

Technology Readiness Assessments



NATIONAL NUCLEAR SECURITY ADMINISTRATION **Office of Cost Estimating and Program Evaluation**

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TECHNOLOGY READINESS ASSESSMENT

1. PURPOSE. To establish the process and procedures for conducting Technology Readiness Assessments (TRA) for any given acquisition process.
2. AUTHORITY. This NNSA Policy (NAP) is written under the Administrator's authority to set policy established pursuant to 50 United States Code (U.S.C.) 2402(d) and 50 U.S.C. 2411.
3. CANCELLATION. NAP 413.4, *Technology Readiness Assessments*, dated 12-22-16.
4. APPLICABILITY.
 - a. Federal. This applies to all National Nuclear Security Administration (NNSA) Elements.
 - b. Contractors. Does not apply to contractors.
 - c. Equivalencies/Exemptions.
 - (1) Equivalency. In accordance with the responsibilities and authorities assigned by Executive Order 12344, codified at 50 U.S.C. sections 2406 and 2511 and to ensure consistency through the joint Navy/Department of Energy (DOE) Naval Nuclear Propulsion Program, the Deputy Administrator for Naval Reactors (Director) will implement and oversee requirements and practices pertaining to this NAP for activities under the Director's cognizance, as deemed appropriate.
 - (2) Exemption. Not applicable.
5. SUMMARY OF CHANGES.
 - a. This NAP updates the threshold requirements for construction projects to be consistent with changes in 50 U.S.C. 2411 and corrects language to reflect that current law and policy governing the Phase X or 6.X process only require TRA on weapons prior to Phase 2 or 6.2 authorization.
 - b. The use of the term "TRA calculator" was removed to reflect current terminology for the calculator, and assessment of readiness levels was limited only to specific types (technology, manufacturing, and programmatic) that are currently recognized in policy and the current calculator.
 - c. The requirement for a Technology Maturation Plan (TMP) was clarified to include common terminology such as Technology Development Plan or Program Plan, and also requires system specific maturation plans.

- d. Responsibility for retaining TRA documentation was assigned to the Heads of NNSA Elements, with coordination and capability development assistance provided by the Director of Office of Cost Estimating and Program Evaluation.
6. BACKGROUND. A TRA is a systematic, metrics-based process that assesses the maturity of, and the risk associated with, critical technologies used in meeting product realization goals for a specific product. TRAs inform program and project acquisition decisions and technology maturation planning using objective knowledge gathered from subject matter experts and compiled into a standardized scoring scale. TRAs use Technology Readiness Levels (TRL) to measure the state of the technology development from early research on basic principles through large-scale testing and evaluation prior to commercial deployment. TRA activities start with defining the purpose and scope of the assessment; continue through the selection of critical technologies and evaluation process, and end with the final report and subsequent technology maturation planning.

In conjunction with this TRA exercise and its associated products or artifacts, an independent assessment of the TRA is executed to ensure that the TRA has been conducted in an unbiased manner. This independent assessment is based on metrics and best practices from industry and its conclusions are captured in an evaluation memo.

Throughout this NAP, unless otherwise specified, references to TRA requirements are the responsibility of the TRA Team.

7. REQUIREMENTS.

- a. NNSA Elements must develop policy on what projects, programs, or acquisition processes require a TRA, unless otherwise directed by broader DOE or NNSA directives. These procedures will provide guidance on the execution of TRAs in any given acquisition process in support of milestone decisions or at the direction of the Administrator.
- b. Programs must conduct TRAs using this NAP at critical decision points for projects meeting the following criteria:
 - (1) Prior to Phase 2 or 6.2 authorization: Major Atomic Energy Defense Acquisition (MAEDA) programs managed under the Phase X or 6.X process where the total program cost is greater than \$500 million, or the total lifetime lifecycle cost is greater than \$1 billion.
 - (2) Prior to Critical Decision (CD)-1 and CD-2: Major System Acquisitions covered by DOE Order (O) 413.3B (or successor order) with an estimated Total Project Cost (TPC) greater than or equal to \$750 million or which meet the cost threshold of a MAEDA as defined in 7.b.(1) above.
 - (3) At other decisions points for milestone approval as mandated by DOE O 413.3B (or successor orders).

