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Defense Threat Reduction Agency
SBIR 22.2 Small Business Innovation Research (SBIR)
Proposal Submission Instructions

1.0 INTRODUCTION

The Defense Threat Reduction Agency (DTRA) mission is to enable the DoD, the U.S. Government, and International Partners to counter and deter Weapons of Mass Destruction (WMD) Chemical Biological, Radiological, Nuclear) and Improvised Threat Networks. The DTRA SBIR program is consistent with the purpose of the Federal SBIR/STTR Program, i.e., to stimulate a partnership of ideas and technologies between innovative small business concerns and through Federal-funded research or research and development (R/R&D).

The approved FY22.2 topics solicited for the Defense Threat Reduction Agency (DTRA) Small Business Innovation Research (SBIR) Program is included in these instructions followed by the full topic description. Offerors responding to this Broad Agency Announcement (BAA) must follow all general instructions provided in the related Department of Defense Program BAA and submit proposals by the date and time listed in the DoD Program BAA. Specific DTRA requirements that add to or deviate from the DoD Program BAA instructions are provided below with references to the appropriate section of the DoD document.

The DTRA Small Business Innovation Research (SBIR) Program is implemented, administered, and managed by the DTRA SBIR/STTR Program Office. Specific questions pertaining to the administration of the DTRA SBIR Program and these proposal preparation instructions should be submitted to:

Mr. Mark D Flohr
DTRA SBIR/STTR Program Manager
Mark.D.Flohr.civ@mail.mil
Tel: (571) 616-6066

Defense Threat Reduction Agency
8725 John J. Kingman Road
Stop 6201
Ft. Belvoir, VA 22060-6201

For technical questions about specific topic requirements during the pre-release period, contact the DTRA Technical Point of Contact (TPOC) for that specific topic. To obtain answers to technical questions during the formal BAA open period, visit: https://www.dodsbirsttr.mil/submissions/login. For questions regarding the Defense SBIR/STTR Innovation Portal, contact DSIP Support at odsbirsupport@reisystems.com.

Proposals not conforming to the terms of this announcement will not be considered. DTRA reserves the right to limit awards under any topic, and only those proposals of superior scientific and technical quality as determined by DTRA will be funded. DTRA reserves the right to withdraw from negotiations at any time prior to contract award. The Government may withdraw from negotiations at any time for any reason to include matters of national security (foreign persons, foreign influence or ownership, inability to clear the firm or personnel for security clearances, or other related issues).

Please read the entire DoD announcement and DTRA instructions carefully prior to submitting your proposal as there have been significant updates to the requirements.

The SBIR/STTR Policy Directive is available at:
https://www.sbir.gov/sites/default/files/SBIRSTTR_Policy_Directive_2019.pdf.

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2.0 SMALL BUSINESS ELIGIBILITY REQUIREMENTS

2.1 The Offeror

Each offeror must qualify as a small business at time of award per the Small Business Administration (SBA) regulations at 13 CFR 121.701-121.705 and certify to this in the Cover Sheet section of the proposal. Those small businesses selected for award will also be required to submit a Funding Agreement Certification document provided by DTRA Contracts prior to award.

2.2 SBA Company Registry

Per the 2019 SBIR-STTR Policy Directive, all SBIR applicants are required to register their firm at SBA's Company Registry prior to submitting a proposal. Upon registering, each firm will receive a unique control ID to be used for submissions at any of the eleven (11) participating agencies in the program. For more information, please visit the SBA's Firm Registration Page: https://www.sbir.gov/user/login/.

2.3 Use of Foreign Nationals, Green Card Holders and Dual Citizens

See the "Foreign Nationals" section of the DoD SBIR Broad Agency Announcement for the definition of a Foreign National (also known as Foreign Persons).

ALL offerors proposing to use foreign nationals, green-card holders, or dual citizens, MUST disclose this information regardless of whether the topic is subject to export control restrictions. Offers must identify any foreign nationals or individuals holding dual citizenship expected to be involved on this project as a direct employee, subcontractor, or consultant. For those individuals, please specify their country of origin, the type of visa or work permit under which they are performing and an explanation of their anticipated level of involvement on this project. You may be asked to provide additional information during negotiations in order to verify the foreign citizen's eligibility to participate on a SBIR contract. Supplemental information provided in response to this paragraph will be protected in accordance with the Privacy Act (5 U.S.C. 552a), if applicable, and the Freedom of Information Act (5 U.S.C. 552(b)(6)).

Proposals submitted to export control-restricted topics and/or those with foreign nationals, dual citizens or green card holders listed will be subject to security review during the contract negotiation process (if selected for award). DTRA reserves the right to vet all uncleared individuals involved in the project, regardless of citizenship, who will have access to Controlled Unclassified Information (CUI) such as export-controlled information. If the security review disqualifies a person from participating in the proposed work, the contractor may propose a suitable replacement. In the event a proposed person is found ineligible by the government to perform proposed work, the contracting officer will advise the offeror of any disqualifications but may not disclose the underlying rationale. In the event a firm is found ineligible to perform proposed work, the contracting officer will advise the offeror of any disqualifications but may not disclose the underlying rationale.

3.0 PHASE I PROPOSAL GUIDELINES

The Defense SBIR/STTR Innovation Portal (DSIP) is the official portal for DoD SBIR/STTR proposal submission. Proposers are required to submit proposals via DSIP; proposals submitted by any other means will be disregarded. Detailed instructions regarding registration and proposal submission via DSIP are provided in the DoD SBIR Program BAA.

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3.1 Technical Volume (Volume 2)
The Phase I technical volume is not to exceed 20 pages in length and must follow the formatting requirements provided in the DoD SBIR Program BAA. Any pages in the technical volume over the 20 pages will not be considered in the proposal evaluations.

3.2 Content of the Technical Volume
The Technical Volume should cover the following items in the order given below:

(a) Identification and Significance of the Problem or Opportunity.
Define the specific technical problem or opportunity addressed and its importance.

(b) Phase I Technical Objectives.
Enumerate the specific objectives of the Phase I work, including the questions the research and development effort will try to answer to determine the feasibility of the proposed approach.

