AMENDMENT No. 4 TO THE NASA RESEARCH ANNOUNCEMENT (NRA) ENTITLED "RESEARCH OPPORTUNITIES IN AERONAUTICS – 2019 (ROA-2019)," NNH19ZEA001N, RELEASED APRIL 3, 2020

Changes are made to the following:

- Updated Table of Contents
- Table 5. Solicited Research Programs (in order of proposal due dates)
- Table 6. Solicited Research Programs (in order of Appendices A-D)
- Appendix D.4 - University Leadership Initiative (ULI)

TABLE 5. SOLICITED RESEARCH PROGRAMS (IN ORDER OF PROPOSAL DUE DATES)

APPENDIX	PROGRAM	NOI DUE DATE	PROPOSAL DUE DATE
D.5	University Student Research Challenge (USRC)	n/a	See note 1
D.2	Transformational Tools and Technologies (TTT)	4/2/2020	4/27/2020
D.4	University Leadership Initiative (ULI)	06/30/2020 See note 2	See note 3

Note: It is expected that additional project areas will be added in future amendments.

1. University Student Research Challenge (USRC) will evaluate all proposals submitted to date in three cycles: Cycle One Due Date is October 30, 2019; Cycle Two Due Date is February 26, 2020; and Cycle Three Due Date is June 24, 2020.
2. University Leadership Initiative will use a 2-step proposal process. Step-A proposals are required, in place of the NOI, and are due 06/30/2020.
3. University Leadership Initiative will use a 2-step proposal process. Step-B proposals will be due 60 days after the notification for Step-B proposals is issued.

TABLE 6. SOLICITED RESEARCH PROGRAMS (IN ORDER OF APPENDICES A–D)

APPENDIX	PROGRAM	NOI DUE DATE	PROPOSAL DUE DATE
D.2	Transformational Tools and Technologies (TTT)	4/2/2020	4/27/2020
D.4	University Leadership Initiative (ULI)	06/30/2020 See note 2	See note 3
D.5	University Student Research Challenge (USRC)	n/a	See note 1

Note: It is expected that additional project areas will be added in future amendments.

1. University Student Research Challenge (USRC) will evaluate all proposals submitted to date in three cycles: Cycle One Due Date is October 30, 2019; Cycle Two Due Date is February 26, 2020; and Cycle Three Due Date is June 24, 2020.
2. University Leadership Initiative will use a 2-step proposal process. Step-A proposals are required, in place of the NOI, and are due 06/30/2020.
3. University Leadership Initiative will use a 2-step proposal process. Step-B proposals will be due 60 days after the notification for Step-B proposals is issued.

APPENDIX D: Transformative Aeronautics Concepts Program

D.4 University Leadership Initiative (ULI)

D.4.1 ULI Overview

ARMD created ULI for universities to take the lead, build their own teams, and set their own research path. ULI seeks new, innovative ideas that can complement the NASA ARMD portfolio and support the U.S. aviation community.

ULI's strategic goals are:

- Assist in achieving aviation outcomes defined in the ARMD Strategic Implementation Plan ("Strategic Plan") [1] through NASA-complementary research;
- Transition research results to an appropriate range of stakeholders that leads to a continuation of the research. Transition can occur in a number of ways, including the following:
  - Creates a new product line in U.S. industry or a new ARMD project,
  - Whole ULI concept is transitioned to U.S. industry/ARMD project,
  - Part of the ULI concept is transitioned to U.S. industry/ARMD project,
  - ULI findings impact direction of U.S. industry/ARMD.
- Provide broad opportunities for students at different levels, including undergraduate and graduate, to participate in aeronautics research;
- Promote greater diversity in aeronautics through increased participation of minority-serving institutions [2] and underrepresented university faculties in ULI activities.

ULI provides the opportunity for university teams to exercise technical and organizational leadership in proposing unique technical challenges, defining interdisciplinary solutions, establishing peer review mechanisms, and applying innovative teaming strategies to strengthen the research impact. By addressing the most complex challenges associated with ARMD strategic thrusts, universities will accelerate progress toward achievement of high impact outcomes while leveraging their capability to bring together the best and brightest minds across many disciplines. In order to transition their research, Principal Investigators (PIs) are expected to actively explore transition opportunities and pursue follow-on funding from stakeholders and industrial partners during the course of the award.

D.4.2 Description of Solicited Research

In this solicitation, NASA's University Innovation (UI) Project is seeking proposals for work in the following seven topic areas:

Topic 1: Safe, Efficient Growth in Global Operations (Strategic Thrust 1)
Topic 2: Innovation in Commercial Supersonic Aircraft (Strategic Thrust 2)
Topic 3: Ultra-Efficient Subsonic Transports (Strategic Thrust 3)
Topic 4: Safe, Quiet, and Affordable Vertical Lift Air Vehicles (Strategic Thrust 4)
Topic 5: In-Time System-Wide Safety Assurance (Strategic Thrust 5)
Topic 6: Assured Autonomy for Aviation Transformation (Strategic Thrust 6)
Topic 7: Novel In-Flight and Ground Measurement Techniques for Hypersonic Flight

Proposals for Topics 1-6:

The first six topics correspond to an ARMD strategic thrust listed in parenthesis, and these thrusts are described further in the ARMD Strategic Implementation Plan [1]. Research objectives for the strategic thrusts are provided in terms of community-based outcomes for three time periods: near-term (2015-2025), mid-term (2025-2035), and far-term (beyond 2035). These outcomes represent NASA's view of expected aviation community advancements within each strategic thrust. Achieving the outcomes will rely on research contributions from NASA and others in the aviation community, as well as the implementation of technologies and procedures onboard aircraft and ground-systems and throughout the National Airspace System.

Proposals for Topic 7:

The seventh and final topic, Novel In-Flight and Ground Measurement Techniques for Hypersonic Flight, is a joint solicitation of AFRL/AFOSR and NASA. This topic seeks to significantly advance the state-of-the-art in diagnostics and sensors, in order to create the scientific basis upon which flight sensing and control systems can be developed. This topic is focused on the complete suite of aerodynamic surfaces; hence, both the external aerodynamic surfaces and the internal aerodynamic surfaces are relevant, inclusive of propulsion flowpaths. The basic sensing technologies, and associated concepts, ultimately are meant to provide a relevant characterization of the off-surface and on-surface aerodynamic parameters that are deemed necessary and sufficient for input for controlled hypersonic flight. It is envisioned that the basic research, and any applications inspired or enabled by it, may require novel analysis and test approaches to yield relevant flight-environment simulations; and thus, the topic is not constrained to existing ground-test facility utilization, but rather, focusses on the acquisition of the knowledge and data that underpin the development of technologies and their potential application to controlled hypersonic flight.

This topic requires an integrated academic and industrial partnership, incorporating a multi-disciplinary, multi-institutional team approach that leverages previous investments and capabilities from both inside and outside the aerospace sector. Proposers are required to collaborate and should leverage any team members' system-level experience from existing and/or previous hypersonic flight programs, and other related activities, in order to understand the most resilient technical gaps in measurements applicable to hypersonic flight and thus focus where basic and fundamental research efforts are most needed for this topic. If new quantities need to be measured, we welcome ideas of what to measure and how. Similarly, we welcome concepts of how best to simulate the atmospheric environment in ground test facilities.

The following research outcomes are desired:

- Demonstrated advances in the state-of-the-art in diagnostics and sensors, which can then be improved upon to be applicable to realistic flight-control systems
- Fundamental and basic hypersonic aerodynamic research outcomes, which demonstrate the ability to accurately measure, supported by quantified uncertainty estimates, both off-surface and on-surface flow-field parameters in environments of interest

Proposals are requested for a three year period of performance with nominal budgets in the $1M/year range. Based on the team performance consideration for a fourth year is possible.

Proposals should be non-ITAR and clearly indicate how their research products will contribute to the topic outcomes.

Applied research proposals should be submitted to NASA (see Section D.4.3.4), and basic research proposals should be submitted to both NASA and AFOSR. AFOSR proposal submissions should conform to all the eligibility requirements and evaluation criteria set forth at the AFRL's BAA, FA9550-19-S-0003, Research Interests of the Air Force Office of Scientific Research, Department of Defense at https://www.grants.gov/web/grants/view-opportunity.html?oppId=314753.

If you have questions on this topic, contact either the NASA or AFOSR POC.

