Guidelines for a Laboratory University Collaboration Initiative (LUCI) Proposal

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I. Background

The Laboratory University Collaboration Initiative (LUCI) is a research program sponsored by the Basic Research Office (BRO), Office of Under Secretary of Defense for Research and Engineering (USD R&E) (http://basicresearch.defense.gov/). It is designed to support the DoD Laboratory researchers for performing basic research, in collaboration with DoD funded university researchers. These terms are defined more precisely below, but first, it is important to make a few observations to provide some background:

- This was a pilot program created in 2016, which recently (in 2019) had its status elevated to permanent, part of the Vannevar Bush Faculty Fellowship (VBFF) program of record (POR). Currently, both the VBFF and LUCI share the same budget line, although this may change in the future.
- LUCI was initially created with the intention to encourage collaborations between the Vannevar Bush fellows in academia, and DoD laboratory researchers. It was expanded for the 2020 class to include the possibility of collaboration with MURI recipients. Both VBFF and MURI are large DoD research programs that are at the forefront of innovative and challenging basic research. Therefore, it makes sense to leverage both programs to advance the capabilities of the DoD laboratories and the scientific knowledge and experience of the S&T workforce. By expanding the collaboration opportunities, a greater range of scientific topics can be addressed, and preliminary results have been encouraging.
- This is a *competitive* program being funded and managed by the Department, and it is therefore agnostic to the services. There is no preset number of awards given to each laboratory (AFRL, ARL, NRL), and all submissions compete against each other. The Principal Investigators (PI) have the opportunity to join forces across the service boundaries and submit a collaborative proposal, but there are no requirements to do so, and this is not an evaluation criterion. It is a benefit only when such collaboration yields clear advantages to the technical work plan. While such cross-service collaboration is very desirable from the perspective of the Department, there is currently no incentive in the program, either financial or through scoring criteria, to promote it.

This document is addressed to the Laboratory scientist as potential applicant ("you'), but also includes recommendations to the Laboratory management.

There are three key concepts to remember at all times, whether you are planning to submit a proposal, writing it, or executing an award:

- Key Concept #1: Basic research;
- Key concept #2: Collaboration (Lab-Academia);
- Key Concept #3: Competition.

These will be referred to as such throughout this document.

II. Program Objectives

Overall the BRO intends, via this award, to promote the value of basic research in the DoD laboratories; it allows the S&T workforce to explore new ideas, at the frontier of their regular and more applied areas of research, or even new areas that they strongly believe worth investigating and/or expanding into. These ideas may come from the Academic collaborator, or they may be co-developed during discussions with the potential collaborator.

More specifically, the program objectives can be summarized as follows:

1) To bring the best ideas and fundamental scientific knowledge from Academia into the DoD laboratories. The University partners are chosen from highly competitive, flagship 6.1 programs: the VBFF and Multidisciplinary University Research Initiative (MURI).
2) To stimulate innovation and creativity inside these laboratories and enhance the value of 6.1 research in the Lab ecosystem. A better appreciation of fundamental discoveries and their possibilities allows higher levels of exploration, disruptive approaches, and a wider range of alternatives to technical challenges.
3) To improve the skills and knowledge of the S&T workforce. The program allows for long-term (3 years) and deep interaction with faculty, post-docs and graduate students, optimizing the opportunities for training and insertion into new fields.
4) To create a community of Lab researchers who are leaders in their fields and can be leveraged by OSD and other organizations within the DoD. The fellows share ideas and knowledge across service boundaries, and are relied upon by OSD to provide guidance.
5) To enhance Laboratory-Academia links and mutual understanding of opportunities, problems, environments, and constraints. Not only do the DoD scientists gain new fundamental knowledge, University researchers also gain an understanding of the types of problems the DoD can face, and helps them graduate their ideas and methods from proof-of-concepts to more realistic situations. This increased understanding can improve their future contributions.

An additional benefit may be the identification of highly-skilled junior researchers at the Academic institution (e.g., graduate students and post-docs) who may be good candidates for addition to the S&T workforce. However, this may not always be achievable; by contrast, the outcomes listed above are, to one degree or another, guaranteed to occur if the project is successfully executed.

The program objectives and expected benefits must be well understood, not only by the scientists looking to apply to the program, but also by the Lab management and chain of command. It is tempting to view the LUCI as an extension of the regular activities of the applicant, and filter or "guide" projects accordingly; after all, the laboratory contributes, via the salaries of the PI, and other government staff involved, if applicable. However, such an intervention would be counter-productive; a proposal narrative that reflects this process would be, in all likelihood, rated poorly.