(c) Phase I Statement of Work (including Subcontractors' Efforts)

(1) Provide an explicit, detailed description of the Phase I approach. The Statement of Work should indicate what tasks are planned, how and where the work will be conducted, a schedule of major events, and the final product(s) to be delivered. The Phase I effort should attempt to determine the technical feasibility of the proposed concept. The methods planned to achieve each objective or task should be discussed explicitly and in detail. This section should be a substantial portion of the Technical Volume section.

(2) This BAA may contain topics that have been identified by the Program Manager as research or activities involving Human/Animal Subjects and/or Recombinant DNA. In the event that Phase I performance includes performance of these kinds of research or activities, please identify the applicable protocols and how those protocols will be followed during Phase I. Please note that funds cannot be released or used on any portion of the project involving human/animal subjects or recombinant DNA research or activities until all of the proper approvals have been obtained. **Submitters proposing research involving human and/or animal use are encouraged to separate these tasks in the technical proposal and cost proposal in order to avoid potential delay of contract award.**

(d) Related Work.
Describe significant activities directly related to the proposed effort, including any conducted by the principal investigator, the proposing firm, consultants, or others. Describe how these activities interface with the proposed project and discuss any planned coordination with outside sources. The technical volume must persuade reviewers of the proposer's awareness of the state-of-the-art in the specific topic. Describe previous work not directly related to the proposed effort but similar. Provide the following:

(1) Short description,
(2) Client for which work was performed (including individual to be contacted and phone number), and
(3) Date of completion.

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(e) Relationship with Future Research or Research and Development

(1) State the anticipated results of the proposed approach if the project is successful.

(2) Discuss the significance of the Phase I effort in providing a foundation for Phase II research or research and development effort.

(3) Identify the applicable clearances, certifications and approvals required to conduct Phase II testing and outline the plan for ensuring timely completion of said authorizations in support of Phase II research or research and development effort.

(f) Commercialization Strategy. Describe in approximately one page your company's strategy for commercializing this technology in DoD (such as a formal DoD Program), other Federal Agencies, and/or private sector markets. Provide specific information on the market need the technology will address and the size of the market. Also include a schedule showing the quantitative commercialization results from this SBIR project that your company expects to achieve.

(g) Key Personnel. Identify key personnel who will be involved in the Phase I effort including information on directly related education and experience. A concise technical resume of the principal investigator, including a list of relevant publications (if any), must be included (Please do not include Privacy Act Information). All resumes will count toward the page limitations for Volume 2.

(h) Foreign Citizens. Identify any foreign citizens or individuals holding dual citizenship expected to be involved on this project as a direct employee, subcontractor, or consultant. For these individuals, please specify their country of origin, the type of visa or work permit under which they are performing and an explanation of their anticipated level of involvement on this project. Proposers frequently assume that individuals with dual citizenship or a work permit will be permitted to work on an SBIR project and do not report them. This is not necessarily the case and a proposal will be rejected if the requested information is not provided. Therefore, firms should report any and all individuals expected to be involved on this project that are considered a foreign national as defined in the BAA. You may be asked to provide additional information (e.g., copy of valid passport, visa, work permit, etc.) during negotiations in order to verify the foreign citizen's eligibility to participate on a SBIR contract. Supplemental information provided in response to this paragraph will be protected in accordance with the Privacy Act (5 U.S.C. 552a), if applicable, and the Freedom of Information Act (5 U.S.C. 552(b)(6)).

(i) Facilities/Equipment. Describe available instrumentation and physical facilities necessary to carry out the Phase I effort. Justify equipment purchases in this section and include detailed pricing information in the Cost Volume. State whether or not the facilities where the proposed work will be performed meet environmental laws and regulations of federal, state (name), and local Governments for, but not limited to, the following groupings: airborne emissions, waterborne effluents, external radiation levels, outdoor noise, solid and bulk waste disposal practices, and handling and storage of toxic and hazardous materials.

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(j) Subcontractors/Consultants. Involvement of a university or other subcontractors or consultants in the project may be appropriate. If such involvement is intended, it should be identified and described to the same level of detail as the prime contractor costs. A minimum of two-thirds of the research and/or analytical work in Phase I, as measured by direct and indirect costs, must be conducted by the proposing firm, unless otherwise approved in writing by the Contracting Officer. SBIR efforts may include subcontracts with Federal Laboratories and Federally Funded Research and Development Centers (FFRDCs). A waiver is no longer required for the use of federal laboratories and FFRDCs; however, proposer must certify their use of such facilities on the Cover Sheet of the proposal.

(k) Prior, Current, or Pending Support of Similar Proposals or Awards. If a proposal submitted in response to this BAA is substantially the same as another proposal that was funded, is now being funded, or is pending with another Federal Agency, or another or the same DoD Component, you must reveal this on the Proposal Cover Sheet and provide the following information. Refer to the instructions provided in the DoD STTR BAA for this requirement.
Note: If this does not apply, state in the proposal "No prior, current, or pending support for Proposed work"

3.3 Cost Volume (Volume 3)

The Phase I Base amount must not exceed $167,500.00. Proposers must use the online cost volume form in DSIP.

Important: when completing the cost volume, enough information should be provided to allow the agency to understand how you plan to use the requested funds if a contract is awarded. Itemized costs of any subcontract or consultant should be provided to the same level as for the prime small business. If an unsanitized version of costs cannot be provided with the proposal, the Government may request it during negotations if selected. Refer to the instruction provided in the DoD SBIR program BAA for additional details on the content of the Cost Volume.

Note: Cost for travel funds must be justified and related to the needs of the project. DTRA does not include any fee on travel costs, so proposal should exclude fee on any travel costs proposed.

For more information about cost proposals and accounting standards, see https://www.dcaa.mil/Guidance/Audit- Process-Overview/.

3.4 Company Commercialization Report (CCR) (Volume 4)
Completion of the CCR as Volume 4 of the proposal submission in DSIP is required. Please refer to the DoD SBIR Program BAA for full details on this requirement. Information contained in the CCR will not be considered by DTRA during proposal evaluations.

3.5 Supporting Documents (Volume 5)

Volume 5 is provided for proposers to submit additional documentation to support the Coversheet (Volume 1), Technical Volume (Volume 2), and the Cost Volume (Volume 3).

