

~~CONFIDENTIAL~~

82-63-413
82-63-465

PROJECT AGREEMENT NO. 5

to

729678

APPENDIX B

R

to

SUBCONTRACT 212

between

THE REGENTS OF THE UNIVERSITY OF CALIFORNIA

and

MONSANTO RESEARCH CORPORATION

Pursuant to Appendix B of Subcontract 212, between The Regents of the University of California, (hereinafter called the "University") and Monsanto Research Corporation, (hereinafter called the "Subcontractor") the University and Subcontractor have on this 1st day of March, 1963, entered into this Project Agreement No. 5, which is subject to all applicable provisions of such Subcontract and to the more detailed supplementary provisions as set forth below. In accordance with ARTICLE VII - CHANGES, the Business Manager of the University of California Lawrence Radiation Laboratory may, in writing, direct changes in the scope of work set forth in this Project Agreement.

I - GENERAL SCOPE OF WORK

As approved and directed by the University's Technical Coordinator, the Subcontractor shall, on a best efforts basis, devote approximately one and one-half man years of technical effort to the development of binders for bonded high explosives. In this effort, the Subcontractor will attempt to develop binders which will result in bonded explosives having mechanical properties and explosive strength superior to present bonded explosives. Subcontractor will prepare binders by dissolving lithium perchlorate in a mixture of plasticizers and polymer precursors which can subsequently be polymerized. These binders will be combined with explosives to form bonded explosives which can be pressed or cast to appropriate configurations. Explosives with various binders will be tested to evaluate the physical and explosive properties of the various binder-explosive combinations.

II - TECHNICAL SCOPE OF WORK

A. Properties

Subcontractor will endeavor to develop bonded high explosives with the following properties:

- 1. Resistance to impact and friction.

CLASSIFICATION CANCELLED OR
CHANGED TO Unclassified
BY AUTH: EO 12958 3.4
BY: [Signature] DATE 10-27-95
[Signature] DATE 10/20/95

February 6, 1963

1257911

~~CONFIDENTIAL~~

This material contains information affecting the National Defense of the United States within the meaning of the Espionage Laws, Title 18, U.S.C., Secs. 793 and 794, the transmission or revelation of which in any manner to an unauthorized person is prohibited by law.

~~CONFIDENTIAL~~

2. Castability or pressability.
3. Curability at room temperature or slightly elevated temperature, or else adequate properties without curing.
4. Low creep.
5. Moderate or high tensile strength.
6. Maximum extensibility over a wide temperature range.

B. Materials Preparation

Subcontractor will primarily investigate solid solution binders although other polymers such as "nitroso rubbers" will also be investigated. Subcontractor will, as necessary, modify the binder composition by varying the following:

1. The per cent and the identity of the plasticizer.
2. The per cent and identity of a crosslinking monomer such as methylene-bis-acrylamide.
3. The amount and type of polymerization initiator and inhibitor.
4. The identity of the polymer precursor.
5. The quantity of dissolved oxidizer.

C. Explosives

Subcontractor will use the following explosives:

1. HMX which will be provided by the University.
2. Other plasticizers, including formamide, adiponitrile, N, N-bis(3-cyanopropyl)-formamide and N, N-dimethylformamide.

D. Tests

The Subcontractor will correlate the composition of the solid solution binder with the mechanical properties, thermal stability, and resistance to impact, friction and creep. Correspondingly, the Subcontractor will correlate the properties of the bonded explosive with the volume per cent binder content and properties of the unfilled binder.

To make these correlations Subcontractor will perform the following tests:

1. The binder and bonded explosive will be tested for resistance to impact using the Bureau of Mines Standard Impact Test apparatus and tested for resistance to friction using the standard friction test for high explosives.
2. Other properties such as fluidity or plasticity, curability polymerization exotherm, and density will be determined by the usual test procedures.
3. Extensibility and ultimate tensile strength will be measured initially by an Instron Tensile Tester.

PA #5
SC 212
February 8, 1963

-2-
~~CONFIDENTIAL~~

1257912

~~CONFIDENTIAL~~

4. Coefficient of thermal expansion will be measured as a cubical coefficient.
5. The creep test will be made using essentially a parallel plate plastometer and cylindrical specimens. Preliminary screening will be accomplished by measuring total deformation after a fixed time interval at a moderately elevated temperature. Compositions judged successful in preliminary screening will be tested at various stresses at moderately elevated temperatures to determine the maximum stresses at which no creep is observable over a considerably longer period of time.
6. Relative chemical stability will be determined by exposing the binder and bonded explosives to a temperature of 120°C for 24 hours and subsequent analysis of any evolved gases by quantitative vapor phase chromatography.
7. The thermodynamic characteristics such as heat of explosion and heat of formation of all binders and explosive compositions will be calculated by the usual test procedures.
8. Later in the program Subcontractor will conduct more sophisticated mechanical property tests such as high rate tests and dynamic property tests using the most promising binder and explosive compositions.

E. Polymer Coating

Subcontractor will investigate polymer coatings designed to prevent water absorption by the binders.