- (4) As directed by the Administrator or the Project Management Executive (PME), for first-of-a-kind engineering endeavors.
- c. The TRA must be planned and resourced for a comprehensive analysis, completed prior to the appropriate milestone as defined by the applicable acquisition policy (for example, designated acquisition milestone, gate review, critical decision event, etc.).
- d. TRAs must document assessment objectives, to include the applicable milestone decision event or the acquisition executive direction the TRA will support.
- e. TRAs must have a Team Lead accountable for the TRA process and results. Additionally subject matter experts (SMEs) representing critical technologies under evaluation must be identified. In the absence of a Federal Team Lead, the TRA must have a named Federal employee accountable for the TRA results.
- f. Commensurate with the size and scope of the effort, the following TRA information is required. A single artifact or group of artifacts may be provided to satisfy these requirements:
 - (1) TRA Schedule/Plan. A TRA schedule and action plan must be developed for the complete assessment process.
 - (2) Assessment Tool (Readiness Level (RL) Calculator). The RL Calculator(s) must be developed and applicable to the context and Critical Technology Elements (CTEs) under analysis. The RL Calculator should follow the format of the DOE TRL scale contained in the approved DOE TRL guide (DOE Guide (G) 413.3-4A or successor) and include other readiness level factors as deemed necessary to fully characterize the maturity risk of the CTE(s) for the supported decision, event, or executive tasking. The latest version of the Defense Programs Readiness Level (DPRL) calculator is recommended for use by Program Offices. RL factors may include:
 - (a) Technology Readiness Level (TRL);
 - (b) Manufacturability Readiness Levels (MRLs); and
 - (c) Programmatic Readiness Level (PRLs).
 - (3) TRA Final Report. The TRA must produce a TRA Final Report containing the results of the analysis, a list of the TRA team members and their roles, the assessed scoring per CTE to include supporting rationale or scoring justification, and the applicable RL calculator. The report must fully characterize technology maturity risks of the applicable CTE(s).

- (4) Technology Maturation Plan (TMP). Prior to the TRA, a TMP or equivalent, such as a Technology Development Plan or Program Plan, must be produced for all technologies assessed within regulatory thresholds per cognizant acquisition policy. The TMP must include the approach, activities, resources, and timelines associated with maturing technologies to the target level and must include maturation plans for use in the specific system being developed.
- (5) Evaluation Memorandum. This memorandum must document an assessment of the completeness and analytical quality of the TRA process to ensure programs and projects are meeting levels of confidence associated with appropriate overall system performance. The assessment must review the TRA against best practices and applicable DOE guidance (See Appendix A: TRA Metrics), however, it will not validate the technical findings or results of the TRA scoring.

8. RESPONSIBILITIES.

a. Heads of NNSA Elements (DA/AA).

- (1) Assigns the TRA Team Lead;
- (2) Ensures resources are available for the execution of the TRA;
- (3) Reviews and approves the TRA Plan, Schedule, TRA Report, and subsequent Technology Maturation Plan or equivalent as required. Commensurate with scope and size of the effort, the Deputy/Associate Administrator may delegate down this responsibility; and
- (4) Retains TRA documentation for future use and reference.

b. Director, Office of Cost Estimating and Program Evaluation. Reviews the TRA plan, the assessment tool, the TRA Final Report, and the TMP and documents the result in the Evaluation Memorandum provided to the program or project office and Administrator. Coordinates and develops capability with DA/AAs to retain and store TRA and TMP related information.

c. TRA Team Lead.

- (1) Serves as the TRA team primary point of contact;
- (2) Reviews TRA Team members' qualifications to ensure that the team has the appropriate expertise and abilities to execute the TRA; and
- (3) Develops the TRA Plan, TRA Schedule, Readiness Level Calculator, and TRA Final Report and associated TMP.

d. TRA Team Members.

- (1) Serves as SMEs in technical areas relevant to the technology under review.
- (2) Serves independently of the offices assigned direct line management responsibility for the work reviewed.
- (3) Objectively assess technologies, determine Readiness Levels (and other relevant metrics), and document their determination.
- (4) Encourages participation of SMEs from the field offices to ensure relevant expertise are included in the assessment.

9. REFERENCES.

- a. DOE Secretarial Memorandum, *Project Management Policies and Principles*, 6-8-15.
- b. DOE O 413.3B Admin Change 7, *Program and Project Management for the Acquisition of Capital Assets*, 6-21-23.
- c. DOE G 413.3-4A Admin Change 1, *Technology Readiness Assessment Guide*, 10-22-15.
- d. NNSA Defense Programs *Technology Readiness Assessment (TRA) Implementation Guide*, Revision 2, January 2017.

