

**NOAA NESDIS
CENTER for SATELLITE APPLICATIONS
and RESEARCH (STAR)
STAKEHOLDER GUIDELINE**

**SG-11
RESEARCH PROGRAMMER
GUIDELINES
Version 3.0**

NOAA NESDIS STAR

STAKEHOLDER GUIDELINE SG-11

Version: 3.0

Date: December 31, 2009

TITLE: Research Programmer Guidelines

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TITLE: SG-11: RESEARCH PROGRAMMER GUIDELINES VERSION 3.0

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VERSION HISTORY SUMMARY

Version	Description	Revised Sections	Date
1.0	No version 1		
2.0	No version 2		
3.0	New Stakeholder Guideline adapted from CMMI guidelines by Ken Jensen (Raytheon Information Solutions)	New Document	12/31/2009

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LIST OF ACRONYMS

ATBD	Algorithm Theoretical Basis Document
BB	Baseline Build
CI	Cooperative Institute
CICS	Cooperative Institute for Climate Studies
CIMSS	Cooperative Institute for Meteorological Satellite Studies
CIOSS	Cooperative Institute for Oceanographic Satellite Studies
CIRA	Cooperative Institute for Research in the Atmosphere
CL	Check List
CLI	Check List Item
CoRP	Cooperative Research Program
CM	Configuration Management
CMMI	Capability Maturity Model Integration
CREST	Cooperative Remote Sensing and Technology Center
DG	Document Guidelines
DPR	Development Project Report
EPG	Enterprise Process Group
EPL	Enterprise Product Lifecycle
G1R	Gate1 Review
G1RR	Gate1 Review Report
G2R	Gate 2 Review
G2RR	Gate 2 Review Report
NESDIS	National Environmental Satellite, Data, and Information Service
NOAA	National Oceanic and Atmospheric Administration
PAR	Process Asset Repository
PG	Process Guidelines
PP	Project Proposal
PRG	Peer Review Guidelines
QA	Quality Assurance
R&D	Research & Development
RCOD	Research Code
RTEST	Research Test Data

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SC	Steering Committee
SEI	Software Engineering Institute
SG	Stakeholder Guideline
SPSRB	Satellite Products and Services Review Board
STAR	Center for Satellite Applications and Research
SWA	Software Architecture Document
TD	Training Document
TG	Task Guideline

1. INTRODUCTION

The NOAA/NESDIS Center for Satellite Applications and Research (STAR) develops a diverse spectrum of complex, often interrelated, environmental algorithms and software systems. These systems are developed through extensive research programs, and transitioned from research to operations when a sufficient level of maturity and end-user acceptance is achieved. Progress is often iterative, with subsequent deliveries providing additional robustness and functionality. Development and deployment is distributed, involving STAR, the Cooperative Institutes (CICS¹, CIMSS², CIOSS³, CIRA⁴, CREST⁵) distributed throughout the US, multiple support contractors, and NESDIS Operations.

NESDIS/STAR is implementing an increased level of process maturity to support the development of these software systems from research to operations. This document is a Stakeholder Guideline (SG) for users of this process, which has been designated as the STAR Enterprise Product Lifecycle (EPL).

1.1. Objective

The STAR Enterprise is comprised of a large number of organizations that participate and cooperate in the development and production of environmental satellite data products and services. Individual project teams are customarily composed of personnel from these organizations, supplemented by contractor personnel. These organizations and project teams are referred to as the STAR Enterprise stakeholders.

The objective of this Stakeholder Guideline (SG-9) is to provide a detailed description of the standard tasks of a **Research Programmer**. The intended users of this SG are those who have been assigned to provide science activities on a research project.

A **Research Programmer** is a programmer located at a research organization who has been assigned by the Research Lead to one or more of the tasks of designing research code, writing research code, and supporting **Research Testers** in testing research code.

¹ Cooperative Institute for Climate Studies

² Cooperative Institute for Meteorological Satellite Studies

³ Cooperative Institute for Oceanographic Satellite Studies

⁴ Cooperative Institute for Research in the Atmosphere

⁵ Cooperative Remote Sensing and Technology Center

Stakeholder satisfaction is a critical component of the process. The intention is for the process to be more of a benefit than a burden to stakeholders. If stakeholders are not satisfied that this is the case, the process will require improvement.

