REPORT DOCUMENTATION PAGE

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28-03-2018	FINAL	05-05-2015 to 28-02-2018

4. TITLE AND SUBTITLE
NEXT GENERATION LOADING SYSTEM FOR DETONATORS AND PRIMERS

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5b. GRANT NUMBER
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6. AUTHOR(S)
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5d. PROJECT NUMBER
DOTC-15-01-INIT725

5e. TASK NUMBER
N/A

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N/A

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
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ARLINGTON, TX 76011-5438

8. PERFORMING ORGANIZATION REPORT NUMBER
SO # 8215

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
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10. SPONSOR/MONITOR'S ACRONYM(S)
US ARMY ARDEC

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12. DISTRIBUTION/AVAILABILITY STATEMENT
DISTRIBUTION A

13. SUPPLEMENTARY NOTES

14. ABSTRACT
Designed, fabricated and installed next generation tooling to provide additional manufacturing capabilities for new detonators and other small prototype munitions on automated, semi-automated and manual machines. Lead design effort, procured and installed a primary explosive Drying Oven for a pilot plant facility. Provided a computer numerically controlled (CNC) lathe for machining energetic materials remotely in an explosive prototype machining facility. Designed, fabricated and installed a Primary Explosives Waste Treatment System in a pilot environmental processing facility. Designed, fabricated and installed modifications to an existing 30 and 50 liter Reactor System to enable remote processing of new explosive compounds.

15. SUBJECT TERMS
Tooling, Drying Oven, Explosion-Proof CNC Lathe, Wastewater Treatment System, 30 and 50 liter Reactor System

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			Anthony J. Rowley
UU	UU	UU	UU	9	19b. TELEPHONE NUMBER *(Include area code)* 817-385-0700

Final Technical Status Report

for

Next Generation Loading System for Detonators and Primers

Initiative No. **DOTC-15-01-INIT725**

Reporting Period: Effective Date - 28 FEB '18

Ordnance Technology Initiative Team

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Submitted: 28 MAR 2018

1. Comments on Technical/Cost/Schedule Performance

Task A – Design, fabricate, procure, install and prove-out the next generation of tooling and modify / adjust equipment stations to provide additional manufacturing capabilities on the prototype Wheaton Loader in Bldg 813 at Picatinny Arsenal.

Status: Completed on schedule

Task B - Install three GFE Presses and design, fabricate, procure, install and prove-out the 1st generation of tooling for each process station to provide M82 Delay Detonator Load and Assembly manufacturing capability on the pilot semi-automated Press/Weigh Stations in Bldg 813 at Picatinny Arsenal.

Status: Completed on schedule

Task C - Design, fabricate, procure, install and prove-out the 2nd generation of tooling to provide C70 Detonator process development capability on the prototype Drake Arbor Presses in Bldg 3024 at Picatinny Arsenal.

Status: Completed on schedule

Task D - Provide design, fabrication, installation, programming support and system prove-out of a primary explosive (i.e. Lead Azide) Drying Oven for the pilot plant facility in Bldg 221 at Picatinny Arsenal.

Status: Completed on schedule

Task E - Procure, install and prove-out an Explosion-Proof Lathe for the explosive machining prototype facility in Bldg 235 at Picatinny Arsenal.

Status: This prototype Explosion-Proof Lathe was funded near the end of the original contract period of performance. The PoP was extended to allow more time to design, build, prove-out and install the new equipment. Due to debug problems that are inherent in newly-designed sophisticated machines, a second no-cost extension was granted to allow the equipment to be installed after the Christmas/New Year holiday season. The equipment is now installed and complete.

Task F - Prepare engineering concept and final design drawings for a Primary Explosives Waste Treatment System on a pilot Environmental Processing Line in Bldg 813 at Picatinny Arsenal.

Status: Completed on schedule

Mod #8 - Design, fabricate, install and test specific modifications to the existing 30 and 50 Liter Reactor system installed in Bldg. 1417 at Picatinny Arsenal to enable remote processing of new explosive materials.