NASA POC: Koushik Datta
Email: koushik.datta@nasa.gov
(650) 604-2195

AFOSR POC: Dr. Ivett A. Leyva
Email: aerothermodynamics@us.af.mil
(703) 696-8478

Research Topic and Technical Challenge Identification

When selecting a topic to address, proposers are encouraged to consider a distinct set of outcome needs in a single topic area and then determine technical challenges and research activities that will meet those needs. Technical challenges are distinct barriers that must be overcome in order to achieve the topic outcomes. Research activities are limited-duration projects contributing the knowledge or capabilities needed to accomplish the proposer-defined technical challenges. While a given research product may be able to meet outcomes in more than one topic area, proposers must explicitly connect their research products to specific outcomes in a single topic area. Proposers may note compatibility with multiple topics, but should avoid making general associations between their expected products and multiple topics (i.e. avoid stating, "This technology could also support topics X, Y, and Z."). Alignment and focus are more important than breadth of applicability. This emphasis supports a "topic-driven" rather than "technology-driven" approach.

Through this announcement, proposers will have the opportunity to:

- Independently identify the most critical technical challenges that must be solved to achieve the topic outcomes;
- Propose independent, innovative research activities to solve the technical challenges, including developing the success criteria, progress indicators, and technical approach;
- Bring forward system-level, revolutionary concepts;
- Build a talented, diverse, and cross-disciplinary team to explore innovative, integrated solutions toward the technical challenges;
- Consider application of multi-disciplinary, multi-industry approaches, including those outside of traditional aeronautics disciplines (technology "convergence"); and
- Offer novel, high technical risk approaches that open avenues for accelerated progress.

Expected Research Products

Proposers are expected to produce specific research products in the process of addressing their technical challenges. These products may include technologies, operational concepts, methods, design tools, models, or other technical advancements. Proposals should clearly indicate how the products will contribute to the chosen topic outcomes.

Research products developed over the course of the award period should demonstrate a growing level of validation, integration, and technical maturity. Strong proposals will build upon early-stage exploration and progress toward system-level solutions later in the award period. For these proposals, earlier research products will effectively converge to address increasingly more complex and multi-faceted problems as the work advances. Proposals offering integrated, multi-disciplinary solutions will be considered more favorably than a group of loosely-connected single-discipline solutions, even if the single-discipline solutions address challenging problems in their own right.

The desire for increasing technical maturity notwithstanding, proposers are encouraged to bring forward revolutionary, high technical risk approaches that open avenues for accelerated progress toward the strategic outcomes. Research results that do not ultimately meet their technical objectives will be readily accepted, provided the proposers openly share their findings and insight.

Teams are expected to explore transition opportunities for their research products or technologies developed over the course of the award. The intent is to have a successful transfer of the technologies from a research environment to an operational environment that provides the U.S. aviation industry with the best possible technologies at the earliest possible dates.

D.4.3 Programmatic Considerations

D.4.3.1 Technical Challenge and Progress Indicators

This section provides proposers with insight on developing technical challenges and supporting research milestones. The complete set of elements discussed below applies most directly to second stage ("Step-B") proposals. First stage ("Step-A") proposals may only require a sub-set of the information described. Please see Section D.4.3.4 for a complete list of required elements for Step-A and Step-B proposals.

Proposers shall identify one or more technical challenges corresponding to one of the above topics. Technical challenges have the following characteristics: they are stated in crisp, clear, and concise terms; a technical barrier or enabler is clearly defined; there is a quantifiable measure of success; and, progress is measurable in discrete increments (progress indicators). To accomplish an outcome, the aviation community must address progressively more difficult challenges across a range of research themes. Each technical challenge represents an important step toward achieving the outcomes. Proposers shall provide technical challenge(s) they expect to be achievable through their own contributions within the research activity duration.

In developing the technical challenges, proposers are encouraged to review the topic areas above, including the Strategic Plan, and determine a topic to which they can contribute. Through their own analyses, proposers should determine the technical challenges they consider important. The technical challenges may correspond to the research themes provided in the Strategic Plan or may address different themes the proposer deems necessary to accomplish the outcome. This process is comparable to that used by NASA teams in developing the current ARMD portfolio.

Through this solicitation, NASA looks to introduce independent research paths toward achieving the strategic outcomes. To support this goal, as well as avoid duplication of effort, proposers are encouraged to develop different technical challenges than those currently pursued by ARMD and its research partners. Reference 3 provides the current ARMD technical challenges and Reference 5 provides the list of existing ULI awards. ARMD does not claim these technical challenges to be all-inclusive of those needed to address the thrust outcomes, nor do they necessarily represent the most important barriers that must be overcome. NASA's research portfolio will be enhanced through the addition of new technical challenges brought in by awardees of this solicitation. Proposer-defined technical challenges will be evaluated based on their anticipated impact, without any effort to determine their compatibility with the current ARMD portfolio.

A technical challenge includes the following elements: statement, duration, performance metric(s), and success criteria. The statement shall be represented as a research contribution that addresses a technical barrier. A well-written statement clearly reflects a barrier that can be overcome within the established timeframe. It should be an important step towards achieving the strategic outcome and not the research area's long-term, ultimate goal. Duration of the technical challenge is measured from the start of award, in years (maximum 4 years). Where required, proposers shall provide a small number (nominally 1-2) of key performance metrics. These metrics will be used to determine progress and final completion of the technical challenge. Success criteria provide target levels of the performance metric upon completion of the technical challenge.

Awardees will be expected to plan and measure progress toward their technical challenges. Progress indicator charts are one such way to support this task. Reference 4 provides current or recent NASA examples for different types of research products, including tools, technologies, and concepts (Examples 1-3, respectively). Charts include the following elements: technical challenge statement, duration, technical performance plot, and technical maturity plot. Technical performance and technical maturity are represented in the upper and lower plots of each example, respectively. Technical performance indicates the expected interim and final performance of the research products contributing to the technical challenge. Performance is measured using the technical challenge performance metric(s). Approximate error bands may be included. Any bands are used for illustrative purposes only and are not intended to be precise. Performance can advance through improvement in the value itself and/or a reduction in its uncertainty. Technical maturity reflects the progress of research products on the way to achieving the technical challenge. Various means to assess technical maturity may be used. Technology readiness level (TRL) can be a helpful metric for a technology, but may not relate well to a tool, method, or model. For both plots, performance and maturity are assessed at selected milestones. Proposers may note that the Reference 4 examples represent NASA work in progress and therefore include some features that are not applicable to the planning stage (e.g. completed and/or slipped milestones).

Proposers may apply different approaches to planning their technical challenges, provided they show expected advancements in technical performance and maturity as milestones are completed. Technical performance should culminate in the target established for the technical challenge.

For each technical challenge, proposers shall develop an associated set of research milestones addressing the challenge. A fully-defined milestone includes the following information: title, description, duration (year and quarter-year from start of award), exit criteria, and deliverables. The description should provide a few sentences on the research activity's objectives and technical approach leading to the milestone. Exit criteria include the metrics and target levels used to determine that the milestone objectives have been achieved. They may or may not be the same as the corresponding technical challenge performance metric and success criteria. Deliverables are the research products and/or publications provided by the proposer that are associated with milestone completion. Proposers should include periodic research deliverables and/or milestones that can be used to assess research performance by non-advocate reviewers in annual meetings.

D.4.3.2 Management Information

Funding Information and Projected Distribution of Awards

The UI Project anticipates investing in five awards with nominal budgets in the $1-2M range per award per year. Proposals are invited for the 3-4 year range. Maximum total budgets should range between $3-8M per award, depending on the award duration. Actual budget usage by the awardees is important to NASA and so proposed budgets must take into account ramp ups within the team. To promote portfolio balance, the UI Project anticipates issuing one applied research award in Topic 7 (Novel In-Flight and Ground Measurement Techniques for Hypersonic Flight) for a three year period of performance, and four other awards (two 4-year and two 3-year awards) in any of the first six topics (topics 1-6). Proposals in Topic 1 (Safe, Efficient Growth in Global Operations) and Topic 4 (Safe, Quiet, and Affordable Vertical Lift Air Vehicles) are of strong interest to the UI Project.

AFOSR anticipates issuing a separate basic research award in Topic 7 (Novel In-Flight and Ground Measurement Techniques for Hypersonic Flight) for a three year period of performance. Based on team performance, consideration for a fourth year is possible for both AFOSR's and UI Project's Topic 7 awards.

The actual number, value, duration, and topic of the awards will depend on the quality of the proposals received, the scope of the proposed work, funding availability, and program needs. In addition, these projections represent the program's plans at the time of the release of this solicitation. These conditions are subject to change, and therefore there is no guarantee that the awards will be allocated as described above. Awards for multiple years of performance are subject to adequate performance during previous years and funding availability in subsequent fiscal years. In some cases, only a portion of a proposal may be selected for award.

