**High Temperature Materials Processing Science**

1. **NAME OF PERFORMING ORGANIZATION**
   - Cornell University

2. **ADDRESS (City, State, and ZIP Code)**
   - Ithaca, New York 14853

3. **NAME OF MONITORING ORGANIZATION**
   - Dr. A. H. Rosenstein

4. **ADDRESS (City, State, and ZIP Code)**

5. **PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER**
   - AFOSR-85-0062

6. **NAME OF FUNDING/SPONSORING ORGANIZATION**
   - AFOSR

7. **ADDRESS (City, State, and ZIP Code)**
   - 410 Bolling Air Force Base Washington, DC 22209

8. **NAME OF FUNDING/SPONSORING ORGANIZATION**
   - AFOSR

9. **ADDRESS (City, State, and ZIP Code)**
   - 410 Bolling Air Force Base Washington, DC 22209

10. **SOURCE OF FUNDING NUMBERS**
    - PROJECT NO. 2917
    - TASK NO. A3

11. **TITLE (Include Security Classification)**
    - High Temperature Materials Processing Science

12. **PERSONAL AUTHOR(S)**
    - Raj, Rishi

13. **TYPE OF REPORT**
    - Final--Grant

14. **DATE OF REPORT (Year, Month, Day)**
    - 1987, 6, 26

15. **PAGE COUNT**
    - 6, 26

16. **SUPPLEMENTARY NOTATION**
    - The equipment authorized under this Equipment Grant has been purchased by Cornell University. The equipment consists of (a) Differential Thermal Analyzer and (b) Hot-Isostatic-Press. Equipment (a) has been installed and is being actively used. Equipment (b) is in the process of being installed.

17. **COSATI CODES**
    - | FIELD | GROUP | SUB-GROUP |
      | --- | --- | --- |

18. **SUBJECT TERMS**
    - Equipment Grant
    - Cornell University
    - Differential Thermal Analyzer
    - Hot-Isostatic-Press

19. **ABSTRACT**
    - The equipment authorized under this Equipment Grant has been purchased by Cornell University. The equipment consists of (a) Differential Thermal Analyzer and (b) Hot-Isostatic-Press. Equipment (a) has been installed and is being actively used. Equipment (b) is in the process of being installed.
June 29, 1987

Dr. A. H. Rosenstein
Director, Electronic and Solid State Sciences
Air Force Office of Scientific Research
Bolling Air Force Base
Building 410
Washington, D.C. 20332

RE: Final Report for the Equipment Grant AFOSR-85-0062
entitled "High Temperature Materials Processing Science"

Dear Dr. Rosenstein:

The above Grant provided for the acquisition for two pieces of equipment: (a) Differential Thermal Analyzer with temperature capability up to 1600°C, and (b) Hot-Isostatic-Press with a hot zone size of 4" dia x 5" high and with a pressure and temperature capability of 30,000 psi and 2000°C. Both pieces of equipment have been purchased by Cornell University. Quotations for the equipment were obtained from Theta Industries Inc., Netzsch Incorporated, ASEA Pressure Systems Incorporated, and Autoclave Engineers, Inc. The DTA/TGA system was purchased from Netzsch and the HIP from Autoclave Engineers. The specifications for both systems are described by the quotations which were used to fill the orders. Copies of these quotations are attached.

Both pieces of equipment have arrived at Cornell University. The DTA/TGA is already being extensively used in powder processing applications. The HIP is in the process of being installed. Our technician has received factory training for the operation of the equipment and space has been assigned for the installation of the equipment. Currently utilities are being brought to the HIP for power and water hook up. The equipment has made a significant difference in the facilities available for doing high temperature processing research at Cornell University.

We appreciate AFOSR sponsorship of this grant at Cornell University.

Yours sincerely,

Rishi Raj

RR/clr
May 23, 1985

Dr. R. Raj
Dept. of Materials Science & Engineering
Cornell University
Ithaca, NY 14853

Model STA 409/3/410 Thermal Analysis System

A. Measuring Part, composed of:

6.223.3-01 Balance with 20 g capacity; housing is vacuum-tight to $10^{-4}$ torr; inlet and outlet valves and all gas tubing is stainless steel for operating under corrosive or non-corrosive gas atmospheres

6.225.3-22 Single furnace hoisting device

6.225.3-03 Furnace - Temperature Range 25° to 1550° C. with regulating thermocouple, Type S, and vacuum-tight protective tube

6.225.3-56 STA Measuring Head, Type S thermocouple, with radiation shield
Temperature Range 25° to 1600° C.