The LUCI program also does not seek incremental improvements, or straightforward applications of a new scientific result from Academia to the current problem investigated by the lab scientist. The idea must be novel, disruptive, and likely to be a significant advance over the state of the art. Although this proposition appears to contain significant risk, that is perfectly acceptable. A risky but potentially disruptive proposal will be judged of much higher interest, than a low-risk but modest improvement. Radical departures from well-known approaches that underlie current research should not be discarded under the pretext that they may impact or up-end established programs[1]. To the contrary, they should be investigated and experimented with, and this LUCI program intends to provide that opportunity.

The improvement of the S&T workforce at the DoD laboratories is another key objective of this program. Some may believe they do not need much improvement; indeed, many Lab scientists are already talented, and receiving the LUCI award could be constituted as additional proof. Nevertheless, learning should never cease, and there is great value in this collaboration. The fact that the scientist can partner with top researchers from Academia, themselves having been selected through a very competitive process, is a unique opportunity that should be leveraged to the fullest. Another opportunity for improvement comes from the process itself; the LUCI program is very competitive, and the best ideas and communication skills are called for. The process of applying and re-applying is not wasted if the scientist makes use of it to refine the idea and find better and more convincing arguments. Thus, there is value in the competition itself, the 3rd key aspect of this program, as mentioned in the previous section.

LUCI awardees are designated fellows. This is a fitting, since the highly selective process implies that they are among the best, and as such, the BRO will rely upon them. They have a passion for basic research, they are at the leading edge, and exposed to the best of the best in Academia. Therefore, their opinion matters, they have valuable information to share, and their advice will be sought after. LUCI fellows may keep contributing well past the duration of the award, and the BRO will therefore look for individuals who can fulfill that role.

III. Type of Research

The LUCI calls for *basic* research (key concept #1), under a variety of topics. These are typically lifted from the VBFF announcement, and are defined broadly therein, mostly for the purpose of classification and attribution to expert review panels. Overall, the topics include all scientific areas of potential interest to the DoD, even if some of them take precedence over others, simply as a consequence of shifting priorities. Even if the lab scientists propose to do research in areas which are not currently in the limelight, but are part of the core interests of the DoD, such proposals will be given proper attention. The BRO is not interested only in the topic *du jour*, and there are many important scientific areas that remain essential to the DoD's core missions and

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[1] Also known as the psychology of sunk cost.

deserve continued attention and progress. However, what matters most in those cases is the novelty of the approach; a new look at solving the problem, or a new emerging capability, that can radically transform the area, from the status-quo or near-stagnation, towards radical advances. This is as important as the exploration of a new field. The innovation must have a profound potential impact; it should not be narrow and applicable only to a niche problem, but open a new field, so that others can follow your path and continue to advance further, pushing the limits, and/or expanding the scope…

The innovation in the topic will be the key driver in developing the technical merit component of the proposal. While all, the components of the VBFF proposal (technical merit, budget, recommendation letters, etc.) are scored equally, the technical merit is an area that PI must spend the most time in crafting in order to win the hearts of panelists and not trigger heartburn.

IV. Role of Collaboration

As the name of the program indicates, this proposal is a collaboration. This is important (key concept #2), and worth expanding upon. Collaborations can be viewed in a variety of ways. For example, the PI may realize that an expert is needed in a specific area to complement her/his own and move the project along. A quick search may identify a VBFF fellow or a MURI PI, and after a brief discussion, the name of that collaborator is added to the proposal, thus satisfying a program requirement. However, this is **not** a good use of a collaboration. What would the scientist learn from this collaboration? The partner would only be playing the role of a sub-contractor. The intent is not to have the scientists continue along their usual paths, but to use the collaborations to open their mind. Thus, the ideas must be shared; they must result from a serious, even deep intellectual exchange between the DoD lab scientist and the collaborator. The nature of this exchange is variable; one side may explain his/her own part of the understanding of the problem to the other, and together they achieve a common strategy to solving a problem. The closer to this ideal situation, the better the proposal. This may take preparation and a definite time commitment, and one should take that into consideration. The enthusiasm of the collaboration is important, and is usually reflected in the letter of support by the collaborator – thus its requirement.