Eligibility and Teaming

For this solicitation, the proposing (lead) organization must be an accredited, degree-granting U.S. college or university. Proposing organizations are invited to include partners as part of their team - a partner can receive funds from the NASA award. Partners may include other U.S. colleges and universities, U.S. companies, non-profit organizations, federally funded research and development centers (FFRDC), and any other

public or private U.S. entity. Other government agencies and NASA centers are not eligible to participate as partners.

Collaborators may not receive funds from the NASA award. Collaboration with other U.S. government agencies that adds value towards the research and development of the innovative concepts, while preserving the university leadership aspect of this initiative, is encouraged. Collaboration with NASA is covered in Section D.4.3.3.

Proposers may describe potential plans for collaboration with other U.S. government agencies in their Step-A or Step-B ULI proposals. Any proposed collaboration with a U.S. government agency must conform to the solicitation's instructions. Focused but unfunded collaboration under ULI may take many different forms. Some examples may include, but are not limited to: technology convergence, where an idea previously developed for a different government agency is utilized for NASA aeronautics in a novel way; a partnership where the government agency that will eventually utilize the proposed concept works with the ULI team to ensure this possibility; and use of a government agency partner's facilities, equipment, or research capabilities.

Foreign-owned U.S. subsidiaries and foreign organizations are not permitted for this solicitation – not as partners, collaborators, peer reviewers, technology recipients, etc. However, the direct purchase of supplies and/or services, which do not constitute research or research data exchange, from non-U.S. sources with NASA-awarded funds is permitted.

Building and applying a diverse, multi-disciplinary team is part of the strategic leadership role entrusted to awardees of this solicitation. Proposers are expected to incorporate wide-ranging capabilities and apply innovative teaming methods that strengthen the proposal's overall contributions and promote education of the next generation of engineers. When putting together their teams, lead institutions are encouraged to explore new partnerships in addition to leveraging those they have previously developed. Collaborations could include other departments at the PI's institution, other colleges or universities, industry members, non-profit organizations, or other U.S.-based entities. Undergraduate education programs could be incorporated. Historically Black Colleges and Universities (HBCU) and other minority-serving institutions (MSI) are strongly encouraged to participate. Proposers are expected to consider partnerships with schools that may have less prior experience in working on NASA Aeronautics research projects. Lead organizations can demonstrate leadership by creating mentoring opportunities, providing access to facilities or contacts, and otherwise helping to nurture and fully integrate the capabilities of less-established partners.

ULI encourages special groups to increase their participation in this solicitation: female PIs, minority PIs, and new PIs. Each of these groups is crucial to making the national aeronautics research infrastructure healthy and reflective of the US.

Diverse partnerships are expected to bring a wealth of talent and different perspectives that can contribute to novel, innovative approaches. These benefits notwithstanding, proposers should not add members solely for the purpose of lengthening their partnership list. Each contributor should have a meaningful role.

Non-Advocate Peer Review

As part of the strategic leadership aspect of this initiative, proposers and the university-led teams must take primary responsibility for maintaining high levels of relevance, quality, and performance across their portfolio. Proposers should therefore establish their own methods for regular external peer review and reporting of the review results to NASA. Proposers have broad leeway to select external reviewers they believe will add value to their research efforts. These reviewers should be non-advocates – i.e. experts that are not otherwise involved in performing the team's research. Reviewers selected from industry should be from U.S. companies (see Eligibility and Teaming). To promote independence from NASA research activities and minimize NASA's role in technical oversight, proposers should not include current NASA employees on their review panels. Proposals can include a travel budget for peer reviewers.

During the course of the research effort, awardees are encouraged to propose necessary course corrections to maintain continued relevance based on peer review recommendations and other interactions with key stakeholders.

Reporting and NASA Oversight

NASA intends to conduct oversight through annual reviews and quarterly reports.

As part of the non-advocate peer review process, awardees are asked to hold an in-person annual review to assess the work effort's relevance, quality and performance. The location for this review is at the discretion of the awardee. The review will also provide a forum to discuss the awardee's handling of issues and risks that have arisen during the year, as well as any technology transfer that has occurred. In addition, awardees will be asked to share results from peer assessments occurring during the prior year. NASA, who will be a participant at the annual meeting, will allow time for private caucus between the university team and its non-advocate reviewers, and will be an additional recipient of the peer review information.

Awardees shall also conduct quarterly status reviews with their peer reviewers and NASA. These reviews shall provide an update on technical challenge progress, completed milestones, notable accomplishments, and any changes to the plan that occurred during the quarter. This review discussion is expected to take place via video or teleconference. Quarterly status reviews will occur after the first, second, and third quarters of each fiscal year during the period of performance. No quarterly status review is required for the fourth quarter (i.e. the quarter preceding the annual review). Information from the fourth quarter can be incorporated into the annual review.

NASA's determination of adequate progress will consider results from the annual review, quarterly status reviews/reports, and additional insight gained from the non-advocate peer reviews. NASA reserves the right to discontinue funding if it determines the awardee has been unable to correct serious performance problems.

In addition to reviews and reports, there will be a kick-off meeting at the beginning of the award period. Annual oral presentations made as part of an open technical exchange meeting for purposes of technology transfer and knowledge dissemination are also required. These events must be attended by at least the PI (or a designated representative)

for the award. Direct participation by contributing partners and collaborators is encouraged, especially for the kick-off meeting and annual reviews. NASA program and project personnel may also coordinate with the awardee to arrange informal visits to the awardee's institution or facilities.

All technical deliverables identified in the proposal, along with a final report documenting the approach, results, recommendations, and conclusions of the entire work effort shall be submitted no later than 90 days after the end of the period of performance. Sensitive information may be provided to NASA in a proprietary appendix. Software developments and/or enhancements shall be developed in modular form and delivered in appropriate computer file formats.

Cost Monitoring

Cost monitoring is a part of performance monitoring. The ULI teams should have procedures for planning, budgeting, tracking, and reporting their costs from all partners. To enable the UI Project to optimize the use of available funds, a phasing plan (costing to NASA) for the first fiscal year shall be submitted within 30 calendar days of the award date and within 30 days of start of the following fiscal years of the award (by October 30th). NASA will provide the phasing plan templates for costing. Monthly and quarterly assessment of execution to phasing plans is the responsibility of the PI. Although NASA understands that there will be a time lag between the institutions' use of funds and when funds are drawn down, invoicing should be timely and prompt.

D.4.3.3 Collaboration with NASA and Contact during Solicitation Period

As noted above, proposers may not include NASA centers or researchers as partners. NASA does seek to collaborate with awardees in a manner that adds value towards the research and development of the innovative concepts, while preserving the university leadership aspect of this initiative. Therefore, proposed informal collaboration with NASA researchers during the performance period is encouraged only where it a) adds value towards achieving the research objectives of the topic area, b) promotes technology transfer into NASA or the broader aviation community, and c) preserves inherent differences in technical approach between proposer-led and NASA research activities. The proposers may propose such informal collaborative activities, but without specifying NASA researchers' names in the proposal. If a proposal is selected for negotiation towards a potential award, then and only then can the details of any proposed collaboration including time in residency at a NASA Center, if applicable, be discussed and finalized.

Except to obtain information about NASA facilities, communications with NASA during the solicitation period can only occur through the designated POC (see Section D.4.4). There can be no direct or indirect communications with NASA researchers and managers from the time this solicitation is posted to the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) until proposal selections are final. NASA personnel may not be involved in any aspect of proposal writing.

Communications with NASA facility POCs are permitted during the solicitation blackout period - solely to obtain facility capability, availability, and costs information for the

proposed tests. Proposers may refer to Section D.4.3.7 for information on NASA facilities and points of contact.

D.4.3.4 Proposal and Submission Information

Proposals involving multiple cooperating organizations must be submitted by a single institution, which becomes the Lead Institution. The Lead Institution must be the PI's home institution. Proposals must be submitted by an official at the PI's organization who is authorized to make such a submission.

Proposal Submission Site

Proposers must submit electronic proposals in response to this solicitation to NSPIRES (https://nspires.nasaprs.com). The NSPIRES system will guide proposers through submission of all required proposal information. The presentation *NSPIRES Organization Registration*, located in the "Tutorials and User Guides" section of this website, provides information on how to register an organization in NSPIRES.

In order to be able to submit a proposal all investigators must be preregistered in NSPIRES and have received a User ID and password. This includes the PI, all Co-Is, Partners and Collaborators (and is not needed for Advisory Board members, Technical Panelists, or Peer Reviewers). NSPIRES registration can be done at the website https://nspires.nasaprs.com/external/aboutRegistration.do. Early registration is advised. A Help Desk is available at (202) 479-9376 or by E-mail at nspires-help@nasaprs.com.