10. DEFINITIONS.

- a. Artifact. Any publication or document that defines the methods, processes, tools, data, or product deliverables because of, or in support of, a systems engineering life cycle, captured in electronic or hard copy format. Examples of this might be: design documents, data models, workflow diagrams, test matrices and plans, setup scripts, etc.
- b. Critical Technology Element (CTE). A technology element is “critical” if the system being acquired depends on the technology element to meet operational requirements (with acceptable development, cost and schedule, and with acceptable production and operations costs) and if the technology element or its application is either new or novel.
- c. Critical Decision (CD). A formal transition point in a project’s lifecycle where “CD approvers” evaluate a set of required deliverables to ensure they were completed and accepted properly. CDs mark key milestones in the project lifecycle and are part of a structured framework of project approvals. The framework is flexible and can be tailored to the specific needs of individual projects.
- d. Major Atomic Energy Defense Acquisition (MAEDAs) Program. An atomic energy defense acquisition program is a NNSA program of which the total project

cost is more than \$500 million and/or the total lifetime cost is more than \$1 billion as defined in 50 U.S.C. 2411.

- e. Manufacturability Readiness Levels (MRLs). MRLs are a measurement scale designed to provide a common metric and vocabulary for assessing manufacturing maturity and risk of a particular technology, manufacturing process, weapon system, subsystem, or element of a legacy program at key milestones throughout the acquisition life cycle. There are 10 basic MRLs designed to be roughly congruent with comparable levels of TRLs for ease of use and understanding.
 - f. Programmatic Readiness Levels (PRLs). This index addresses program management concerns, such as documentation of programmatic milestones seen as vital to successful technology product development. This scale is also a nine-level scale to match TRLs.
 - g. Project Management Executive. The individual designated to integrate and unify the management system for a program portfolio of projects and implement prescribed policies and practices. Formerly known as the Acquisition Executive.
 - h. Subject Matter Expert (SME). Individual with sufficient technical knowledge of the critical technologies under review, commensurate with the depth and rigor of the TRA. These individuals may be either federal or contractor personnel.
 - i. Technology. A manner of accomplishing a task especially using technical processes, methods, or knowledge. This may include hardware, software, materials, etc.
 - j. Technology Development. Activities in connection with corporate or governmental innovation.
 - k. Technology Maturation Plan (TMP). A TMP details the steps necessary for developing technologies that are less mature than desired to the point where they are ready for project insertion.
 - l. Technology Readiness Assessment (TRA). A systematic, metric-based assessment of how far technology development has progressed. It is not a pass/fail exercise and does not intend to provide a value judgment of the technology developers or the technology development program.
 - m. Technology Readiness Level (TRL). A metric used for describing technology maturity. It is a measure used by many U.S. Government agencies to assess maturity of evolving technologies prior to incorporating that technology into a system or subsystem. These are defined by each organizational element.
11. CONTACT. Director, Office of Cost Estimating and Program Evaluation,
202-586-6762

BY ORDER OF THE ADMINISTRATOR:

A handwritten signature in black ink, appearing to read "Jill Hruby". The signature is fluid and cursive, with the first name "Jill" and the last name "Hruby" clearly distinguishable.

Jill Hruby
Administrator

Appendixes:

- A. Technology Readiness Assessment Metrics
- B. Technology Readiness Assessment Process Workflow

APPENDIX A: TECHNOLOGY READINESS ASSESSMENT METRICS

1. Best Practices for Technology Readiness Assessment (TRA) Process – General Principles

- a. A TRA Lead designee.
- b. The TRA schedule allows adequate lead-time to socialize the TRA prior to the supported decision and develop Technology Maturation plans if required.
- c. Subject Matter Experts (SME) represent critical technologies under analysis.

2. Best Practices for TRA Process – Determining Critical Technologies

The TRA shows evidence of disciplined systems engineering and systems analysis methods for determining critical technologies. (e.g., requirements analysis, functional decomposition, design synthesis, work breakdown structures, mission/performance analysis, and enterprise architecture analysis).

3. Best Practices for TRA Process – Assessing Technology Maturity

- a. The type of readiness assessment and Readiness Level (RL) calculator scale (e.g., Technology Readiness Level (TRL), Manufacturability Readiness Levels (MRL), Programmatic Readiness Levels (PRL), and/or Hybrid) is clearly identified for each Critical Technology Element (CTE) (if different types of RLs), traceable to the applicable acquisition framework, and remains stable throughout the analysis.
- b. The TRA clearly shows the TRL score for each CTE with substantiating analysis and data.
- c. The TRA analysis framework, methodology, and scoring is supported with details commensurate with the assessed levels according to the Calculator.
- d. TRA assessment shortfalls in the characterization of technology risk are identified.

