pressure in the belljar. A 400 l/sec noble VacIon pump will be used to maintain a vacuum around the converter. The freon cooled belljar which surrounds the converter will be metal sealed to the instrumentation spool and sealed with a copper gasket to the ion pump. Cryopumps will be used to rough pump the system. The purpose of this all-metal system is to minimize the generation of hydrogen from cracking hydrocarbons and to permit high temperature bakeout of the belljar, pump, and instrumentation spool.

It is hoped that these design approaches will result in a slow converter performance improvement with time as hydrogen is removed from the converter and the negative ion production is reduced. To further verify that the improvement results from elimination of hydrogen, hydrogen at low pressures will be introduced into the vacuum system to see if the performance improvement trend is reversed.