Applicant's Workshop

An applicant's workshop will be held on the date and time given in Section D.4.4 to provide interested parties with the opportunity to better understand the intent, scope, and selection criteria of this solicitation. A presentation on the solicitation will be followed by a question and answer period. The briefing will be live-streamed with participation available to anyone having Internet access.

You can attend this briefing in one of three ways:

- Phone-in only, and ask your questions when called upon at the end of the session if time allows
- Phone in and use Adobe Connect via your computer, so that you can see the charts and submit text question via the chat window
- Participate via Adobe Connect only and listen through your computer (no phone line needed).

	See Speaker	Hear Speaker	See Charts	Type a Question	Ask a Question
1) Phone-in only		X			X
2) Phone in and use Adobe Connect via your computer	X	X	X	X	X
3) Participate via Adobe Connect only	X	X	X	X	

and listen through your computer					

When using Adobe Connect you can raise your hand via the chat room and follow up verbally, via chat when called upon, or just ask your questions by typing into the chat room.

To log in to the Adobe Connect link, go to https://ac.arc.nasa.gov/ppbriefing/ and sign in as a "Guest" using your full name. If you would like to ask your question by voice, please dial into the teleconference line at 1-844-467-6272 and use Passcode: 592382#. Mute your computer speakers if dialing into the teleconference line. Some Adobe Connect help is available at the website https://nari.arc.nasa.gov/connecthelp.

Two-Step Proposal Procedure

The information in Section IV of this ROA and the *NASA Guidebook for Proposers* is superseded by the following:

This solicitation will use a two-step proposal process in which a mandatory Step-A proposal is first submitted. A separate Step-A proposal must be submitted for each intended, and thus corresponding, Step-B proposal. Only proposers who submit a Step-A proposal and are invited to submit a Step-B proposal are eligible to submit a Step-B proposal. The submission of a Step-A proposal is not a commitment to submit a Step-B proposal.

Proposals submitted in response to this solicitation are required to be clearly legible in both the body of the text and in the figure captions. Text within figures and tables may be smaller but must still be judged by the reviewers to be readable. Expository text necessary for the proposal may not be located solely in figures or tables, or in their captions.

Step-A Proposal Format and Contents

The Step-A proposal Scientific/Technical/Management section may not exceed five (5) pages in length, with a minimum 12-point font size and one-inch margins on all sides. Step-A proposals that exceed the five-page limit may be rejected without review. This section must cover the following topics:

- Title of proposed task
- Topic and outcome addressed
- Name and organization of PI
- List of partners known to date (may be changed if proposer is selected to submit a Step-B proposal)
- Research objectives
- Partially-defined technical challenge(s) (to include only technical challenge statement and duration for each technical challenge submitted)
- Summary of technical approach for the effort
- Assessment of what is innovative or novel in the proposed concept and how it will contribute to the chosen strategic thrust outcome(s)
- Expected research products

- Anticipated transition opportunities of research products/technologies to the U.S. aviation industry or NASA
- Overall teaming and education strategy

Proposals may also include a list of references which will not count against the 5-page Scientific/Technical/Management section limit in Step-A proposals.

The NSPIRES proposal submission system requires certain information be input before proposal submission. Note that the Proposal Summary, Business Data, Program Specific Data, and Proposal Team are required Cover Page Elements even for a Step-A proposal. In Step-A, NASA will only review the five-page proposal. The other information (Proposal Summary, Business Data, Program Specific Data, Detailed Budget, Letters of Commitment, etc.) will not be reviewed.

Step-A proposals do not need to submit a Detailed Budget, but proposers are requested to provide an estimated yearly and total budget in the Cover Page Elements of the proposal. If the Step-A budget form is not available for NSPIRES entry, please add an extra page with the yearly and total budgets in your submission. This page will not count against the 5-page limit for the Scientific/Technical/Management section.

The period of performance will be an important consideration in the Step-A evaluation process – proposals will be evaluated from two pools, one for 3-year awards and another for 4-year awards. NASA will use the period of performance and total budget to ensure final selections can be supported by the anticipated ULI budget. The period of performance should remain the same between Step-A and Step-B, and proposers may only increase their total Step-B budget request within 7% of their total Step-A budget request.

Note: Besides the budget, there may be other elements required by NSPIRES for submitting a Step-A proposal, otherwise the Step-A proposal will not be accepted by NSPIRES. Proposers need to complete these elements even though NASA may not review these elements.

Post Step-A Industry Networking Opportunity

NASA will host an industry networking opportunity for proposers who are selected to submit Step-B proposals. Participation by the Step-B proposers is optional. NASA will select dates and invite PIs selected to proceed to Step-B to present their Step-A proposal virtually to a group of industry leaders. Industry leaders will offer insight into connections between the proposed concepts and the needs of the aviation community as well as create an information exchange for technology transition. In addition, the industry networking opportunity may facilitate contacts between the proposal teams and U.S. aviation industry for the purposes of exploring potential partnerships and investment in the Step-B proposals.

NASA will invite U.S. industry leaders to the networking opportunity from both established and emerging aviation companies. If desired, Step-B proposers may suggest additional attendees along with their company affiliations to the NASA POC listed in Section D.4.4. At its discretion, NASA may extend invitations to these parties.

The decision to participate or to incorporate any information or ideas obtained from the industry networking opportunity into the Step-B proposal is entirely at the proposer's discretion. NASA will evaluate Step-B proposals based on the content and criteria described below. Proposals will be evaluated on their own merit, without giving any consideration to whether the proposal was adjusted as a result of the industry networking opportunity.

Step-B Proposal Format and Contents

The Scientific/Technical/Management section may not exceed twenty-five (25) pages in length, with a minimum 12-point font size and one-inch margins on all sides. This section must cover the following topics:

- Title of proposed task
- Topic and outcome addressed
- Name and organization of PI and Co-Is
- List of partners
- Research objectives and overall strategy
- Fully-defined technical challenge(s):
    - Statement
    - Duration (year from start of award)
    - Performance metric(s)
    - Success criteria
- Progress indicators for each technical challenge, including:
    - Statement
    - Duration (year from start of award)
    - Technical performance, using the proposer-defined performance metric
    - Technical maturity, using the proposer's preferred means to assess technical maturity

  Proposers may provide this information using progress indicator charts (modeled after the examples shown in Reference 4) or any other method that uses distinct events to mark improving performance and maturity on a path toward achieving the technical challenge. A legend should be provided as necessary to define any colors and symbols used.

  If applying the Reference 4 examples, proposers should use their own performance metric(s), success criteria, and interim and final milestones. Proposers are encouraged to use the examples as a general guide, adapting the content and style as needed to fit their technical challenges. If the required technical challenge elements are provided in full in the progress indicator depiction, they need not be repeated in a separate table or list. Further discussion on progress indicators is provided in Section D.4.3.1.
- Milestones (at least one per year):
    - Title
    - Description
    - Duration (year and quarter-year from start of award)
    - Exit criteria (metrics and expected performance levels)
    - Deliverables

    - Technical challenge supported (if more than one technical challenge proposed)
- Technical approach
- Assessment of what is innovative or novel in the proposed concept and how it will contribute to the chosen strategic thrust outcome(s)
- Expected research products and schedule during the period of performance
- Plans for peer review to assess relevance, technical quality, and performance on a quarterly and annual basis
- Anticipated transition opportunities of research products/technologies to NASA or the U.S. aviation industry. The ULI award should serve as a catalyst with stakeholder-funding taking over. Provide a roadmap for transitioning research with stakeholder requirements and increasing stakeholder involvement.
- Qualifications, capabilities, and experience of the team members, including PI, Co-Is, and other collaborators
- Teaming strategy
- Plans to mentor faculty and students from HBCU and/or other minority-serving institutions.
- Innovative training for U.S. citizen or permanent resident student team members in leadership, management, entrepreneurship and/or public policy. This would support the graduation of students who are trained to lead and would encourage partnership between engineering schools with other university departments.
- Proposers may include cost sharing in their proposals at their own discretion. Such offers will become binding and auditable resource commitments upon award. Cost sharing is not an evaluation criteria for peer review. However, cost sharing may be considered by the Selecting Official in the final selection of awards.
- Statement of what intellectual property is expected to be publicly available at the conclusion of the work
    - Note: It is NASA's intent to share knowledge developed under this solicitation, thus, any restrictions to this objective may impact the evaluation of the proposal. Securing intellectual property rights through the patent process is permitted. It is the responsibility of the investigator to secure desired protections prior to public briefings required by ULI.
- Test facilities to be used including proposed use of NASA facilities (see Section D.4.3.7)
- If any NASA Supercomputing resource usage is proposed, include specific computing requirements (CPUs, hours, memory, storage, timeframe, etc.) and state its criticality to the proposed work (select either one of two from below):
    - Require NASA computation resources as go/no go for proposed work
    - Optional need for NASA computation resources to enhance research execution

Please refer to Section IV of ROA-2019 for additional requirements on proposal content, format, budget details, and submission procedures. A budget justification, including justification for any foreign travel, is required for the Step-B proposal, but will not be counted toward the Scientific/Management page limit; nor will other supporting information, such as the Data Management Plan (DMP), references, résumés and optional letters of support from partners and collaborators.