Status: Completed on schedule

2. Initiative Quad Chart

<table>
<tr><th colspan="2">Next Generation Loading System for Detonators and Primers</th></tr>
<tr><th>Goals & Objectives</th><th>Initiative Information</th></tr>
<tr><td>Task A – Develop and provide next generation tooling to provide additional manufacturing capabilities on an existing prototype Wheaton Loader in Bldg 813.

Task B – Develop and provide 1st generation tooling to provide M82 Delay Detonator Load and Assembly manufacturing capability on the pilot semi-automated Press/Weigh Stations in Bldg 813.

Task C – Develop and provide 2nd generation tooling to provide C70 Detonator manufacturing capability on the prototype Drake Arbor Presses in Bldg 3024.

Task D – Develop and provide a primary explosive (i.e. Lead Azide) Drying Oven for the pilot plant facility in Bldg 221.

Task E – Develop and provide an Explosion-Proof Lathe for the explosive machining prototype facility in Bldg 235.

Task F – Develop and provide a Primary Explosives Waste Treatment System on a pilot-scale Environmental Processing Line in Bldg 813.

Mod # 8 - Develop and provide specific modifications to the existing 30 and 50 Liter Reactor system installed in Bldg. 1417 to enable remote processing of new explosive materials.</td><td>Initiative Lead:
Donald K. Jackson - Contractual POC

Team Members:
Anthony J. Rowley - Technical POC
Paul H. Childers – Project Management
Vyomesh B. Patel - Controls Engineering
Charles R. Ladner - Drawings & Documentation

Period of Performance:
5 May 2015 – 28 February 2018

Funding:
$1,839,217</td></tr>
<tr><th>Milestones & Technical Achievements</th><th>Implementation & Payoff</th></tr>
<tr><td>Task A – Next generation tooling was designed, built, & proven on an existing prototype detonator loader. The existing loader had rusted due to storage in an uncontrolled environment and was cleaned and lubricated prior to operation.</td><td>Task A – This next generation tooling was completed on schedule and will provide the Government additional capabilities at a much lower cost than building a new machine.

Task B – This 1st generation tooling was completed on schedule and will provide the</td></tr>
</table>

Task B – First generation tooling was designed, built, installed & proven on four pilot Press/Weigh Stations to provide M82 Delay Detonator Load and Assemble capability at a much lower cost than building four new machines. **Task C –** Second generation tooling was designed, built, installed & proven to provide C70 Detonator manufacturing capability on the prototype Drake Arbor Presses. **Task D –** A primary explosive Drying Oven was provided for the pilot plant facility. **Task E –** An explosion-proof lathe was designed, built & installed for the explosive machining prototype facility. **Task F –** A Primary Explosives Waste Treatment System was designed, built, installed & proven for a pilot-scale environmental processing line. **Mod # 8 -** Modifications were made to an existing 30 and 50 Liter Reactor system located in Bldg 1417 to enable remote processing of new explosive materials.	Government the capability to load & assemble M82 Delay Detonators at a much lower cost than building 4 new Press/Weigh machines. **Task C –** This 2nd generation tooling was completed on schedule and will provide the Government the capability to build C70 Detonators at a much lower cost than building new Presses. **Task D –** This primary explosive Drying Oven was completed on schedule and will provide the Government with additional capabilities for drying new explosive compounds in the pilot plant facility. **Task E –** This prototype lathe for machining explosives was funded late in the project and required additional time for debug and testing prior to installing at Picatinny Arsenal. This lathe will provide the Government with the ability to machine energetic materials remotely to provide a safer environment for the operator. **Task F –** This Primary Explosives Waste Treatment System was completed on schedule and provides the Government with a pilot-scale environmental processing line to test various filter media prior to investing in a larger scale production line. **Mod # 8 -** Modifications to the existing 30 and 50 Liter Reactor system were completed on schedule. These improvements will provide the operators a safer means of remotely processing energetic materials.
Current Status: Technical = **Green** ⇨	Schedule = **Green** ⇧ Cost = **Green** ⇨

Current Status Legend:

Green = Good/On Budget **Yellow** = Minor Weakness/Known Risk **Red** = Major Weakness/Critical

Delta: ⇧ = upgrade from last assessment; ⇩ = downgrade from last assessment; ⇨ = no change

3. Supplemental Information

3.1 Technical Achievements

All tasks required in the contract and described above are complete.