(a) All proposers are REQUIRED to submit the following documents to Volume 5:
1. Contractor Certification Regarding Provision of Prohibition on Contracting for

Certain Telecommunications and Video Surveillance Services or Equipment (BAA Attachment 1) (REQUIRED)

2. Foreign Ownership or Control Disclosure (BAA Attachment 2) (Proposers must review Attachment 2: Foreign Ownership or Control Disclosure to determine applicability)

(b) Any of the following documents may be included in Volume 5 if applicable to the proposal.

1. Letters of Support
2. Additional Cost Information
3. Funding Agreement Certification
4. Technical Data Rights (Assertions)
5. Lifecycle Certification
6. Allocation of Rights

4.0 DIRECT TO PHASE II PROPOSAL GUIDELINES

The Defense Threat Reduction Agency does not participate in the Direct to Phase II Program.

5.0 PHASE II PROPOSAL GUIDELINES

Small business concerns awarded a Phase I contract are permitted to submit a Phase II proposal for evaluation and potential award selection. The Phase II proposals are best submitted no later than (NLT) 30 days AFTER the end of the 7 month Phase I period of performance.

All SBIR Phase II awards made on topics from solicitations prior to FY13 will be conducted in accordance with the procedures specified in those solicitations.

DTRA is not responsible for any money expended by the proposer prior to contract award.

DTRA has established a **40-page limitation** for the Technical Volume submitted in response to its topics. This does not include the Proposal Cover Sheets (pages 1 and 2, added electronically by the DoD submission site), or the Cost Volume, or the Company Commercialization Report. The Technical Volume includes, but is not limited to: table of contents, pages left blank, references and letters of support, appendices, key personnel biographical information, and all attachments.

Further details on the due date, content, and submission requirements of the Phase II proposal will be provided either in the Phase I award or by subsequent notification.

Phase II Proposal Instructions

Each Phase II proposal must be submitted through the Defense SBIR/STTR Innovation Portal by the deadline as specified in the Phase II Proposal Guidelines, or in the Phase I award or subsequent notification. **The format should be similar to Phase I proposal except the Phase II Technical Proposal is limited to 40 pages.** Each proposal submission must contain a Proposal Cover Sheet, Technical Volume, Cost Volume, a Company Commercialization Report (see the appropriate section of the BAA Announcement) and Volume 5. The Commercialization Strategy Volume should be more specific than was required for Phase I.

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As indicated in the DoD STTR Program BAA, the CCR is generated by the submission website based on information provided by you through the "Company Commercialization Report" tool.

Commercialization Strategy

See the appropriate section DoD SBIR 22.2 BAA.

Phase II Evaluation Criteria

Phase II proposals will be reviewed for overall merit based upon the criteria specified in this Broad Agency Announcement and will be similar to the Phase I process.

Public Release of Award Information

If your proposal is selected for award, the technical abstract and discussion of anticipated benefits will be publicly released via the Internet. Therefore, do not include proprietary or classified information in these sections. For examples of past publicly released DoD SBIR/STTR Phase I and II awards, visit https://www.dodsbirsttr.mil/submissions/login.

6.0 DISCRETIONARY TECHNICAL AND BUSINESS ASSISTANCE (TABA)

In accordance with the Small Business Act (15 U.S.C. 632), DTRA will authorize the recipient of a Phase I or Phase II SBIR award to purchase Discretionary Technical & Business Assistance services, such as access to a network of scientists and engineers engaged in a wide range of technologies, or access to technical and business literature available through on-line data bases, for the purpose of assisting such concerns as:

- making better technical decisions concerning such projects;
- solving technical problems which arise during the conduct of such projects;
- minimizing technical risks associated with such projects;
- developing/ commercializing new commercial products/processes resulting from such projects; and,
- meeting cyber security requirements.

If you are proposing use of Discretionary Technical and Business Assistance (TABA), you must provide a cost breakdown in the Cost Volume under "Other Direct Costs (ODCs)" and provide a one-page description of the vendor you will use and the Technical and Business Assistance you will receive. For the Phase I project, the amount for TABA may not exceed $6,500 per award. For the Phase II project, the TABA amount may be less than, equal to, but not more than $50,000 per project. The description should be included in Volume 5 of the proposal.

Approval of Discretionary Technical and Business Assistance is not guaranteed and is subject to review of the contracting officer.

For Discretionary Technical and Business Assistance, small business concerns may propose one or more vendors. Additionally, business-related services aimed at improving the commercialization success of a small business concern may be obtained from an entity, such as a public or private organization or an agency or other entity established or funded by a State that facilitates or accelerates the

commercialization of technologies or assists in the creation and growth of private enterprises that are commercializing technology.

7.0 EVALUATION AND SELECTION

All proposals will be evaluated in accordance with the evaluation criteria listed in the DoD SBIR Program BAA.

7.1 DTRA Evaluation Authority. DTRA has a single Evaluation Authority (EA) for all proposals received under this solicitation. The EA either selects or rejects Phase I and Phase II proposals based upon the results of the review and evaluation process plus other considerations including limitation of funds, and investment balance across all the DTRA topics in the solicitation. To provide this balance, a lower rated proposal in one topic could be selected over a higher rated proposal in a different topic. DTRA reserves the right to select all, some, or none of the proposals in a particular topic.

7.2 Notifications. Following the EA decision, the DTRA SBIR/STTR office will release notification e-mails of selection or non-selection status for a Phase I award within 90 days of the closing date of the BAA. E-mails will be sent to the addresses provided for the Principal Investigator and Corporate Official. Offerors may request a debriefing of the evaluation of their not selected proposal and should submit this request via email to: dtra.belvoir.RD.mbx.sbir@mail.mil and include "SBIR 22.2 / Topic XX Debriefing Request" in the subject line. Debriefings are provided to help improve the offeror's potential response to future solicitations. Debriefings do not represent an opportunity to revise or rebut the EA decision.

For selected offers, DTRA will initiate contracting actions which, if successfully completed, will result in contract award. DTRA Phase I awards are issued as fixed-price purchase orders with a maximum period of performance of seven-months. DTRA may complete Phase I awards without additional negotiations by the contracting officer or without opportunity for revision for proposals that are reasonable and complete.