The requirements for DMP are in Section II (c) of the ROA. Reasonable costs associated with the DMP (i.e., costs of sharing, preservation, etc.) may be included in the proposal budget. Specific questions regarding a DMP should be directed towards the POCs in Section D.4.4 as they may provide guidance to proposers and awardees, in addition to their responsibility for compliance with DMPs.

D.4.3.5 Proposal Evaluation and Selection

All proposals will be reviewed according to the Selection and Evaluation Criteria listed in this section. AFRL/AFOSR and NASA will jointly review Topic 7 proposals.

Selection Process

The following steps will be followed for this solicitation and selection process.

- NASA releases this solicitation.
- Proposers submit a Step-A proposal in NSPIRES.
- NASA will review and make the final selection decision on which Step-A proposals will be invited to submit a Step-B proposal. Through NSPIRES, NASA will also notify all proposers who are not selected.
- NASA will invite all the selected Step-A proposers to submit a Step-B proposal for this solicitation.
- The invitation letter to participate in a Post Step-A Industry Networking Opportunity, as described in Section D.4.3.4, will follow.
- Step-B proposals will be due at least 60 days from the issue date of the notification and/or invitation E-mail. At its sole discretion, NASA may choose to extend the Step-B due date to accommodate the Post Step-A Industry Networking Opportunity. In any case, NASA will clarify the due date in the invitation to submit a Step-B proposal.
- Invited proposers submit a Step-B proposal in NSPIRES.
- Proposals are evaluated by a Technical Review Panel consisting of government subject matter experts.
- The Selecting Official is the ARMD Transformative Aeronautics Concepts Program Director.
- NASA will notify all Step-B proposers of the final award decisions.

E-mail debriefs of the rationale for selection/non-selection of Step-A and Step-B proposals from NASA management will be provided after Step-A and Step-B are completed, respectively.

Note that NASA reserves the right to offer selection of only a portion of a proposed investigation; in such a case, the proposer will be given the opportunity to accept or decline NASA's offer.

Step-A Proposal Evaluation Criteria

Step-A proposals will be evaluated against the criteria listed below. The evaluation criteria in the *Guidebook for Proposers* are superseded by the following:

- Relevance to ULI objectives (weight 40%)
  - Relevance to ULI strategic goals of Section D.4.1.

  - Clear link between the proposed technical challenges and research products to the selected topic outcomes.
  - Viable transition path for the research products/technologies.
- Technical Merit (weight 40%)
  - Overall scientific or technical merit of the proposal, including unique and innovative methods (such as technology convergence), approaches, or concepts.
  - Technical challenges that represent complex, system-level problems.
- Innovative Teaming and Education (weight 20%)
  - Innovative and inclusive teaming methods that promote diversity, contribute to overall proposal strength, and promote education of the next generation of undergraduate and graduate engineers (see ULI Goals in Section D.4.1).

Failure of a Step-A proposal to be highly rated in any one of the evaluation criteria is sufficient cause for the proposal to not be selected. Proposals without an appropriate involvement of HBCU or MSI will be rejected. Step-A proposals will be evaluated from two pools, one for 3-year awards and another for 4-year awards. The period of performance cannot change between Step-A and Step-B.

Step-B Proposal Evaluation Criteria

Step-B proposals will be evaluated against the criteria listed below. The evaluation criteria in the *Guidebook for Proposers* are superseded by the following:

- Relevance to ULI objectives (weight 25%)
  - Relevance to ULI strategic goals of Section D.4.1.
  - Clear link between the proposed technical challenges, milestones, and research products to the selected topic outcomes.
  - Viable research transition roadmap for the research products/technologies. See ULI transition goals in Section D.4.1.
- Technical Merit (weight 25%)
  - Overall scientific or technical merit of the proposal, including unique and innovative methods (such as technology convergence), approaches, or concepts.
  - Technical challenges provide distinct research barrier and represent complex, system-level problems.
  - Demonstrated ability and technical breadth of proposed team.
  - Credible, integrated, multi-disciplinary technical approach, including a clear assessment of primary risks and means to address them.
- Innovative Teaming and Education (20%)
  - Integrated team contributes to overall proposal strength.
  - Innovative and inclusive teaming methods that promote diversity, mentoring of faculty from HBCU and/or other minority-serving institutions, and promoting education of the next generation of undergraduate and graduate engineers (see ULI Goals in Section D.4.1).
  - Innovative training of student team members to become future leaders.
- Effectiveness of the Proposed Work Plan (weight 15%)
  - Comprehensiveness of work plan, effective use of resources, management approach, and proposed schedule for meeting the objectives.

  - Strong peer review process for assessing relevance, technical quality, and performance.
- Cost (weight 15%)
  - Proposed cost realism and reasonableness. Appropriateness of proposed effort and proposed other direct costs with those required to accomplish the goals of the investigation. Phasing plans provided by teams on plans to meet the funding required at start up and during the rest of the years.
  - Value of the proposal - cost to NASA in time and budget relative to the expected impact.

Failure of a proposal to be highly rated in any one of the evaluation criteria is sufficient cause for the proposal to not be selected. Proposals without an appropriate involvement of HBCU or MSI will be rejected. Total Step-B budget request should not be over 7% of the total Step-A budget request.

Transformative Aeronautics Concepts Program Portfolio Consideration
After the review of Step-B proposals, the Selecting Official has the option to consider program portfolio priorities, cost sharing and budget constraints when making a final selection.

D.4.3.6 References

[1] NASA, "NASA Aeronautics Strategic Implementation Plan, 2019 Update" https://www.nasa.gov/aeroresearch/strategy, 2019.

[2] U.S. Department of Education, "List of postsecondary institutions enrolling populations with significant undergraduate minority students," http://www2.ed.gov/about/offices/list/ocr/edlite-minorityinst.html.

[3] List of ARMD Technical Challenge Statements

Program and Project Acronyms (as listed in technical challenge statements):

AAVP – Advanced Air Vehicles Program *AATT* – Advanced Air Transport Technology Project *AC* – Advanced Composites Project *CST* – Commercial Supersonic Technology Project *RVLT* – Revolutionary Vertical Lift Technology Project *HT* – Hypersonic Technology Project
AOSP – Airspace Operations and Safety Program *ATD* – Airspace Technology Demonstrations Project *ATM*-X – Air Traffic Management – Exploration Project *SWS* – System-Wide Safety Project *UTM* – Unmanned Aircraft Systems Traffic Management Project
IASP – Integrated Aviation Systems Program *FDC* – Flight Demonstrations and Capabilities Project *UAS in the NAS* – Unmanned Aircraft Systems Integration in the National Airspace System Project

TACP – Transformative Aeronautics Concepts Program
TTT – Transformational Tools and Technologies Project

ARMD Technical Challenge Statements by Program and Project

(As of December 12, 2018)