Milestone Status:

No.	Deliverable or Milestone	Due Date	Percent Complete this Period	Cumulative Percent Complete
1	Contract Award & Kick-off Meeting at Picatinny	15 May 2015	100	100
2	Quarterly Technical & Business Status Report	20 June 2015	100	100
3	Submit Concept Design Drawings	30 July 2015	100	100
4	Purchase Major Equipment	15 Aug 2015	100	100
5	Quarterly Technical Report	20 Sep 2015	100	100
6	Purchase Raw Materials for Manufacturing	30 Sep 2015	100	100
7	Begin Manufacturing of Equipment	15 Oct 2015	100	100
8	Receive Equipment, 50% Manufacturing Complete	15 Nov 2015	100	100
9	Submit Final Drawing Package for Review (for current releases)	15 Dec 2015	100	100
10	Quarterly Technical & Status Business Report	20 Dec 2015	100	100
11	100% Manufacturing Complete	15 Jan 2016	100	100
12	50% Mechanical Assembly Complete	15 Feb 2016	100	100
13	50% Controls Assembly Complete	15 Mar 2016	100	100
14	Annual Technical and Quarterly Business Status Report	20 Mar 2016	100	100
15	100% Mechanical Assembly Complete	30 May 2016	100	100
16	Quarterly Technical & Business Status Report	20 June 2016	100	100
17	100% Controls Assembly Complete	30 June 2016	100	100
18	Debug. Test & Demonstrate at IPS Facility	15 Aug 2016	100	100
19	Pack, Crate & Deliver Equipment to Picatinny Arsenal, Provide Rigging, Labor & Equip. to Position Equip. in Bldg	15 Aug 2016	100	100
20	Quarterly Technical & Business Status Report	20 Sep 2016	100	100
21	Begin On-site Installation & Set-up at Picatinny Arsenal	15 Oct 2016	100	100
22	50% On-site Installation Complete	15 Sep 2016	100	100

23	Complete Installation at Picatinny Arsenal (including recent task releases)	15 Dec 2016	100	100
24	Quarterly Technical & Business Status Report	20 Dec 2016	100	100
25	Conduct Acceptance Test at Picatinny Arsenal (including recent task releases)	15 Jan 2017	100	100
26	Annual Technical and Quarterly Business Status Report	20 Mar 2017	100	100
27	Quarterly Technical & Business Status Report	20 Jun 2017	100	100
28	Quarterly Technical & Business Status Report	20 Sep 2017	100	100
29	Quarterly Technical & Business Status Report	20 Dec 2017	100	100
30	Final Technical & Business Report (Transfer Software Rights to Government & Submit)	28 Feb 2018	100	100

3.2 Technical Readiness Level Status (TRL):

Project Equipment Category	**Current Technology Readiness Level** (at start of the agreement)	**Current Technology Readiness Level**	**Final Technology Readiness Level** (expected at end of the agreement)
New Prototype Tooling for Small Munitions	5	7	7
Primary Explosives Waste Water Treatment System	1	7	7
30 and 50 Liter Reactor System	3	7	7
Remote-Controlled CNC Lathe for Hazardous Locations	4	8	8

Technology Readiness Levels in the Department of Defense (DoD)
(Source: DoD (2006), Defense Acquisition Guidebook)

Technology Readiness Level	**Description**
1. Basic principles observed and reported	Lowest level of technology readiness. Scientific research begins to be translated into applied research & development. Example might include paper studies of a technology's basic properties.