7.3 DTRA Support Contractors

Select DTRA-employed support contractors may have access to contractor information, technical data or computer software that may be marked as proprietary or otherwise marked with restrictive legends. Each DTRA support contractor performs under a contract that contains organizational conflict of interest provisions and/or includes contractual requirements for nondisclosure of proprietary contractor information or data/software marked with restrictive legends. These contractors require access while providing DTRA such support as advisory and assistance services, contract specialist support, and support of the Defense Threat Reduction Information Analysis Center (DTRIAC). The contractor, by submitting a proposal or entering into this contract, is deemed to have consented to the disclosure of its information to DTRA's support contractors.

The following are, at present, the prime contractors anticipated to access such documentation: Broadleaf Inc (contract specialist support), Kent, Campa and Kate, Inc. (contract closeout support), ARServices (Program Management Advisory and Assistance Services--A&AS), Systems Planning and Analysis, Inc. (Subject Matter Expertise A&AS), Polaris Consulting (Small Business Program Support), Seventh Sense Consulting, LLC (Acquisition Support), Kapili Services, LLC and TekSynap (DTRIAC) and Savantage Solutions (Accounting and Financial Systems Support). This list is not all inclusive (e.g., subcontractors) and is subject to change.

7.4 Protests. Refer to the DoD SBIR Program BAA for procedures to protest the Announcement.

As further prescribed in FAR 33.106(b), FAR 52.233-3, Protests after Award should be submitted to: Service of Protest (Sept 2006)

(a) Protests, as defined in section 33.101 of the Federal Acquisition Regulation, that are filed directly with an agency, and copies of any protests that are filed with the Government Accountability Office (GAO), shall be served on the Contracting Officer (addressed to Mr. Herbert Thompson, Contracting Officer, as follows) by obtaining written and dated acknowledgment of receipt from (if mailed letter) Defense Threat Reduction Agency, ATTN: AL-ACQ (Mr. Herbert Thompson), 1680 Texas Street, Kirtland AFB, NM 87117. If Federal Express is used for the transmittal, the appropriate address is: Defense Threat Reduction Agency, ATTN: AL-ACQ (Mr. Herbert Thompson), 8151 Griffin Avenue SE, Building 20414, Kirtland AFB, NM 87117-5669.

(b) The copy of any protest shall be received in the office designated above within one day of filing a protest with the GAO.

(End of provision)

8.0 AWARD AND CONTRACT INFORMATION

DTRA plans on Phase I projects for a seven (7) month period of performance with six months devoted to the research and the final month for the final report. The award size of the Phase I contract is no more than $167,500.00 not withstanding a maximum of $6,500.00 for Discretionary Technical and Business Allowance (TABA). For a Phase II project, DTRA plans on a 24 month period of performance. The award size of a Phase II contract is no more than $1,100,000.00 not withstanding a maximum of $50,000.00 for the entire project.

9.0 ADDITIONAL INFORMATION

9.1 Export Control Restrictions

The International Traffic in Arms Regulations (ITAR), 22 CFR Parts 120 through 130, and the Export Administration Regulations (EAR), 15 CFR Parts 730 through 799, will apply to all projects with military or dual-use applications that develop beyond fundamental research, which is basic and applied research ordinarily published and shared broadly within the scientific community. More information is available at https://www.pmddtc.state.gov/ddtc_public.

The technology within some DTRA topics is restricted under export control regulations including the International Traffic in Arms Regulations (ITAR) and the Export Administration Regulations (EAR). ITAR controls the export and import of listed defense-related material, technical data and services that provide the United States with a critical military advantage. EAR controls military, dual-use and commercial items not listed on the United States Munitions List or any other export control lists. EAR regulates export-controlled items based on user, country, and purpose. **The offeror must ensure that their firm complies with all applicable export control regulations.**
NOTE: Export control compliance statements found in these proposal instructions are not meant to be all inclusive. They do not remove any liability from the submitter to comply with applicable ITAR or EAR export control restrictions or from informing the Government of any potential export restriction as fundamental research and development efforts proceed.

9.2 Cyber Security

Any Small Business Concern receiving an SBIR award is required to provide adequate security on all covered contractor information systems. Specific security requirements are listed in DFARS 252.204.7012, and compliance is mandatory.

9.3 Feedback

In an effort to encourage participation in, and improve the overall SBIR award process, offerors may submit feedback on the SBIR solicitation and award process to: dtra.belvoir.RD.mbx.sbir@mail.mil for consideration for future SBIR BAAs.

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DTRA SBIR 22.2 Phase I Topic Index

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DTRA222-001 TITLE: Application of Machine Learning, Artificial Intelligence, and Data Science techniques to improve NL Data Management and Application Services

OUSD (R&E) MODERNIZATION PRIORITY: Artificial Intelligence/ Machine Learning; Cybersecurity; Nuclear

TECHNOLOGY AREA(S): Information Systems; Nuclear

OBJECTIVE: To develop proof of concept and demonstrate feasibility for a customized application development platform and database management integrated with intelligent, self-learning cybersecurity control monitoring system prototype. As envisioned, the capability will use industry leading technologies, such as Machine Learning (ML), Artificial Intelligence (AI) and Data Science (DS) capabilities, to recognize normal usage patterns for Nuclear Logistics management and reporting application, then apply data analytics and reporting to identify, report and suspend anomalous activities that may represent a cybersecurity threat or operating environment deviation from normal. NL goal is to develop customized applications and database management system using no-code or low-code application environments and commercial of the shelf database software. While these tools incorporate proven components implementing secure coding best practices, we expect incorporating AI/ML/DS technologies and analytics with the low-code environment will enable developing more intelligent monitoring capabilities directly within the applications. The amount of data inherent within custom Nuclear Logistics applications is relatively small by contemporary standards, but usage data from module and database field access is orders of magnitude greater and significantly more dynamic. Automatically incorporating big data analytics and reporting capabilities into low-code developed applications to warrant Surety and Accountability of the nation's deterrence stockpile. AI/ML/DS capabilities will be integrated into application usage and database access patterns to learn "normal" expected behavior and quickly identify, alert and block anomalous actions.