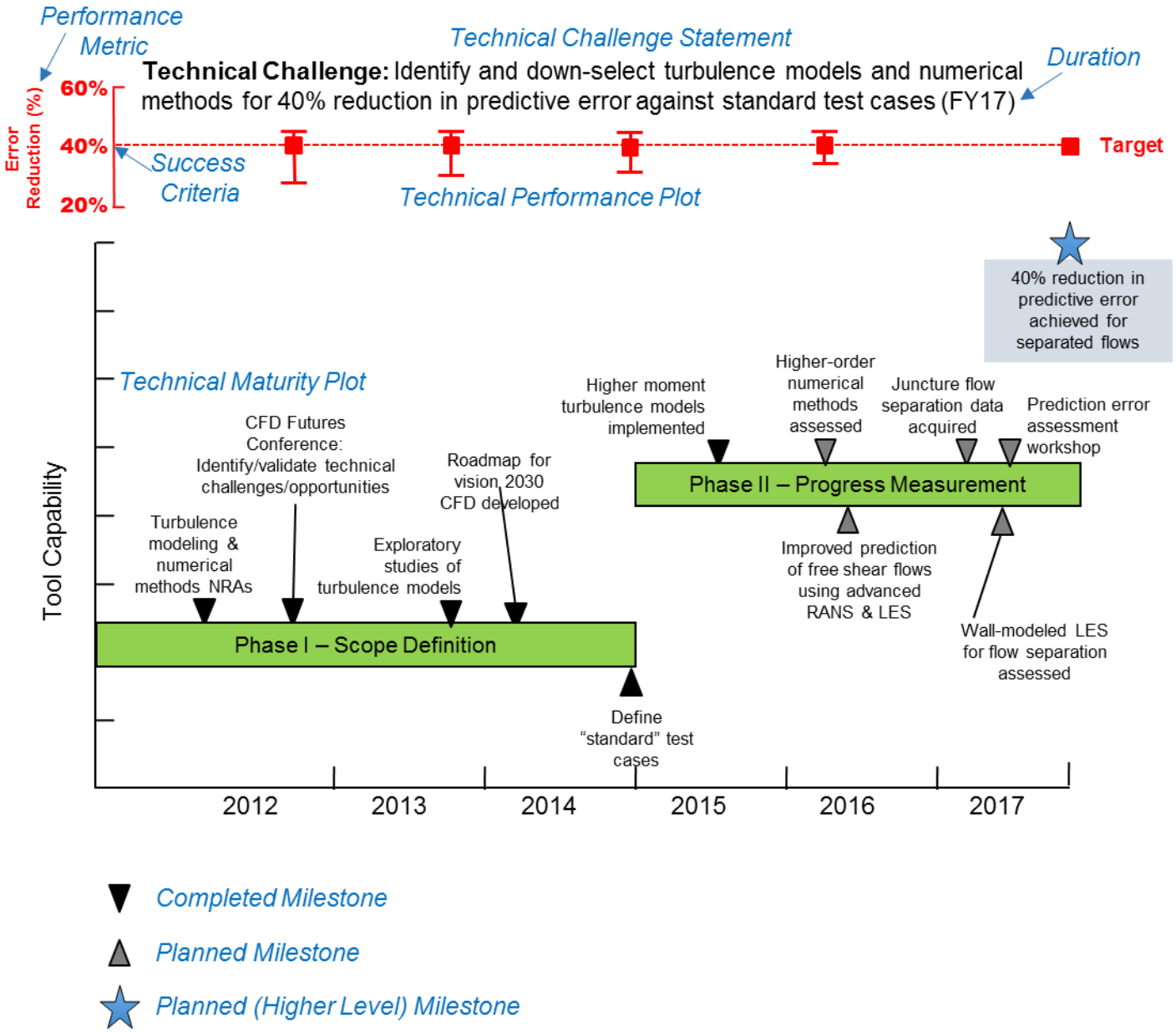
Program	Project	TC Name	TC Statement	FY Complete
AAVP	CST	Sonic Boom Community Response Metric & Methodology	Validated field study methodology, including indoor and outdoor noise metrics, exposure estimates, survey tools, and test protocols to support community studies with a low-boom flight demonstration aircraft	FY19
AAVP	CST	LBFD Prediction Validation Tools (ProViT)	In preparation for community response testing, NASA will provide a suite of prediction tools to support timely and accurate validation of the acoustic performance of the LBFD aircraft, rapid pre-flight exposure planning for Community Response Testing, and provide a foundation for future configuration design and certification analysis of supersonic aircraft. (Short Description: Develop a suite of tools to support the validation of the acoustic characteristics of the X-59 Low Boom Flight Demonstrator	FY23
AAVP	CST	Sonic Boom Community Response Metric & Method	Prepare and test plans, procedures and equipment required for overflight tests with QueSST aircraft over a large non-experienced community anywhere in the U.S. Collect initial data on community response to the QueSST aircraft acoustic signature	FY23
AAVP	AC	Accurate Strength & Life Prediction	Develop validated strength and life prediction tools with known accuracy for complex composite structures and standardized procedures for their reliable use.	FY19
AAVP	AC	Rapid Inspection & Characterization	Develop and demonstrate Non-Destructive Examination (NDE) systems and enabling technologies to fully inspect and rapidly disposition findings in complex composite structures.	FY19
AAVP	AC	Efficient Manufacturing Process Development	Develop and demonstrate new computational methods to relate manufacturing parameters to defect formation, and connect to commercial design and analysis software to allow structural optimization while resolving predicted manufacturing issues.	FY19
AAVP	AATT	Higher Aspect Ratio Optimal Wing	Enable a 1.5-2X increase in the aspect ratio of a lightweight wing with safe structures and flight controls.	FY19
AAVP	AATT	Fan and High-Lift Noise	Reduce fan (lateral and flyover) and high-lift system (approach) noise on a component basis by 4 dB with minimal impact on weight and performance	FY21
AAVP	AATT	Low NOx Fuel-Flex Combustor	Reduce NOx emissions from fuel-flexible combustors to 80% below the CAEP/6 standard with minimal impacts on weight, noise, or component life	FY19
AAVP	AATT	Compact High OPR Gas Generator	Enable reduced size/flow high pressure compressors and high temperature disk/seals that are critical for 50+ OPR gas generators with minimal impact on noise and component life	FY20
AAVP	AATT	Hybrid Gas-Electric Propulsion Concept	Establish viable concept for 5-10 MW hybrid gas-electric propulsion system for a commercial transport aircraft	FY19
AAVP	AATT	Engine Icing	Predict likelihood of icing events with 90% probability in current engines operating in ice crystal environments to enable icing susceptibility assessments of advanced ultra-efficient engines.	FY21
AAVP	RVLT	Demonstration of Design and Flight Operation Methods for Reduced Vertical Take-off and Landing (VTOL) Aircraft Noise Impact	To overcome the growth in community helicopter noise complaints, NASA will combine improved flight operations, a high-fidelity rotor/vehicle design approach, and human factors research to provide a 50% reduction in the Sound Exposure Level (SEL) footprint area for commercial VTOL vehicles in common use. This goal is targeted at vehicles that are nominally from 4-20 passengers or 2400 to 24,000 pounds gross weight, but the methods may be applicable to other vehicle sizes.	FY19
AAVP	HT	System-level Uncertainty Quantification (UQ) Method Development and Validation	Develop/validate a system-level uncertainty propagation methodology to guide uncertainty-informed decision-making. Hypersonic vehicles are highly integrated, complex systems with sensitive performance characteristics. There is a high reliance on modeling and simulation to predict system-level flight performance due to an inability to test full-scale models in a flight relevant	FY21

Program	Project	TC Name	TC Statement	FY Complete
			environment, including mission duration and varying conditions. The methodology and tools to identify and quantify significant uncertainty contributors and their impact to system/mission performance does not exist.	
AAVP	HT	Combined Cycle Mode Transition Progress Indicator	Demonstrate autonomous control and establish performance/operability assessment methodologies for future reusable hypersonic propulsion systems that use turbine engines at slow speeds and transition to scramjets for high-speed operations. Address the technology barrier of propulsion system mode transition via ground tests.	FY23
AOSP	ATD	Integrated/Arrival/Departure/Surface Operations (ATD-2: IADS)	Develop and deliver an integrated metroplex traffic manager to the FAA NextGen and Air Traffic Organizations, flight operators, and airport operators, that leverages NASA, FAA and industry technologies to enable simultaneous improvement of the predictability and efficiency of arrival, departure and surface operations.	FY20
AOSP	ATD	Domestic Applied Traffic Flow Management (ATD-3: ATFM-D)	Develop and deliver air/ground technologies and procedures to the FAA and flight operators that enable reduced weather-induced delays through the integration of weather information to better manage aircraft, traffic flow, airspace and schedule constraints.	FY20
AOSP	ATM-X	Integrated Demand Management Trajectory Based Operations (IDM TBO)	Develop requirements and procedures validated through high-fidelity experiments to enable unimpeded gate-to-gate TBO that improves throughput, reduces delays and enables user-preferred trajectories by synchronizing their access to airspace, airport, and weather constraint bottlenecks across the NAS.	FY21
AOSP	SWS	Safe Avionics and ATM Future Evolution (SAAFE)	Develop and demonstrate cost-efficient V&V tools, methods and guidance that provide justifiable confidence in safety claims for designs of complex safety- critical ATM/avionics systems	FY22
AOSP	SWS	In-Time Terminal Area Risk Management (TA)	Develop and demonstrate integrated risk assessment capabilities to monitor terminal area operations based on data analytics and predictive models.	FY22
AOSP	SWS	In-Time Safety Nets for Emerging Operations (EO)	Develop and demonstrate integrated dependable monitoring, assessment and mitigation capabilities for safety-critical risks to low altitude urban BVLOS sUAS operations.	FY22
AOSP	SWS	Complex Autonomous Systems Assurance (CASA)	Develop and demonstrate innovative V&V tools and methods to provide assurance of the safe operation of complex, increasingly autonomous, non-deterministic systems.	FY23
AOSP	UTM	UAS Traffic Management (UTM)	Develop and validate airspace operational and integration performance requirements to enable safe, large-scale UAS operations in low-altitude airspace.	FY20
IASP	FDC	Landing Gear Community Noise	Demonstrate novel landing gear porous fairing and wheel cavity treatments that reduce the airframe component of community noise by 1.5 dB with minimal impact on aircraft weight and performance, and to validate an advanced, physics-based methodology for the accurate prediction of airframe noise.	FY19
IASP	FDC	Electric Propulsion Airframe Integration	Demonstrate 5x reduction in energy usage with zero in-flight emissions through innovative electric propulsion airframe integration.	FY23
IASP	FDC	In Flight Measurements	Develop and demonstrate LBFD Mission Phase 2 capabilities to safely measure in-flight 1) near-field acoustic characteristics of the LBFD aircraft and 2) atmospheric effects on the far-field sonic boom signatures	FY22
IASP	FDC	Mobile Operations Facility	Develop and demonstrate mobile operations facility (MOF) capabilities required to safely conduct LBFD Mission Phase 3 community response overflight studies.	FY22
IASP	UAS in the NAS	UAS Detect and Avoid Operational Concepts and Technologies	Develop Detect and Avoid (DAA) operational concepts and technologies in support of standards to enable a broad range of UAS that have Communication, Navigation, and Surveillance (CNS) capabilities consistent with IFR operations and are required to detect and avoid manned and unmanned air traffic	FY20
IASP	UAS in the NAS	UAS Satcom and Terrestrial Command and Control	Develop Satellite (Satcom) and Terrestrial based Command and Control (C2) operational concepts and technologies in support of standards to enable the broad range of UAS that have Communication, Navigation, and Surveillance (CNS) capabilities	FY20