F. Additional Investigations

As mutually agreed between the Technical Coordinators of the Subcontractor and University, Subcontractor will investigate the following:

1. The burning rate and pressure rate of burning of cast explosives as a function of particle size of the explosives.
2. Low viscosity liquid solutions of lithium perchlorate or lithium perchlorate eutectic oxidizers in organic fuels useful for the preparation of slurry explosives.

III - MATERIALS AND EQUIPMENT

The University will furnish Subcontractor adequate quantities of HMX for use under this Project Agreement.

Government owned Master-Slave Manipulator, Bureau of Mines impact test apparatus and Atlantic Research Corporation strand burning rate

PA#5
SC 212
February 6, 1963

-3-

~~CONFIDENTIAL~~

1257913

~~CONFIDENTIAL~~

apparatus will be used by the Subcontractor for work under this Project Agreement.

IV - SHIPMENT OF MATERIALS

As directed by the University Technical Coordinator, Subcontractor will furnish the University samples of material produced under this Project Agreement. Subcontractor will ship classified or unclassified high explosives via Railway Express to the following address:

University of California
Lawrence Radiation Laboratory
P. O. Box 808
Livermore, California
Attn: G. Hobbs
Telephone: 447-1100, Extension 82-328
Railway Express
16th Street Station
Oakland, California

Subcontract 212
Project Agreement No. 5

V - SCHEDULE AND DELIVERY

Research and development work under this Agreement shall commence March 1, 1963 and continue for a period of approximately 12 months. Work described in Section II - TECHNICAL SCOPE OF WORK - shall be completed prior to February 28, 1964. All work shall be completed and all reports submitted prior to April 15, 1964.

VI - TERM ESTIMATES, FIXED FEE COSTS AND EXPENSES

In accordance with ARTICLE II - TERMS and ARTICLE III - ESTIMATES AND FIXED FEE and Appendix A - COSTS AND EXPENSES of Subcontract 212, for services rendered by the Subcontractor between March 1, 1963 and April 15, 1964 Subcontractor shall be reimbursed in the amount not to exceed \$46,518 which shall include Subcontractor's fixed fee of \$3,043. For purposes of this Project Agreement No. 5 General Overhead Costs shall be limited to an amount not to exceed 95% of direct labor including payroll burden charged to this Project Agreement. Actual reimburseable General and Administrative expense shall be limited to an amount not to exceed 5% of total allowable cost under this Project Agreement.

VII - ASSIGNMENT OF PERSONNEL

It is understood and agreed that Subcontractor's key technical personnel assigned to work under this Project Agreement will not be reassigned or replaced without prior University approval, except where such instances are beyond the control of the Subcontractor. Subcontractor shall not assign replacement or substitute key personnel without prior University approval.

VIII - COORDINATION AND ADMINISTRATION

- A. The Contract Administrator for the University is Mr. C. L. Blue, his designee or successor. All matters regarding administration of this Subcontract and interpretation thereof

PA #5
SC 212
March 15, 1963

-4-

1257914

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

shall be conducted through the Contract Administrator.

- B. The Technical Coordinator for the University and within this scope of work is Mr. Edward James, Jr., his designee or successor.
- C. The Subcontractor's Technical Coordinator for this scope of work is Dr. Lucius Gilman.

IX - REPORTS

A. Progress Reports

The Subcontractor shall prepare and submit by the 15th of each month, progress reports describing work performed during the previous month.

B. Financial Reports

Subcontractor will submit monthly expenditure analysis reports which shall confirm and/or explain actual cost experience.

C. Final Report

Subcontractor will submit a final terminal report upon completion of work under this Project Agreement.

D. Distribution of Reports

Formal reports shall be distributed as follows:

<u>Mailing Address:</u>	University of California Lawrence Radiation Laboratory P. O. Box 808 Livermore, California
<u>Number of Copies:</u>	
3	Edward James, Jr., Bldg. 107C, Rm 1033
1	Technical Information, Bldg. 112,
1	Room 1067
1	Director's Office, Bldg. 112, Rm. 1041
1	Business Office, Bldg. 161, Rm. 1113

E. Interim Reports

It is understood that from time to time there will be other information exchanged between the parties. These data may be exchanged directly between the parties concerned. Formal report form and distribution is not required in these instances.

X - SECURITY

The work, documents and materials under this Project Agreement

PA #5
SC 212
February 6, 1963

1257915

~~CONFIDENTIAL~~

may be classified Confidential, Defense Information.

ACCEPTED:

AUTHORIZED:

MONSANTO RESEARCH CORPORATION

UNIVERSITY OF CALIFORNIA
LAWRENCE RADIATION LABORATORY

By J.H. Platon

By W.B. Reynolds

Title President

Title W. B. Reynolds, Business Manager

Date 5 April 1963

Date APR 11 1963

APPROVED:

U. S. ATOMIC ENERGY COMMISSION

By P.M. Goodbread

Title P. M. Goodbread
Assistant Manager

Date for Administration, SAN
APR 11 1963

PA# 5
SC 212
February 8, 1963

~~CONFIDENTIAL~~

1257916