DESCRIPTION: Nuclear Logistics Technical Division (NLT) is directly responsible for providing application and database services to the DoD customers as part of their mission to maintain the national nuclear stockpile databases. NLT requires next generation systems that will provide the capabilities to securely maintain the integrity of mission essential applications and databases by applying cybersecurity protections through the application AI/ML/DS technologies. To support future requirements and nuclear system modernization, NLT is interested in developing a next generation rapid application development platform and database management prototype integrated with intelligent cybersecurity protection measures. NLT's goal is to prototype and demonstrate an enhanced NL Application development platform and Database Service using AI/ML/DS and low-code generated custom applications to support robust and secure user applications for NL needs. The application development platform will be configured to use COTS no-code or low-code platforms, and deliver the prototype system using innovative which can effective make use of AI/ML/DS techniques for both user application data and system collected usage and access patterns. As the Restricted Data aspects of the NLT information systems necessitate a cryptographically isolated environment, this prototype system will leverage AI/ML/DS capabilities within a relatively closed environment to support enhanced analytics, monitoring and reporting for Nuclear Logistics and enhance nuclear logistics management capabilities and system modernization as the foundation for future applications beyond current capabilities. This proposal allows development teams to become part of a paradigm that introduces an end-user application design that creates a fundamental connection between the user, mission essential tasks, business operations procedures and the software that directly impacts department specific productivity. This innovation also

facilitates a custom application design from idea to an operational reality within a few weeks, perhaps even days.

PHASE I: Design a concept for enhancing low-code application development platforms to automatically incorporate capabilities for reviewing all logged system, module and database access events, identifying patterns representing “normal” system usage over a period of time, which will account for monthly, quarterly and annual data entry and reporting activities, as well as ad hoc activities, such as emergency operations exercises. Using this growing collection of event data, the low-code application development platform enhancements will continually monitor the cyber-health of the application environment using AI/ML/DS services and alert system administrators as to anomalous conditions. If possible, the AI/ML/DS services will also be able to identify and alert operational anomalies, such as network, storage or processing issues before actual system failures occur. In addition to identifying concepts and methods for accomplishing these intelligent system monitoring capabilities, analyze additional processing, storage and network loads to support these capabilities. The analysis should include identifying typical cybersecurity monitoring services and controls that may be able to be replaced by the intelligent system monitoring capabilities.

PHASE II: Design, develop, demonstrate and validate a proof of concept technology demonstration for one or more representative modules incorporating the AI/ML/DS services for enhanced intelligent monitoring in parallel with developing the new module(s). Provide a detailed project plan for developing such a capability, and benchmarking against a similar complexity low-code developed module to quantitatively and qualitatively identify specific operational improvements. Conduct formal acceptance testing with user community stakeholders on the module to confirm its correct operation, then monitor the ability to enhanced capability to collect system events, identify normal usage patterns, and alert when repeated anomalous events occur outside the normal range. Once fielded to a select group of operational users, test the system effectiveness for intelligently adapting to changing usage events by introducing specific anomalies. Document the comparison of the representative baseline module against the enhancement intelligent monitoring module, including benefits, weaknesses and opportunities for improvement. Prior to completion of Phase II, perform typical software maintenance and functional enhancements, as would be typical of user reported problem reports and new / improved functionality change requests, and analyze how the intelligent monitoring capabilities respond to a modified software codebase.

PHASE III DUAL USE APPLICATIONS: Working with NL and the low-code application development platform software vendor, jointly develop functional requirements, specifications, high level designs for incorporating the AI/ML/DS techniques, services and capabilities. Document lessons learned from the Phase II proof of concept capability and identify suggested improvements. Identify changes necessary to generalize the AI/ML/DS service enhancements for the COTS low-code application development platform, including approximate estimates of complexity to accomplish. For NL, identify necessary actions to incorporate the intelligent monitoring capabilities into existing low-code based applications. Also identify actions necessary to extend the AI/ML/DS based intelligent monitoring capabilities from being able to alert system administrators regarding anomalous conditions to enhancements necessary for the intelligent cyber monitoring capabilities to proactively take actions to automatically shut down identified threats. It is assumed identified network, storage and system identified anomalies will need to be manually addressed by system administrators at the end of Phase III. If there are opportunities for commercializing corrective actions in response to system failure modes identified, these should be documented and communicated to NL and the COTS low-code application development platform vendor as well.

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REFERENCES:

1. Low Code Development Platform: https://www.helpnetsecurity.com/2022/02/10/low-code-applications
2. https://safe.menlosecurity.com/doc/docview/viewer/docNAC769ABB678Dc422920aa9c3d6eaf2d662394fa07e662eba489423543de314ebba0ff35a05e7
3. AI/ML/DS techniques in application to cyber security: https://www.securityhq.com/blog/debunking-the-myths-how-machine-learning-ml-benefits-cyber-security/
4. Database machine learning: https://www.infoworld.com/article/3607762/8-databases-supporting-in-database-machine-learning.html

KEYWORDS: Machine Learning, Artificial Intelligence, Data Science, Database Management System, Application Development, and low-code application development.

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DTRA222-002 TITLE: Geiger–Müller Tube Alternative with Electronics

OUSD (R&E) MODERNIZATION PRIORITY: Nuclear

TECHNOLOGY AREA(S): Electronics; Materials; Nuclear; Sensors

OBJECTIVE: DTRA seeks to develop and field an alternative to Geiger–Müller tubes to include the accompanying acquisition and analysis electronics that will provide similar or enhanced detection capabilities while also allowing the instrument to operate in a high radiation environment without causing damage to the detector or the electronics.

DESCRIPTION: Geiger–Müller tubes have been an important option for designers of radiation detection instrumentation for the past century primarily due to sensitivity and low costs. Under typical fielding environments, they prove to be rugged while providing long-term acquisition stability when used in the intended radiation fields. However, application of these devices in high radiation fields can lead to their failure due to system deadtime limitations and the degradation of fill gas. This development will conceptualize (Phase I), prototype (Phase II), and commercialize (Phase III) a Geiger–Müller tube alternative that would meet the desired requirements while providing a detector that can withstand prolonged exposure in radiation fields of up to 10,000 cGy/hour. This development must also include the associated electronics which must also be able to operate following the same exposure to high radiation fields without damage.