4. Best Practices for TRA Process – TRA Reporting, Governance

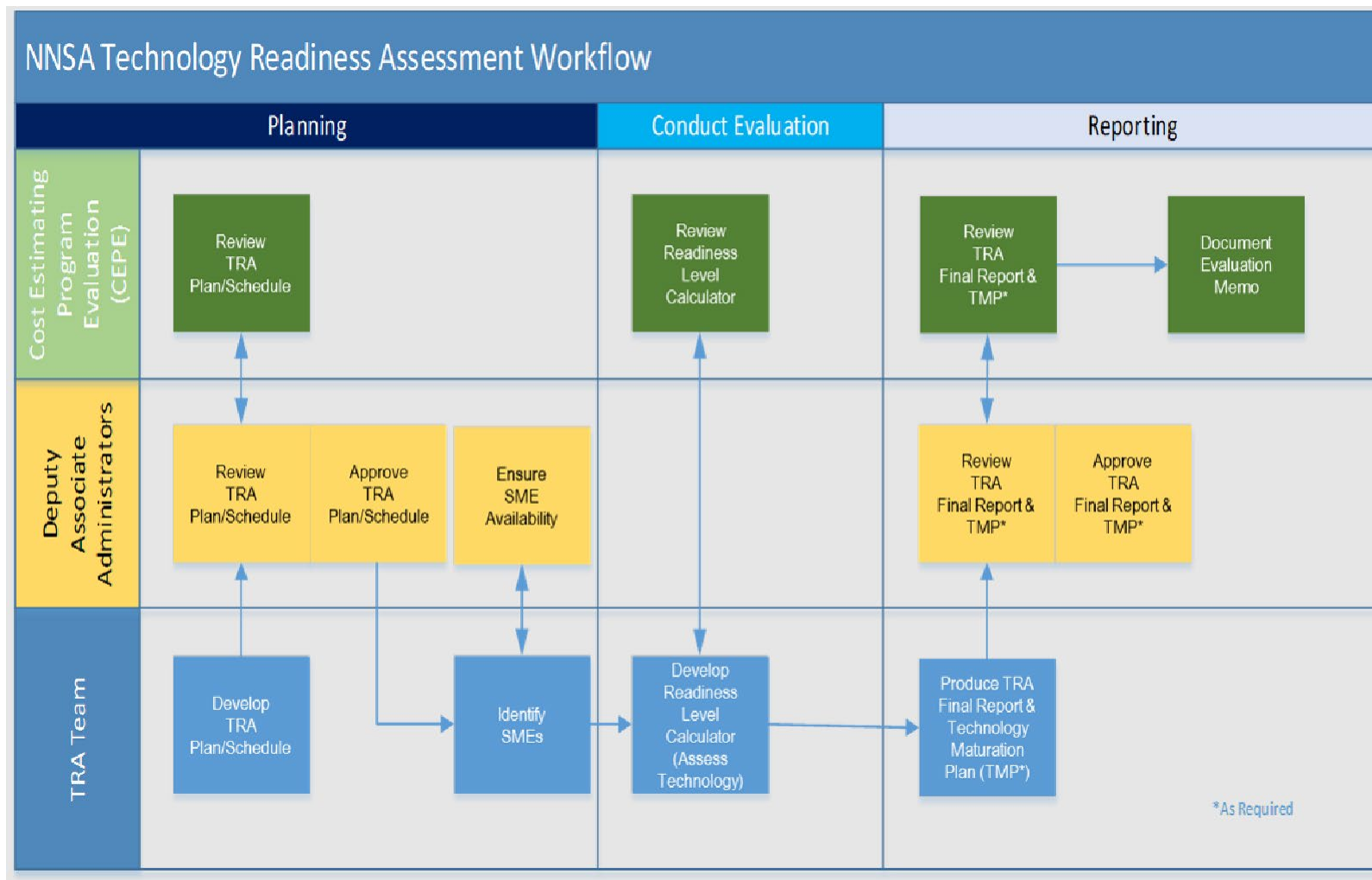
- a. The TRA Report is completed and accepted by the Heads of NNSA Elements or delegate prior to the acquisition decision being supported.
- b. The TRA report contains sufficient supporting information to show how the analysis was conducted and that the results are clear and sufficiently substantiated.
- c. Technology shortfalls and risks identified by CTE.

5. Best Practices for TRA Process – Technology Maturation Planning

The Technology Maturation Plan (TMP), or equivalent, contains the following:

- a. History of past TRL assessments and current TRL levels (shortfalls noted).
- b. Plan to mature CTEs that do not meet required levels.
- c. A comprehensive characterization of the CTE maturation risk.

APPENDIX B: Technology Readiness Assessment Process Workflow



CEPE: Cost Estimating and Program Evaluation
 TMP: Technology maturation Plan
 TRA: Technology Readiness Assessment