There are common practical questions to discuss. Can the academic collaborator be paid with LUCI funds? Yes, that is possible. How much? It depends. It is understood that a practical collaboration may require sharing of resources: a graduate student may be involved to facilitate the exchanges, some travel may be required, specialized equipment, supplies, etc. However, it is also clear that the program intends to fund research at the DoD laboratory, and not to outsource the research work. Currently, there is no fixed limit to the distribution of funds to the University partner, and we leave it to the judgement of the PI to devise a plan that is rational, well-balanced and justified. This is also part of the evaluation criteria: management plan and budget.

This collaboration may also be considered as an opportunity to accelerate "transition". The research conducted at the University is funded by the DoD, and generally speaking, it is highly desirable to find pathways to bring the outcomes of that effort towards practical applications of interest to the DoD. The lab scientist therefore also becomes an agent for transitioning this 6.1 work. However, we do not imply here a conventional and linear concept of 6.1 – 6.2 graduation, which is flawed in many respects. It is not just the product of the University research that is useful; in fact, it would be extremely uncommon to have a straightforward leverage and incorporation of that product into applied research, without some significant and additional work. It is very important to point out that the LUCI is **not** intended to be a traditional, linear transition process. As mentioned repeatedly earlier, the BRO expects *basic* research to be performed. The opportunity of transition therefore comes mostly from the *transfer of knowledge and skills*; the lab scientist and her/his team, if applicable, should gain fundamental understanding that can be carried forward, and towards pursuing new approaches or new applications, mostly conducted outside the scope of the LUCI program. If the proposal has basic research but no clear and immediate potential application, it would be much better than the reverse, i.e., testing on applicability at the expense of basic research.

V. Proposal Writing

The discussion above should now provide enough information to guide the writing of the proposal (white paper). Let us consider then the different parts of this proposal, and the evaluation criteria. First, there is the technical narrative; this is where the idea, the rationale, the approach, the methods, the capabilities, have to be laid out. This is by far the most important part of the proposal; it should consume most of the available space. Similarly, the evaluation of this section ("Technical Merit") carries the most weight. What are the reviewers looking for? First and foremost: is it basic research? Is the idea novel? Is it disruptive, as opposed to incremental? Does this have the potential for opening new research directions? Is there a convincing rationale behind it, based on sound judgement? Are the methods state-of-the-art, or even beyond it? This is not a fixed list, and the arguments provided should be blended in the narrative.

The nature of the collaboration will also be evaluated, as the second most important criterion. Is the collaborator providing scientific knowledge at the leading-edge of the field? Is the proposed idea being developed in-unison? How much expertise, help and scientific value is being brought to the team?

There is also, inevitably, the question about an impact to the DoD. We emphasize again that the LUCI should not look towards answering a single problem, or be focused on a single and/or near-term application. This is basic research, even if being viewed also as the preparation towards DoD relevant problems (the plural being significant).

Finally, there is the management plan and the budget. Given the importance of the previous subjects (listed in decreasing order), only a brief summary is needed, or possible here (given the

space limitations of a white paper). The management plan includes items like: how much time is the PI devoting on the problem? How are the exchanges with the University collaborator being executed? A few succinct and to-the-point sentences are generally sufficient, unless there are some rather special considerations. The budget plan goes hand-in-hand with the management. If visits by the PI to the University are suggested, or vice-versa, there should be a budget item for that purpose. How much goes to in-house contractors? To the University? Remember that this should not be simply outsourcing of research.

This "proposal" being in fact a white-paper, the space available is very constraining. It is generally well-known that writing a white-paper is significantly more difficult than a 15-page full proposal. It cannot be put together carelessly. You have to condense the information, and make each word count. Figures and pictures can be also very important means of conveying information, but they should be well-chosen or designed to provide critical explanation – if they are leading to confusion or are marginally relevant, the space is wasted. References are important, since they can be used to provide more detailed explanations, leaving the project narrative for a clear but summary description. Writing a good proposal requires skills. Writing a good white paper requires even better skills – those which are worthy of a LUCI fellow.

