20. REQUIREMENT AND/OR JUSTIFICATION  GB is urgently required in large quantities as a toxic quick-acting, nonpersistent chemical agent for tactical use. (GB was designated a standard agent on 5 April 1951 (CCTC item 2310).) In addition, there exists an unfilled requirement for a quick-acting, persistent agent which, it is believed, will be filled by one of several G-type compounds. Information on corrosiveness, methods of stabilization and detection, and other chemical and physical properties is necessary.

21. BRIEF OF PROJECT AND OBJECTIVE

a. Brief. (Scientific Problem and Applied Research) Current plans in the Chemical Corps program include the development of improved processes for the synthesis of GB. Information will be obtained on the reactions involved, methods of analysis and control of intermediates, stabilization, and inhibition of corrosion. Research will be continued with GB to develop improved methods of detection, protection, and decontamination; to obtain basic thermodynamic data applicable to synthesis, analysis, and detection; and to improve methods of dissemination. A search will be made for a persistent G agent which is equally effective percutaneously as well as by other routes.

b. Approach.

Effort is directed along seven major lines:

1. Research will be conducted to improve existing processes for the manufacture of the more important G agents and to obtain physico-chemical data relevant to processes, intermediates, and agents. Determinations will be made of the effects of impurities on the stability of compounds and on the processes involved.

2. Work will be conducted to develop new methods or to improve old methods for the analysis and evaluation of intermediates in the HTM, AFC, or

other processes. This will include spectroscopic and electrical methods.

3. Investigations will be carried out to improve methods of stabi-
лизation of G agents, assess their corrosiveness, and develop
methods for prevention of corrosion.

4. Reactions of G agents will be investigated with the view of adapt-
ing the more promising ones into improved detection, protective,
and decontamination devices.

5. Studies will be made with mixtures of GB and other compounds with
the view of enhancing toxicity or other characteristics of mili-
tary interest. This will include a search for a thickening agent
for GB which will form a stable system suitable for airplane spray
dissemination.

6. Various types of phosphorus compounds will be synthesized and
screened for toxicity with the view of obtaining one which is quick
acting and persistent.

7. Thermodynamic studies will be made to obtain basic information on
the heats of formation and bond energies in G agents and interme-
diates. These are required to obtain data applicable to plant de-
sign requirements and to the development of methods of analysis,
control and detection, and to stabilization.

c. Subtasks. None.

d. Other Information. It is anticipated that research contracts on the
following subjects will be effective during the fiscal year 1954:

(1) Spot Tests for G Agents.

(2) Thermodynamic Properties of G Agents.

(3) Chemistry of G Agents.


(5) Resolution of Optically Active Phosphorus Compounds.

(1) Basic Research: The total funds allocated to this project
are $1.72M. Approximately 75% of this amount is directed
toward basic research, and the remaining 25% to applied
research.
(2) **Fund Estimate:** (In units of thousand dollars)

<table>
<thead>
<tr>
<th>Period</th>
<th>Total estimate</th>
<th>Army R&amp;D funds</th>
<th>Procurement &amp; production funds</th>
<th>Other identified army funds</th>
<th>Other agency funds</th>
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<td>FY 1953</td>
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<td>FY 1956</td>
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</table>

(3) **Contract Information:**

Contract DA-18-108-CML-2525
National Bureau of Standards
Washington 25, D. C.
Amount of obligation - $90M
Progress during past year - $30M
Accumulated progress - $75M
Estimated completion date - 30 June 1954

Contract DA-18-108-CML-3563
Standard Oil Development Co.
Linden, N. J.
Amount of obligation - $64M
Progress during year - $32M
Accumulated progress - $42M
Estimated completion date - 30 June 1954

University of Kansas
Lawrence, Kansas
Amount of obligation - $14M
Progress during past year - $9M
Accumulated progress - $11M
Estimated completion date - 1 May 1954

Contract DA-18-108-CML-3786
Louisiana State University
Baton Rouge, La.
Amount of obligation - $32M
Progress during year - $20M
Accumulated progress - $27M
Estimated completion date - 31 May 1954

(4) Standardization Item: None.

(5) Production Limitations & Critical Materials: None.

e. Background.