Requirements for this development are as follows:

- The detector could include, but is not limited to, solid state or scintillator detectors. No photomultiplier tubes are allowed, however, solid state photomultipliers can be employed.
- The sensitivity should not be less than that of Geiger–Müller tubes.
- The electronics must be designed to allow common integration into various systems.
- The detector system and electronics must be designed to allow operation in high radiation environemnts without damage.
- This capability must be general in its application, not designed to fill a limited need.

PHASE I: Development of the design approach to include risk reduction followed by a concept design. This phase should demonstrate the ability of a Phase II prototype to meet the performance goals described in the Description Section. Consideration should be given to literature search, analysis, and modeling to demonstrate to applicability of the proposed capability. Preliminary fabrication can be performed to obtain engineering data for analysis. The phase I deliverable is a final report detailing work performed in Phase I, analysis of the results, the conceptual design, and application to Phase II development.

PHASE II: Phase II projects should develop a prototype device. The prototype should be characterized and tested in a laboratory and/or field environment. The prototype should demonstrate the capabilities as described in the Description Section. The phase II deliverable is a final report and hardware deliverable.

PHASE III DUAL USE APPLICATIONS: Field-deployablity of this development would have commercial applications including operation in high radition fields. Finalize and commercialize this sensor for use by customers (e.g., government, industry). Although additional funding may be provided through DoD

sources, the awardee should look to other public or private sector funding sources for assistance with transition and commercialization.

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KEYWORDS: High Radiation Environment, Radiation Detection, Radiation Damage, Radiation Harden

VERSION 2

DTRA222-003 TITLE: Graphene and helix shaped steel fiber dosed concrete for EMP and Blast Protection

OUSD (R&E) MODERNIZATION PRIORITY: 5G, General Warfighting Requirements (GWR); Nuclear

TECHNOLOGY AREA(S): Electronics; Materials; Nuclear

OBJECTIVE: Develop and demonstrate commercially viable building constructed with light-weight concrete stay-in-place forms and structural poured concrete both dosed with graphene and screw shaped steel microfibers to provide electrically conductive, thermally insulated, ultra-strong, blast, fire and EMP/GMD resistant buildings.

DESCRIPTION: It has been demonstrated that graphene oxide, graphene nano-sheets or carbon-nanotube dosed concrete has improved thermal properties, reduced water absorption, greatly increased strength and electrical conductivity (see references (a) through (e)). The addition of screw shaped steel micro-fibers has also been demonstrated to increase concrete strength (see reference (f)), and steel fibers in conjunction with graphene has higher strength and electrical conductivity (see reference (g)). The electrical conductivity would allow graphene / screw shape steel microfiber dosed concrete to function as a Faraday Cage and provide protection from an EMP induced by an EMP weapon, high altitude nuclear explosion or a geomagnetic disturbance such as a solar flare. Autoclaved Aerated Concrete (AAC) and / or Foam-Crete can be used as stay-in-place forms for construction of concrete facilities; both of their strength increase from use of graphene and / or steel fibers (see references (h) through (l)). Use of AAC or Foam-Crete perform well regarding insulation and fire resistance which would further improve facility performance and survivability. The cost of manufacturing graphene has drastically reduced in the past several years, and it is expected due to recent breakthroughs that the cost will be further reduced (estimated to decrease to 1/200th of the current cost); see references (m) through (n), which makes the application of these materials for these potential applications even more attractive.

PHASE I: Conduct extensive document research to determine state of the art and properties identified from previous experiments and testing regarding graphene oxide concrete, AAC, and Foam-Crete. Identify any knowledge gaps and conduct experiments and testing to fill these gaps (if any). Determine the optimum mix of graphene oxide and / or graphene sheets with screw shaped micro-steel fibers for AAC or Foam-Crete stay-in-place formed Concrete building construction to serve as an EMP/GMD resistant bomb shelter. Demonstrate the material's ability to be welded, or electrically fused with point of entry protections such as EM doors, waveguides, and filters. Provide a written report of the findings.

PHASE II: Based on the knowledge and determination of feasibility obtained in phase I, construct a structure of adequate size using graphene and screw shaped fiber steel dosed AAC or Foam-Crete stay-in-place forms and concrete to test with respect to EMP, flame, and blast resistance using both Non-Destructive, and Destructive Testing.

PHASE III DUAL USE APPLICATIONS: Provision of affordable materials and methods for high strength, fire resistant Insulated Composite Concrete Forms (ICCF) for stay-in-place Concrete construction of High Performance Concrete for Highly survivable facilities to include EMP/GMD protection.

VERSION 2

REFERENCES:

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3. Reference (c)https://journals.sagepub.com/doi/pdf/10.1177/1847980417742304
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5. Reference (e)https://www.sciencedirect.com/science/article/pii/S2352710217301079
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7. Reference (g)https://www.sciencedirect.com/science/article/pii/S2352710217301079
8. Reference (h) https://www.sciencedirect.com/science/article/pii/S2214785318314718
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10. Reference (j)https://www.researchgate.net/publication/236611170_Physical_and_Mechanical_Characterization_of_Fiber-Reinforced_Aerated_Concrete_FRAC
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12. Reference (l)https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.113.9722&rep=rep1&type=pdf
13. Reference (m)https://www.rmit.edu.au/news/all-news/2019/jun/graphene-from-gum-trees
14. Reference (n)https://www.forbes.com/sites/scottsnowden/2020/07/24/ground-breaking-method-to-make-graphene-from-garbage-is-modern-day-alchemy/

KEYWORDS: Insulated Composite Concrete Forms (ICCF), Autoclaved Aerated Concrete (AAC), Graphene, electromagenetic pulse (EMP), Blast, Spalling , Helix steel fibers, geomagnetic distrubance (GMD)

VERSION 2

DTRA222-004 TITLE: Perovskite Radiation Detectors and Imagers

OUSD (R&E) MODERNIZATION PRIORITY: Nuclear

TECHNOLOGY AREA(S): Sensors; Nuclear; Materials; Electronics

OBJECTIVE: Develop a portable, handheld, high-resolution, low operating voltage, spectroscopic-capable radiation detector using direct semiconductor radiation sensing elements that are based on perovskites. The detector could be carried by the warfighter or easily integrated into light vehicles to enable the operator to identify radioisotopes present in the battlefield or operational environment.