Comments and suggestions for improvement of the process architecture, assets, artifacts and tools are always welcome. Stakeholders can provide feedback by contacting:

Ken.Jensen@noaa.gov

1.2. Version History

This is the first version of SG-11. It is identified as version 3.0 to align it with the release of the version 3.0 STAR EPL process assets.

1.3. Overview

This SG contains the following sections:

- Section 1.0 - Introduction
- Section 2.0 - Reference Documents
- Section 3.0 - Reviews
- Section 4.0 - Project Artifacts
- Section 5.0 - Task Descriptions

2. REFERENCE DOCUMENTS

All of the reference documents for the STAR EPL process are STAR EPL process assets that are accessible in a Process Asset Repository (PAR) on the STAR website.

http://www.star.nesdis.noaa.gov/star/EPL_index.php.

Process assets include:

- Process Guidelines
- Stakeholder Guidelines
- Task Guidelines
- Peer Review Guidelines
- Review Check Lists
- Training Documents

2.1. Process Guidelines

Process Guideline (PG) documents describe STAR's standard set of practices and guidelines for tailoring them to specific projects.

- STAR EPL Process Guidelines (PG-1)
- STAR EPL Process Guidelines Appendix (PG-1.A)

PG-1 and PG-1.A apply generally to each EPL step. Each stakeholder performing tasks during each step can benefit from a familiarity with these documents.

2.2. Stakeholder Guidelines

A Stakeholder Guideline (SG) is a description of how to perform all STAR EPL standard tasks assigned to a given type of stakeholder. For each type of stakeholder, the appropriate SG provides that stakeholder with a complete description of the standard tasks for that stakeholder role, along with references to all appropriate process assets and project artifacts. This functions as a complement to the Task Guidelines (TGs), which provide a completion description of all stakeholder tasks for a specific process step. The relevant SG for **Research Programmers** is SG-11 (this document).

2.3. Task Guidelines

The STAR EPL is designed as a sequence of 11 process steps that take a product from initial conception through delivery to operations. These steps are:

- Step 1 - Basic Research
- Step 2 - Focused R & D
- Step 3 - Project Proposal
- Step 4 - Resource Identification
- Step 5 - Project Plan
- Step 6 - Project Requirements
- Step 7 - Preliminary Design
- Step 8 - Detailed Design
- Step 9 - Code & Test Data Development
- Step 10 - Code Test And Refinement
- Step 11 - System Integration and Test

A Task Guideline (TG) is a description of how to perform the tasks of a STAR EPL process step. There is one Task Guideline for each step in the STAR EPL. Table 2.3.1 lists the Task Guidelines that are relevant for **Research Programmers**.

TABLE 2.3.1 – Relevant Task Guidelines

ID	Step
TG-1	Basic Research
TG-2	Focused R&D

2.4. Peer Review Guidelines

For each review (c.f. Section 4), there is a Peer Review Guideline (PRG) that describes the objectives of the review, the required artifacts, standards for reviewers, requirements for approval, and options other than approval. Table 2.4.1 lists the Peer Review Guidelines that are relevant for **Research Programmers**.

TABLE 2.4.1 – Relevant Peer Review Guidelines

ID	Review
PRG-1	Gate 1 Review
PRG-3	Gate 2 Review

2.5. Review Check Lists

For each review (c.f. Section 4), there is a Review Check List (CL) that captures all the objectives for a review as a set of check list items. Each item in the check list should have a "Disposition" column that contains "Pass", "Conditional Pass", "Defer", "Waive", or "N/A" (Not Applicable). Each item will also have columns for Risk Assessment and for Actions generated. Table 2.5.1 lists the Review Check Lists that are relevant for **Research Programmers**.

TABLE 2.5.1 – Relevant Review Check Lists

ID	Review
CL-1	Gate 1 Review
CL-3	Gate 2 Review

2.6. Training Documents

Training Documents (TD) assist the stakeholders (c.f. Section 3) in performing the process tasks. By using the TDs, the stakeholders should be able to perform the tasks more effectively.