(b)(2) HIGH
### RDB PROJECT CARD

<table>
<thead>
<tr>
<th>TYPE OF REPORT</th>
<th>Progress Report</th>
<th>REPORTS CONTROL SYMBOL</th>
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<td>2. SECURITY</td>
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<td>4-82-08-012</td>
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<td>4. INDEX NUMBER</td>
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<td>51 Dec 53</td>
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<td>Processing and Manufacturing Methods &amp; Techniques &amp; Equipment</td>
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<td>7. SUB FIELD OR SUBJECT</td>
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<td>8. COGNIZANT AGENCY</td>
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<td>9. DIRECTING AGENCY</td>
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<td>10. REQUESTING AGENCY</td>
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<td>11. PARTICIPATION AND/OR COORDINATION</td>
<td>(AR) Army</td>
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<td>12. CONTRACTOR AND/OR LABORATORY</td>
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<td>13. RELATED PROJECTS</td>
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<td>14. DATE APPROVED</td>
<td>11 Sept 1953, CCTC item 2730</td>
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<td>15. PRIORITY</td>
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<td>16. MAJOR CATEGORY</td>
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<td>17. EST. COMPL. DATES</td>
<td>RES. Cont</td>
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<td>18. FISCAL ESTIMATES</td>
<td>OP. EVAL. Cont</td>
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<td>19.</td>
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<tr>
<td>20. REQUIREMENT AND/OR JUSTIFICATION</td>
<td>Design, construction, installation, maintenance, and operation of pilot plants for the manufacture of CW agents and intermediates is required. Similar work is necessary in connection with pilot agent filling equipment and facilities.</td>
<td></td>
</tr>
<tr>
<td>21. BRIEF OF PROJECT AND OBJECTIVE</td>
<td>a. Brief. (Applied Research) The object of this project is to design, install, maintain, and operate pilot-plant equipment and facilities used in connection with the development and manufacture of CW agents.</td>
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<td>b. Approach. Work under this project will include the following:</td>
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<td>(1) Design and installation of a pilot plant for the manufacture of CW agents.</td>
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<td>(2) Operation and maintenance of this pilot plant.</td>
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<td>(3) Design, construction, installation, and operation of pilot agent filling plants.</td>
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<td>c. Subtasks. None.</td>
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<td></td>
<td>d. Other Information.</td>
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<td></td>
<td>(1) Basic Research: Under Universal Oil Products Prime Contract DA-18-108-CML-1879, Task DMHP 15 performed by Standard Oil Development, work was completed and a final report submitted on basic research performed on the pyrolysis reactions of dimethyl hydrogen phosphite (DMHP). Under this basic research task new analytical methods were developed which have made possible detailed analysis of the pyrolysis.</td>
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</table>
products of DMHP. General details of the pyrolysis reactions were firmly established. It was found that the initial steps in the reaction may be catalyzed by BF₃ and that reaction completion is aided by higher reaction temperatures.

Action has been initiated to negotiate a contract directly with Standard Oil Development to extend this work to process laboratory scale.

(2) **Fund Estimate:** (In units of thousand dollars)

<table>
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<tr>
<th>Period</th>
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<td>950</td>
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</table>

(3) **Contract Information:**


Chicago, Ill.

Amt. of obligation - $2,315M

Progress during the past year - $1,269M

Accumulated progress - $2,444M

Est. completion date - October 1954

(4) **Standardization Item:** None.

(5) **Production Limitations and Critical Materials:** None.

e. **Background.**

G Agents.

(b)(2) HIGH

(b)(2) HIGH
21. e. Continued.

(b)(2) HIGH
f. Future Plans.

G. Agents.

DMHP Process. Continue the investigations of Step I, on a pilot-plant scale, in those areas that are responsible for operating difficulties in the production facility.

Salt Process. Complete the development of Step IV and Step V. Study the necessity for pilot-plant investigation of by-product, (gaseous) recovery and/or disposal in Steps I and IV of this process.
HJM Process. Complete the pilot-plant development.

Other G Agents. Begin the investigation in the process laboratory of production processes for other agents of this series.

Other Agents.

Q - Develop on process-laboratory scale a process for manufacturing this agent.

Gasoline Thickeners. Investigate, in the process laboratory, a continuous precipitation process for M3 and other metallic soaps.

Filling and Closing Facilities. Continue the development in the mechanical engineering laboratory of filling, closing, and inspection equipment for G-agent-filled munitions.

g. References.

ETF 107.6-14/Final (Task OP-12, Vol I)
Final Rpt on Task OP-12 by Westvaco dtd 20 March 1953.

ETF 107.6-14/Final (Task DMHP-7, Vol II)
Final Rpt on Task DMHP-7 by Vitro Corp. dtd 30 March 1953.

ETF 107.6-14/Final (Task OP-2)
Final Rpt on Task OP-2 by Vitro Corp. dtd 31 March 1953.

ETF 107.6-14/Final (Task OP-12, Vol II)
Final Rpt on Task OP-12 by Westvaco dtd 24 April 1953.

ETF 107.6-14/Final (Task OP-12, Vol III)
Final Rpt on Task OP-12 by Westvaco dtd 22 May 1953.

ETF 107.6-14/Final (DMHP-10, Vol II)
Final Rpt on Task DMHP-10 by Mathieson Cml Corp. dtd 20 August 1953.

ETF 107.6-14/Final (DMHP-22)
Final Rpt on Task DMHP-22 by Mathieson Cml Corp. dtd 21 August 1953.

ETF 107.6-14/Final (Task OP-12, Vol IV)
Final Rpt on Task OP-12 by Louis Schmerling, UOP Co. dtd 5 October 1953.

ETF 107.6-14/Final (Task OP-1, Vol VI)
Final Rpt on Task OP-1 by Mathieson Cml Corp. dtd 4 December 1953.