DESCRIPTION: Currently available radiation detection and imaging systems capable of high-resolution, spectroscopic operation necessary for radioisotope identification and positioning are either incapable of being deployed in handheld, portable systems (due to SWAP or the requirements for cryogenic operation) or are prohibitively expensive to deploy to the general warfighter. Perovskite materials, including organic-inorganic hybrid perovskites and inorganic perovskites, are high-quality semiconductor materials with a high absorption cross-section to ionizing radiation. Additionally, perovskite materials exhibit a long carrier lifetime, moderate mobility, and can be grown using scalable, inexpensive methods, including solution processing. The use of inexpensive, earth-abundant materials in perovskites shows promise to significantly reduce the cost of radiation detection and imaging systems, enabling wider deployment of these systems. Although perovskite materials have been demonstrated to have a good energy resolution (near 2% at 662 keV), they can suffer from bias-induced performance degradation, and the material uniformity, material yield, surface and contact engineering, and compatible readout electronics and imaging systems still need optimization to enable deployment to the warfighter. DTRA envisions the use of such systems in battlefield radioisotope monitoring and warning, and general imaging usage (i.e. non-destructive testing of DoD components). Specific requirements of these systems include:

- Energy resolution < 2% at 662 keV
- Energy resolution < 5% at 2 MeV
- Detection efficiency > 80% at 662 keV
- Detection efficiency > 50% at 2 MeV
- Operating bias < 300 V
- Capability for dual-mode (gamma and fast neutron) operation
- Detector material cost < $15 USD per cubic centimeter
- Radiation survivability up to 10,000 cGy
- Maximum degradation in energy resolution of 20% (in terms of the zero-dose energy resolution) at a TAD of 3,600 cGy of neutrons and gammas in any proportion
- Detector yield > 75 %
- Detector variability (in terms of energy resolution) < 10 %
- Angular resolution for imager < 3 degrees
- System mass for imagers (excluding power supply) < 20 kg.
- Additionally, DTRA seeks the following innovations during the SBIR project:
- Ability for computer-controlled growth and optimization of the perovskite material, with minimal user intervention.
- Optimization of contact materials, interfaces, passivation and deposition techniques to minimize damage to the perovskite material.
- Design and optimization of readout electronics tailored to the material capacitance and carrier mobility and lifetime of the perovskite material.

VERSION 2

PHASE I: Demonstrate the feasibility of low-cost, handheld, portable, high-resolution perovskite detection systems by demonstrating a single-pixel detector meeting the above requirements of: energy resolution, detector efficiency, operating bias, material cost, and radiation survivability. Deliverables will include: radiation response characterization (in the form of spectra from various detectors), perovskite crystal detectors, and material growth procedures and recipes. The design of a customized circuit to improve the detector performance, if needed for performance improvement, can be part of Phase I. The development of stable material performance under bias which can include optimal rectifying contacts and surface passivation and deposition strategies is a critical goal of Phase I. The Phase I effort will include prototype design plans to be developed under Phase II.

PHASE II: Develop a prototype imager, with a minimum of 144 pixels, meeting all the above project requirements. The design of a GUI for the imager, and if applicable, a working, computer-controlled material growth system will be completed. Phase II will include the demonstration of the performance of the prototype system to imaging both gamma-rays and fast neutrons. This demonstration will include mature hardware designs and documentation and prototype testing. A prototype imager, which may include an off-board power supply and data processing, will be delivered to the Government for testing.

PHASE III DUAL USE APPLICATIONS: Final prototype development, including on-boarding all components (including the power supply and data processing systems) will be completed, and designs and initial prototypes for larger (greater number of pixel) imaging systems will be completed. The imaging system will transition to manufacturing, with a focus on acquisition of such systems by the DoD.

Handheld radiation imaging systems, of varying design, are needed across industry for both defense and commercial applications, the latter of which include: medical imaging, non-destructive testing, contraband interdiction, and nonproliferation compliance enforcement.

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2. S. Yakunin, M. Sytnyk, D. Kriegner, S. Shrestha, M. Richter, G. J. Matt, H. Azimi, C. J. Brabec, J. Stangl, M. V. Kovalenko, and W. Heiss, Detection of X-Ray Photons by Solution-Processed Lead Halide Perovskites, Nat. Photonics 9, 444 (2015).
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5. L. Xu, W. Jie, G. Zha, Y. Xu, X. Zhao, T. Feng, L. Luo, W. Zhang, R. Nan, and T. Wang, Radiation Damage on CdZnTe:In Crystals under High Dose 60Co γ-Rays, CrystEngComm 15, 10304 (2013).
6. Y. He, L. Matei, H. J. Jung, K. M. McCall, M. Chen, C. C. Stoumpos, Z. Liu, J. A. Peters, D. Y. Chung, B. W. Wessels, M. R. Wasielewski, V. P. Dravid, A. Burger, and M. G. Kanatzidis, High Spectral Resolution of Gamma-Rays at Room Temperature by Perovskite CsPbBr3 Single Crystals, Nat. Commun. 9, 1 (2018).
7. J. Res. Natl. Inst. Stand. Technol. 109, 451-456 (2004)
8. T. Gozani et al., Passive Nondestructive Assay of Nuclear Materials, NUREG/CR-5550 (US Nuclear Regulatory Commission, Washington, DC, 1991)

9. M. Liu, Z. Li, W. Zheng, L. Kong, and L. Li, Improving the Stability of CsPbBr3 Perovskite Nanocrystals by Peroxides Post-Treatment, Front. Mater. 6, 1 (2019).
10. P. Zhang, G. Zhang, L. Liu, D. Ju, L. Zhang, K. Cheng, and X. Tao, Anisotropic Optoelectronic Properties of Melt-Grown Bulk CsPbBr3 Single Crystal, J. Phys. Chem. Lett. 9, 5040 (2018).