345 024 Water Circulatory System, thermostatically controlled

B. Control Cabinet

Temperature Controller and Amplifiers are housed in a standard 19" cabinet, 615 mm high

6.803.0 TG Amplifier with the following ranges:
0 - 12.5, - 25, - 50, - 125 mg/250 mm chart width with variable zero displacement, and ranges 0 - 250, - 500, and - 1000 mg/250 mm chart width with fixed zero
B. Control Cabinet (cont.)

6.812.3 DTA Amplifier (with automatic zero suppression)
Measuring Ranges: 0 - 25, - 50, - 100, - 200, - 500, - 1000, - 2000 \( \mu \text{V}/250 \) mm chart width

6.820.3 Temperature Amplifier with Type S thermocouple

1.101.1 Microprocessor Temperature Programmer 410
Temperature Range: -200 to +1800°C.
Heating Rates: 0.1 - 99.9 K/min in 0.1 K/min increments;
Isothermal times from 0 - 99 h 59 min in 1 min intervals;
Maximum of 20 program segments.

1.102.1 Supplied with Proportional-Integral Controller 410 with Type S thermocouple module

6.699.11 Silicon-controlled Rectifier and
348 178 Output Transformer
Power Requirements: 220 V, 60 Cycles, single phase

PRICE for Complete System F.O.B. Destination $ 26,000.00

DELIVERY: 14 Weeks after receipt of purchase order

VALIDITY: June 30, 1985

NETZSCH INCORPORATED

John E. Kelly III, Manager

JEK: cq
July 5, 1985

Cornell University
120 Maple Avenue
Ithica, New York 14850

Attention: Mr. Dave Chatterton
Purchasing Department

Subject: Hot Isostatic Press
AE Proposal #Ml0-2513-86F

Gentlemen:

In response to your request for quotation, we are pleased to submit the following for your review and consideration.

Our proposal consists of four sections all of which form an integral part of this proposal.

1. Executive Summary & Pricing
2. Technical Specification
3. Spare Parts List
4. General Information

All of the terms and conditions set forth on attached Form GTCS-5177 (Rev. 12/82) apply to this proposal.

If you have further questions or if we can be of additional assistance, please contact me. Your reference to our proposal number in all correspondence concerning this inquiry will be appreciated.

Very truly yours,

Edward C. Barthelmes
Engineering Product Specialist
Engineered Product Operations

ECB/leb
Attachments

cc: Dr. Raj - Cornell University
    F. X. Zimmerman, D. F. Heubel
ITEM #1

EXECUTIVE SUMMARY & PRICING

Model: 30M 3.2-5.5 GU 200 Y-EHC-O

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
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<tbody>
<tr>
<td>Pressure Vessel Rating:</td>
<td>30,000 PSI.</td>
</tr>
<tr>
<td>Closure</td>
<td>Yoke</td>
</tr>
<tr>
<td>Temperature Rating Maximum:</td>
<td>2000° C.</td>
</tr>
<tr>
<td>Hot Zone Size:</td>
<td>4&quot; Diameter x 5.5&quot; Convection, 3.2&quot; Diameter x 5.5&quot; Radiation</td>
</tr>
<tr>
<td>Compressor:</td>
<td>30,000 PSI. Discharge</td>
</tr>
<tr>
<td>Control System:</td>
<td>TCS/Distributed Control</td>
</tr>
<tr>
<td>Power Requirements:</td>
<td>480V @ 62 Amp.</td>
</tr>
<tr>
<td>Process Gas Consumption:</td>
<td>50 SCF @ 1500 PSI.</td>
</tr>
<tr>
<td>A.S.M.E. Code Stamp:</td>
<td>Included</td>
</tr>
<tr>
<td>Start-Up Spare Parts:</td>
<td>Included</td>
</tr>
<tr>
<td>(2) Cycle Testing at AE:</td>
<td>Included</td>
</tr>
<tr>
<td>Sinter/HIP Capability:</td>
<td>Included</td>
</tr>
<tr>
<td>Operation Manual:</td>
<td>Included</td>
</tr>
<tr>
<td><strong>FIRM LIST PRICE:</strong></td>
<td><strong>$100,100.00</strong></td>
</tr>
<tr>
<td><strong>SHIPMENT:</strong></td>
<td>18-20 weeks after receipt of an order.</td>
</tr>
<tr>
<td><strong>F.O.B.:</strong></td>
<td>Erie, PA</td>
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</table>

**Options**

1. Check-Out & Start-Up at Site: $680.00/Day + Expenses
2. Consumable Spare Parts
   (Mechanical & Electrical) 2,000.00
3. O₂ Monitor for Safety: 3,500.00
4. Turnkey Installation @ Site: 6,180.00
5. Heating Element - 2 Zones: 1,700.00
END
987
DTIC