2. Technology concept and/or application formulated	Invention begins. Once basic principles are observed, practical applications can be invented. The application is speculative & there is no proof or detailed analysis to support the assumption. Examples are still limited to paper studies.
3. Analytical and experimental critical function and/or characteristic proof of concept	Active research & development is initiated. This includes analytical studies & laboratory studies to physically validate analytical predictions of separate elements of the technology. Examples include components that are not yet integrated or representative.
4. Component and/or breadboard validation in laboratory environment	Basic technological components are integrated to establish that the pieces will work together. This is "low fidelity" compared to the eventual system. Examples include integration of "ad hoc" hardware in a laboratory.
5. Component and/or breadboard validation in relevant environment	Fidelity of breadboard technology increases significantly. The basic technological components are integrated with reasonably realistic supporting elements so that the technology can be tested in a simulated environment. Examples include "high fidelity" laboratory integration of components.
6. System/subsystem model or prototype demonstration in a relevant environment	Representative model or prototype system, which is well beyond the breadboard tested for TRL 5, is tested in a relevant environment. Represents a major step up in a technology's demonstrated readiness. Examples include testing a prototype in a high-fidelity laboratory environment or in simulated operational environment.
7. System prototype demonstration in an operational environment	Prototype near or at planned operational system. Represents a major step up from TRL 6, requiring the demonstration of an actual system prototype in an operational environment, such as in an aircraft, vehicle or space. Examples include testing the prototype in a test bed aircraft.
8. Actual System completed and "flight qualified" through test and demonstration	Technology has been proven to work in its final form & under expected conditions. In almost all cases, this TRL represents the end of true system development. Examples include development test & evaluation of the system in its intended weapon system to determine if it meets design specifications.
9. Actual system proven through successful mission operations	Actual application of the technology in its final form and under mission conditions, such as those encountered in operational test and evaluation. Examples include using the system under operational mission conditions.

3.3 Technology Transition Information:

1. Technology or technologies being worked on:
   - New Prototype Tooling for Small Munitions
   - Primary Explosives Waste Water Treatment Pilot System
   - 30 and 50 Liter Reactor System
   - Remote-Controlled CNC Lathe for Hazardous Locations
2. Is this technology an extension of a previous DOTC agreement or contract?
   - No

3. System to which technology can transition:
   - New tooling configured for higher scale production
   - Full-scale Production Primary Explosives Waste Treatment Facility
   - Full-scale Production Reactor System
   - Safer remote operation of hazardous machining operations

4. Commercial applications if applicable:
   - Unknown at this time

5. Government organizations or DoD Armed Force Services interested in technology other than AOR's organization:
   - Unknown at this time

6. DoD Armed Force services or organizations that could benefit from technology:
   - Any organization pressing hazardous materials
   - Any organization generating water contaminated with explosive particles
   - Any organization producing/formulating/mixing explosive compounds
   - Any organization machining hazardous materials

7. Next step in technology transition process
   - Expectations are that the new press tooling designs will provide knowledge to procure new configurations of next level press tooling for energetic materials.
   - Expectations are that this new Primary Explosives Waste Water Treatment Pilot System will provide results that will aid in receiving funding for a full-scale production water treatment facility.
   - Expectations are that this new Reactor System configuration will provide favorable results that will aid in receiving funding for a larger scale system for processing energetic compounds.
   - Expectations are that this new CNC Lathe designed for use in hazardous locations will provide information to warrant procurement of additional remote-controlled machines for shaping energetic materials.

3.4 Problems Encountered and Action Taken:

- **Changes to the initiative objective or schedule:**
  All technical problems are now resolved.
- **Technical problems and approach to correct:**
  All technical problems are now resolved.
- **Schedule problems and approach to correct:**
  All technical problems are now resolved.
- **Risks identified and mitigation plans:**
  All technical problems are now resolved.

3.5 Non-Traditional Defense Contractor Participation:

Name of Nontraditional*	Planned Start Date	Actual Start Date	Reason for Deviation from Plan
IPS Custom Automation	05 May 2015	05 May 2015	No Deviation from Plan
OGL Enterprises LLC	05 May 2015	05 May 2015	No Deviation from Plan
Quality Concepts & Designs	10 Aug 2015		Delays in the task releases negated the need for these outside design services. With the extra time, IPS was able to handle all the designs with our in-house Engineering personnel.

3.6 Plans for Next Quarter:

- The requirements for this contract are complete.

Software Rights

We couldn't find a standard form on-line for this requirement, however, we offer the following statement:

> IPS Custom Automation transfers rights to all IPS created software (such as PLC programs) to the Government for their unlimited use and ownership. This does not include commercially purchased software (such as Allen-Bradley software) that IPS does not own the rights to.

If there is a specific standard form required for this transfer of software rights, please let me know and I will immediately submit it.