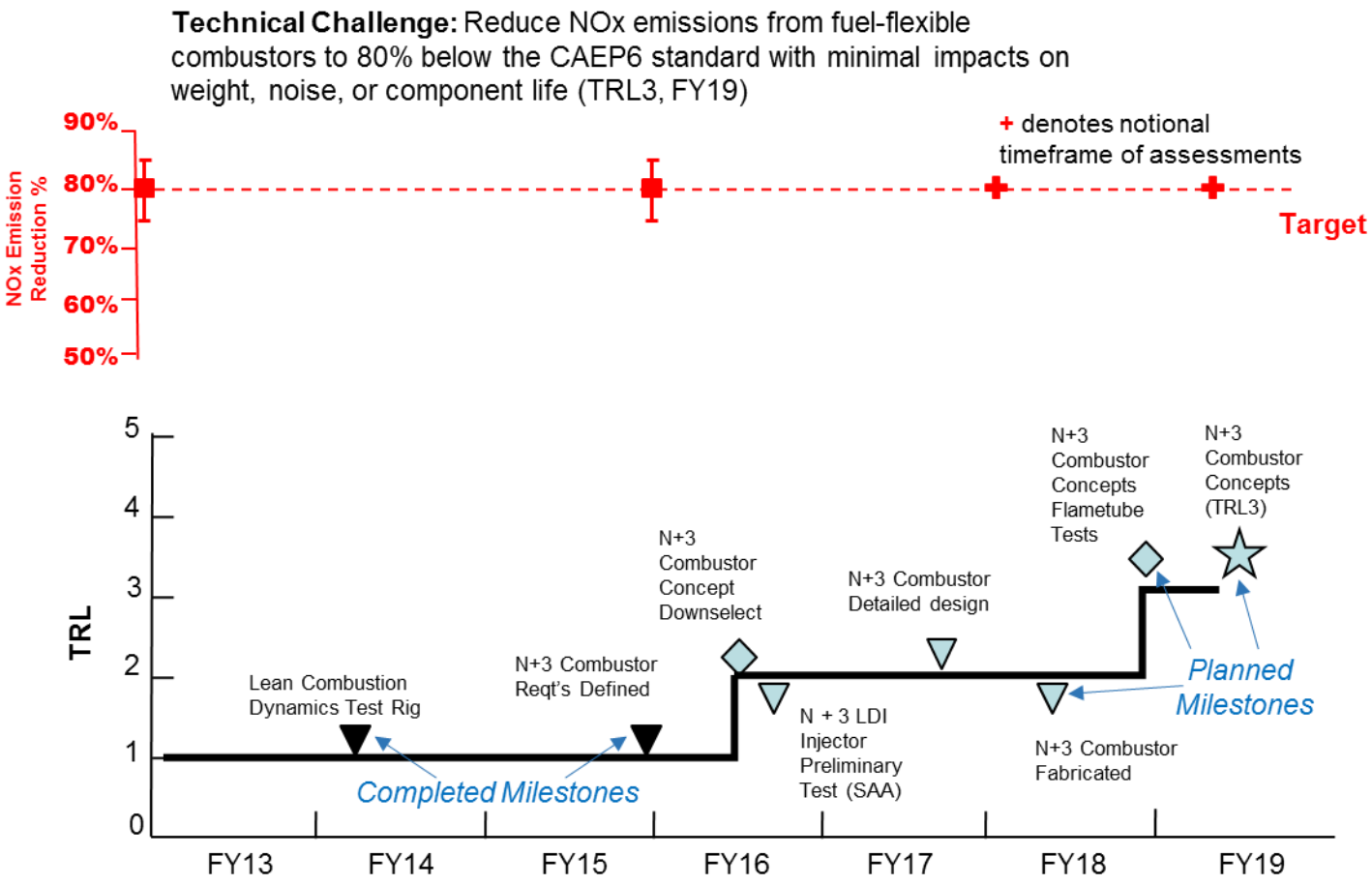
Program	Project	TC Name	TC Statement	FY Complete
			consistent with IFR operations and are required to leverage allocated protected spectrum.	
TACP	TTT	Combustion Modeling	Demonstrate capability to predict sensitivity of combustor efficiency, emissions, and operability to changes in fuel composition.	FY21
TACP	TTT	Multidisciplinary Design Analysis and Optimization (MDAO)	Integrate aero, propulsion, acoustic, and structural (MDAO) tools with multi-fidelity concept assessment tools to enable multi-to-high fidelity optimization of the latest ARMD concept configurations.	FY22
TACP	TTT	Efficient Eddy-Resolving Methods for CL*max* Prediction	Develop and demonstrate computationally efficient, eddy-resolving modeling tools that predict maximum lift coefficient (CL*max*) for transport aircraft with the same accuracy as certification flight tests.	FY25