KEYWORDS: radiation detection, radiation sensor, radiation imaging, perovskite, gamma, neutron

VERSION 2

DTRA222-005 TITLE: Subterranean Wireless Communications for Counter-WMD Missions

OUSD (R&E) MODERNIZATION PRIORITY: 5G, General Warfighting Requirements (GWR); Network Command, Control and Communications; Cybersecurity

TECHNOLOGY AREA(S): Electronics;Information Systems

OBJECTIVE: Investigate novel means to provide practical wireless communications which outperform traditional free-space radio frequency (RF) communications in subterranean environments during DoD missions. Characterize technology performance in underground spaces, especially man-made underground facilities typical of those used for production, storage, and deployment of weapons of mass destruction (WMDs). Demonstrate the ability of the technology to be used for remote operation of multiple robotic systems in an environment typifying an underground facility used for WMD production, storage, or use.

DESCRIPTION: Traditional wireless communications links (RF and non-RF) suffer a number of impairments when used in subterranean spaces. The Army Techniques Publication for subterranean operations acknowledges this, stating:

"Wireless communications [in subterranean spaces] are usually very limited. These include within the [subterranean] facility, subterranean to surface (vice versa), and potentially even surface to surface near a subterranean facility due to excessive noise, confusion, depth (overburden), confined space acoustics, little to no light, combined with surface terrain that is usually restrictive and with limited lines of sight. Strained communications, degraded global positioning systems, confined space in unknown terrain, and other difficult environmental factors make navigation, command and control, and even fratricide prevention measures extremely difficult. [1]"

Underground facilities provide concealment and protection for an array of activities conducted by US adversaries, including production, storage, and deployment of WMDs. These facilities have proliferated globally, with “hundreds” being acknowledged to exist at the turn of the century, and many more being constructed. Their multitude has created a number of challenges which the DoD has made a priority to solve. [2] The problem of communicating in sprawling underground facilities while conducting counter-WMD operations is one such challenge, the solution to which currently relies on conventional free-space RF radio links.

While above-ground radio links are ubiquitous, well understood, and can be accurately modeled in most cases, RF propagation underground is not well understood, in part because it is less commonly needed and also because it is highly dependent on the geometry and electrical properties of a given subterranean environment. [3] The variable and unknown nature of adversary subterranean facilities greatly inhibits the ability of engineers to optimize communication links for these environments, and leads to conventional radio links being repurposed without significant modification for use during subterranean operations. This, combined with the impacts of tunnel curvature, corners, intersections, and discontinuities, results in greatly reduced and highly variable radio link performance in subterranean environments. [4]

Missions conducted by DoD personnel in subterranean environments require the real-time exchange of substantial amounts of information such as voice, video, and sensor data among personnel, sensors, and robotic systems. Accomplishing this with traditional RF radio links requires the use of relay nodes, which

may be either static or mobile, and may be separate from or part of the robotic systems being used. Creating an RF communications network within a large underground facility requires the use of a substantial number of network nodes, as well as the means to command and the logistics to deploy them. A method of communicating in subterranean environments which is not reliant on traditional RF propagation, and which reduced the operational and logistics burdens on the operator, would significantly contribute to the success of operations conducted in underground facilities.

Such a novel solution may rely on the innovative use of a number of physical phenomena (optical, magnetic, plasmonic, acoustic, etc.) to transmit and receive information, and may also leverage infrastructure typically found in underground facilities. Solutions may require a multidisciplinary approach to combine phenomena in order to account for the impacts of dust, smoke, loud noises, illuminators, and other link impairments that may be encountered during DoD operations. Technology developed under this SBIR topic would be invaluable to DoD groups conducting operations in underground facilities, as well as those operating in dense, urban environments, which also are affected by impaired RF propagation. The nature of a non-traditional, non-RF communications capability also lends itself to many other military applications, especially those requiring a low probability of detection (LPD) such as unattended ground sensors, robotic systems, data exfiltration, and intra-squad communications, as well as use in systems which are susceptible to conventional electronic warfare attacks.

PHASE I: The Phase I deliverables are a report and proof of concept demonstrating point-to-point information exchange using novel means of wireless communications as described above. The performer shall characterize basic properties of the communications link in a representative environment, including throughput, latency, and bit error rate as a function of transmitter/receiver separation distance in line-of-sight and non-line-of-sight configurations. The report shall discuss the advantages/disadvantages of the proposed approach, characterization data & metrics, potential network configurations, and suggested applications beyond subterranean communications.

PHASE II: The Phase II deliverable is a final report and final proof of concept demonstration of 3 small unmanned ground vehicles (sUGVs) being simultaneously operated in a relevant environment via the novel wireless communications network developed during this phase. The performer shall execute all integration necessary to remotely control the sUGVs during this phase, and shall characterize the operational utility of the network by conducting simulated, simplified counter-WMD scenarios in a relevant environment and assessing mission outcomes. The performer shall also characterize performance of the communications link in the presence of environmental impairments, as applicable. The performer shall continue to measure performance based on characterization methods developed in Phase I. The final report shall discuss the advantages and disadvantages of the technology, characterization data, and potential use cases beyond subterranean environments. The final report shall also outline a fieldable configuration of the technology.

PHASE III DUAL USE APPLICATIONS: During Phase III, the performer would develop and produce fieldable prototypes using accepted systems engineering practices to ensure satisfaction of functional requirements and proper management of system configuration. The performer would also enable preliminary usage by DoD customers, including DTRA RD-CX and counter-WMD stakeholders, and develop configurations for other DoD systems requiring LPD communication solutions. Although additional funding may be provided through DoD sources, the awardee should look to other public or private sector funding sources for assistance with transition and commercialization.

VERSION 2

REFERENCES:

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3. IEEE Antennas & Propagation Magazine, RF Propagation in Mines and Tunnels (2015). Accessible with subscription at: https://ieeexplore.ieee.org/document/7225146IEEE
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KEYWORDS: Subterranean, Communications, Underground Facilities, UGF, Low Probability of Detection, Low Probability of Intercept, LPI, LPD