Finally, after taking into consideration the above sections, please review the checklist below to make ensure the proposal has the desirable strengths (in the left column) and is free of any weaknesses (right column). Sending this checklist to someone who may be reviewing your proposal, prior to submission, is highly recommended. Please note again, this is not a fixed list, and the arguments can be blended in the narrative:

Strength	Weakness
Technical Merit: Transformative research, paradigm-shifting, high risk, and/or is addressing a research gap(s) that this missing for a very long time	**Technical Merit:** Evolutionary, incremental research, or research which could have been performed as part of the regular activities of the PI.
Proposal: Addresses fundamental research and is disruptive	**Proposal:** Geared mostly towards application(s)
Impact: Impact is revolutionary	**Impact:** Impact is incremental
Methodology: • Uses the most advanced methods, resulting in improved skills • Addresses the challenges that could arise during the research and mentions contingency plans	**Methodology:** • The methodology described is conventional and/or incremental • All the tasks are critically dependent on the success of earlier ones • Confusing approach, missing key steps

• Outlines a logical, well-structured approach • Key steps are well described	• No clear measures of success along the way
Clarity: Well written, free of grammatical errors	**Clarity:** Formatting errors, unexplained technical jargon, and incorrect/unexplained figures.
Budget: • Budget is briefly, but well justified • All costs expected from the narrative are included. • Leveraged funds (if applicable) are clearly listed and a letter of intent of support is included • Justification for the funding of Academic collaborator(s) and Lab partners	**Budget:** • Budget is not commensurate with the scope of the project • Needed travel is not included, or is excessive • Vague or missing reference of leveraged funds (if applicable)
Collaboration: Collaborators will bring interesting ideas and results to the research, but it is clear that the PI takes ownership and leadership of the proposal	**Collaboration:** The PI is very dependent on the collaborator in order for the research to be successful.
DoD Impact: DoD relevance is clear as well as the need and interest. The PI describes a how the academic collaborations will benefit DoD capabilities and workforce	**DoD Impact:** Even if the research is successful, the output has a questionable or undefined utility for the DoD, even in the long term.
Qualifications: PI is productive and considered a leader in her/his field	**Qualifications:** PI has never published or made any impact in the field of research he/she is proposing

VI. Interview

The review of the white papers is only the first step of the selection process. It is followed by a second selection step: the "interview". One may question why this is a selection phase, rather than simply an introduction to the winners. The problem is that not only white papers are notoriously difficult to write, they are sometimes difficult to evaluate. There may not be enough information provided to the reviewers, who may then have some reservations. In that case, the BRO will generally "err" on the side of the applicants. The interview is then a chance to clarify things, if necessary, and provide more detailed information. This is best accomplished via a brief

Q&A session. To help prepare for it, a feedback is provided to the PI, which summarizes key observations from the reviewers; rather than just providing comforting words, this feedback will emphasize the questions or uncertainty, in order to better prepare the PI for the interview session and refine the arguments.

The interview is designed to have minimal requirements and constraints. A brief presentation (targeted to approximately 15 minutes, reserving 15 minutes for questions) is requested, but the PI can choose how to best present the research, address some issues from the feedback, clarify matters and provide a few more technical details if necessary. Not only would it not be possible for the BRO to provide a framework that is optimal for all types of projects, it would also be undesirable to do so. The PI's ability to be creative, yet informative and impactful – all within the time allowed – is also being tested at that point. The university collaborator can be present for the interview, but this is not required. Ideally, the PI alone should be able to effectively communicate or demonstrate during their presentation why the collaboration is important, required for the success of the project, mutual beneficial to both collaborators, and beneficial to the DoD. Furthermore, the PI should be able to explain the project in a concise but accurate fashion, convey a good sense of direction, a broad perspective and, ultimately, a passion for basic research. The interview is an opportunity to answer a basic question: is the PI LUCI fellow material?

VII. Returning Applicants

Often, proposers apply for a LUCI or other BRO awards numerous times before they are selected for the fellowship. The PIs that eventually win, are often the ones who take the time to address all of the comments of the panelists. Panelists may also take note if the PIs have made progress in the research since the last proposal. Submitting the same application as a previous year with no improvements will be have a very low chance of being successful. With that in mind, many successful applicants have expressed that resubmitting a proposal after taking the time to make the necessary changes was well worth the investment and reward.

VIII. Conclusions

The overall process is highly selective, but fair and efficient. The first phase of white paper review is very demanding, resulting in a low fraction (~33% in FY 2020) of those being invited for interviews, but those that are marginal are being given the chance to recover. Full-size proposals could be asked for, but these would place a high demand on the PI's time. Instead, the interviews give the chance to explain things very precisely. Inevitably, there will be disappointment, since the number of interviews would obviously exceed the number of possible awards, but all efforts are made to help the PIs, if they choose to re-apply. The efforts made by the BRO also extend to

the preparation of this document, which designed to provide a uniform guidance on how to prepare for the LUCI application. We therefore hope it proves helpful.