[4] Progress Indicator Examples

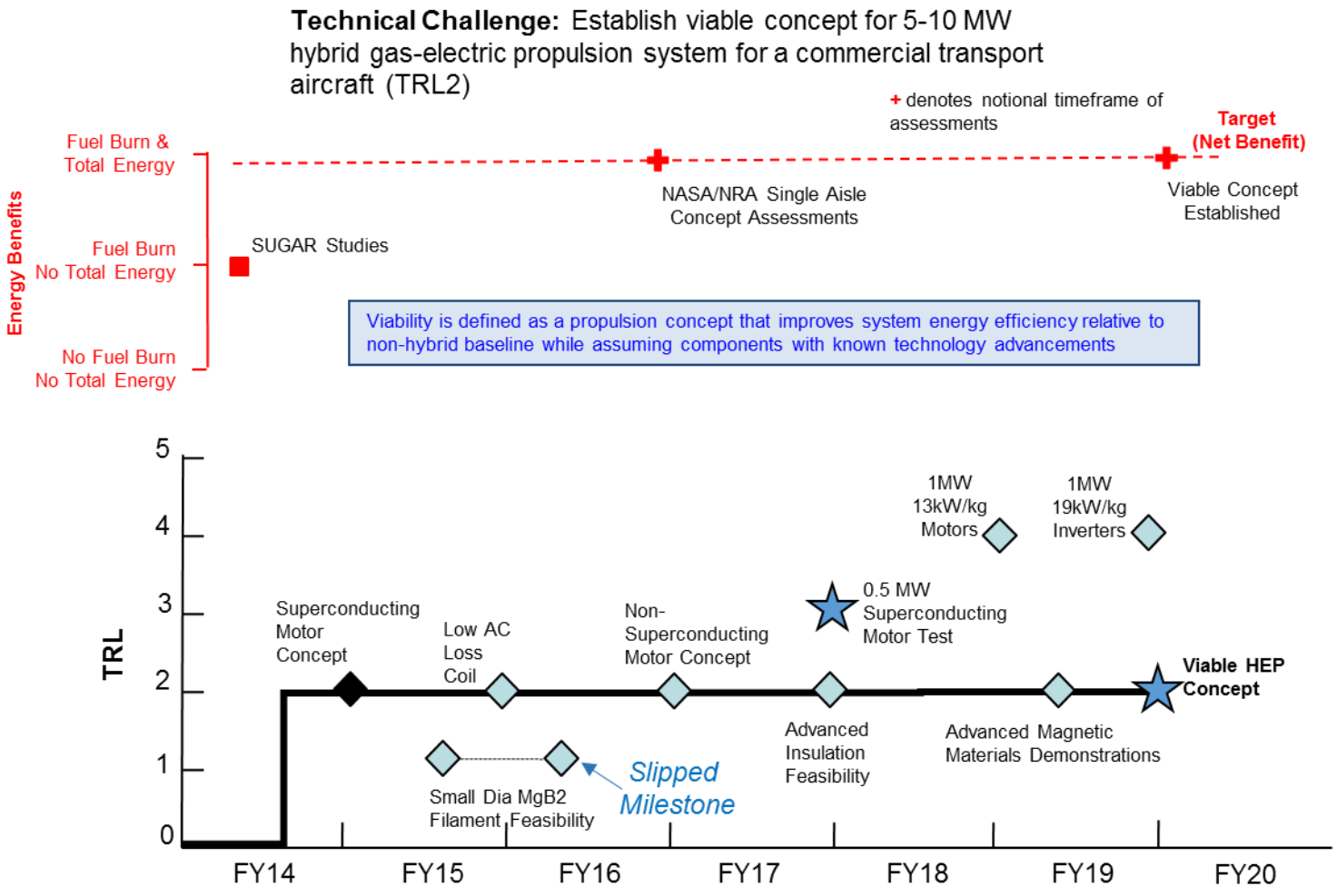
Example 1



Example 2


Technical Challenge: Reduce NOx emissions from fuel-flexible combustors to 80% below the CAEP6 standard with minimal impacts on weight, noise, or component life (TRL3, FY19)
NOx Emission Reduction %
90%
80%
70%
60%
50%
+ denotes notional timeframe of assessments
Target
TRL
5
4
3
2
1
0
Lean Combustion Dynamics Test Rig
N+3 Combustor Reqt's Defined
N+3 Combustor Concept Downselect
N+3 Combustor Detailed design
N+3 Combustor Concepts Flametube Tests
N+3 Combustor Concepts (TRL3)
N + 3 LDI Injector Preliminary Test (SAA)
N+3 Combustor Fabricated
Completed Milestones
Planned Milestones
FY13
FY14
FY15
FY16
FY17
FY18
FY19

Example 3


Technical Challenge: Establish viable concept for 5-10 MW hybrid gas-electric propulsion system for a commercial transport aircraft (TRL2)
+ denotes notional timeframe of assessments
Target (Net Benefit)
Energy Benefits
Fuel Burn & Total Energy
Fuel Burn No Total Energy
No Fuel Burn No Total Energy
NASA/NRA Single Aisle Concept Assessments
Viable Concept Established
SUGAR Studies
Viability is defined as a propulsion concept that improves system energy efficiency relative to non-hybrid baseline while assuming components with known technology advancements
TRL
5
4
3
2
1
0
1MW 13kW/kg Motors
1MW 19kW/kg Inverters
Superconducting Motor Concept
Low AC Loss Coil
Non-Superconducting Motor Concept
0.5 MW Superconducting Motor Test
Viable HEP Concept
Advanced Insulation Feasibility
Advanced Magnetic Materials Demonstrations
Small Dia MgB2 Filament Feasibility
Slipped Milestone
FY14
FY15
FY16
FY17
FY18
FY19
FY20

[5] List of ULI Awards

ARMD University Leadership Initiative Awards
(As of Feb 7, 2020)

Program	Project	ULI Title	Summary	FY Complete
TACP	UI	Hyper-Spectral Communications, Networking & ATM as Foundation for Safe and Efficient Future Flight: Transcending Aviation	Communication capabilities for improving link/network capacity, reliability, security in support of new Air Traffic Management applications	FY20
TACP	UI	Adaptive Aerostructures for Revolutionary Civil Supersonic Transportation	Small real-time geometric outer mold line reconfigurations to minimize boom signatures and drag in response to changing ambient conditions	FY22
TACP	UI	Advanced Aerodynamic Design Center for Ultra-Efficient Commercial Vehicles	Develop slotted, natural laminar flow airfoil to reduce wing profile drag	FY22
TACP	UI	Electric Propulsion: Challenges and Opportunities	Advance electric power systems, battery and energy storage, thermal management supporting electric propulsion aircraft	FY22
TACP	UI	Information Fusion for Real-Time National Air Transportation System Prognostics under Uncertainty	System-wide, real-time prognostics framework with rigorous V&V for proactive health management of NextGen National Airspace System	FY22
TACP	UI	Development of an Additive Manufacturing Ecosystem for Qualification of Additive Manufacturing Processes and Materials in Aviation	Developing a scientifically sound basis for qualifying parts from additive manufacturing, as well as demonstrate facilities for the efficient large-scale production of these parts	FY22
TACP	UI	Effective Human-Robot Teaming to Advance Aviation Manufacturing	Explore new ways in which humans can use robotics to improve the efficiency and flexibility of aviation-related manufacturing processes in a manner that enhances the safety of human workers	FY22
TACP	UI	Center for Cryogenic High-Efficiency Electrical Technologies for Aircraft (CHEETA)	Produce several novel superconducting electrical system components that use liquid hydrogen in fuel cells to power an electric aircraft propulsion system	FY22

D.4.3.7 Proposed Use of Unique NASA Capabilities

Proposers wishing to use NASA facilities should refer to Section I (c) of ROA-2019 for general proposal requirements. If use of NASA facilities is proposed, the costs associated with fabricating test articles, fixtures, instrumentation, and testing required should be included in the proposed cost. Specific timeframe and duration of testing will be negotiated upon selection of a proposal. For use of a NASA facility, a letter of commitment from the facility manager should be included in the Step-B proposal.

Proposers are encouraged to carry out a substantial portion of the overall work objectives (experimental and computational) prior to using a NASA facility and consider NASA facilities for the final validation of concepts or models.

General information on NASA test and evaluation facilities, including points of contact, can be found using the websites given below.

Armstrong Flight Research Center
https://www.nasa.gov/centers/armstrong/capabilities/index.html

Ames Research Center
Air Traffic Management Simulations:
https://www.aviationsystemsdivision.arc.nasa.gov/facilities/index.shtml

Wind Tunnels:
https://www.nasa.gov/centers/ames/orgs/aeronautics/windtunnels/index.html

Glenn Research Center
https://www1.grc.nasa.gov/facilities/

Langley Research Center
https://researchdirectorate.larc.nasa.gov/facilities-capabilities/

Information on NASA Advanced Supercomputing facilities can be found at
https://www.nas.nasa.gov/hecc/resources/

D.4.4 Summary of Key Information

Expected program budget for new awards	Nominally $1-2M per award per year, depending on scope
Anticipated number of new awards pending adequate proposals of merit and funds availability	Nominally two 4-year and three 3-year awards
Maximum duration of awards	Up to 4 years
Applicant's Workshop	Thursday April 30, 2020; 1:00-3:00 p.m. ET
Due date for Step-A proposals	June 30, 2020
Due date for Step-B proposals	60 days after request for Step-B proposals issued
Start of Period of Performance	Fall 2021
General information and overview of this solicitation	See the *Summary of Solicitation* of this NRA.
Detailed instructions for the preparation and submission of proposals	See D.4.3.4 and the *Guidebook for Proposers* Responding to a NASA Research Announcement – March 2018 at https://www.hq.nasa.gov/office/procurement/nraguidebook/
Page limit for the central Science-Technical-Management section of proposal	5 pages for Step-A; 25 pages for Step-B
Submission medium	See the *Guidebook for Proposers* Responding to a NASA Research Announcement – March 2018 at https://www.hq.nasa.gov/office/procurement/nraguidebook/
Web site for submission of proposal via NSPIRES	https://nspires.nasaprs.com (help desk available at nspires-help@nasaprs.com or (202) 479-9376)
Expected award type	Cooperative Agreements
Funding opportunity number	NNH19ZEA001N-ULI

NASA points of contact (POC) NASA will post any Q&A on-line (in the ULI section of NSPIRES) so that all proposers will have access to the same information.	Quickest way to resolve questions about this NRA is to e-mail questions to: HQ-UnivPartnerships@mail.nasa.gov Procurement POC: Ken Albright, <kenneth.e.albright@nasa.gov>, (228) 813-6127 Technical POC: Koushik Datta, <koushik.datta@nasa.gov>, (650) 604-2195 Written responses will be posted on the solicitation website. Facility POCs: See Section D.4.3.7