Table 2.6.1 lists the Training Documents that are relevant for **Research Programmers**.

TABLE 2.6.1 – Relevant Training Documents for Step 1

ID	Training Document
TD-11.1	FORTRAN Coding Standards
TD-11.1.A	Transition from Fortran 77 to Fortran 90
TD-11.2	C Coding Standards

3. REVIEWS

The relevant reviews for **Research Programmers** are:

- Gate 1 Review (G1R)
- Gate 2 Review (G2R)

3.1. Gate 1 Review

Gate 1 is an internal review of Basic Research by the research organization. Its purpose is to determine whether organization funds and resources should be expended on Focused R&D of a new/improved algorithm, leading to a Project Proposal to develop a product for transition to operations.

Standard Gate 1 Review objectives:

- Review the algorithm theoretical basis, software architecture, research code and research test results to determine whether the algorithm should be developed to support a STAR/SPSRB Project Proposal.

Standard Gate 1 Review entry criteria:

- Entry # 1 - An Algorithm Theoretical Basis Document (ATBD) has been written.
- Entry # 2 - A Software Architecture Document (SWA) has been written.
- Entry # 3 – Research code to implement the algorithm has been written.
- Entry # 4 – Test data for the basic research code has been produced.

Standard Gate 1 Review exit criteria:

- Exit # 1 – Algorithm and ATBD are satisfactory
- Exit # 2 – Software architecture and SWA are satisfactory.
- Exit # 3 – Basic research code is satisfactory.
- Exit # 4 – Research test results, documented in the ATBD, demonstrate that the algorithm has operational potential.

- Exit # 5 - Project is ready for the Exploratory phase

Refer to PRG-1 for a more detailed description of the Gate 1 Review. The standard Gate 1 Review Check List Items (CLI) are documented in the process asset CL-1 (c.f. Section 2).

Note that the standard Gate 1 Review objectives, entry criteria, and exit criteria are only recommendations. The research organization is completely free to determine objectives, entry criteria, and exit criteria unique to the organization and/or project. In fact, there is no requirement for the organization to even conduct a Gate 1 Review.

3.2. Gate 2 Review

Gate 2 is a STAR review of a Project Proposal (PP). Its purpose is to determine whether the proposal is compatible with the NESDIS mission and strategic plan, and is technically feasible for development into an operational product. Resource issues are not considered at this time. If a project passes Gate 2, the PP is forwarded to SPSRB for consideration in accordance with the SPSRB process.

Standard Gate 2 Review objectives:

- Review the project proposal and supporting artifacts (algorithm theoretical basis, software architecture, R&D code and R&D test results) to determine whether the algorithm has operational potential.
- Identify a STAR Division and Branch to implement Development

Standard Gate 2 Review entry criteria:

- Entry # 1 - An Algorithm Theoretical Basis Document (ATBD v1r1) has been written.
- Entry # 2 - A Software Architecture Document (SWA v1r1) has been written.
- Entry # 3 – Research code to implement the algorithm has been written.
- Entry # 4 – A Project Proposal (PP) has been submitted to STAR
- Entry # 5 – A User Request has been attached to the PP

Standard Gate 2 Review exit criteria:

- Exit # 1 – Algorithm and ATBD are satisfactory

- Exit # 2 – Software architecture and SWA are satisfactory.
- Exit # 3 – Research test results, documented in the ATBD, demonstrate that the algorithm has operational potential.
- Exit # 4 – Proposed operational products support the NESDIS mission and strategic plan
- Exit # 5 - A STAR Division and Branch has been identified to implement Development
- Exit # 6 - Project is recommended for Development

Refer to PRG-3 for a more detailed description of the Gate 2 Review. The standard Gate 2 Review Check List Items (CLI) are documented in the process asset CL-3 (c.f. Section 2).

4. PROJECT ARTIFACTS

Project Artifacts are a set of items that must be produced by the appropriate stakeholders during the product life cycle to support the reviews. They are established and maintained under Configuration Management (CM) by an Enterprise Process Group (EPG) under the direction of a Steering Committee (SC).

The project artifacts are maintained in a project artifact repository. This is a complete set of configuration-managed artifacts developed by each project in accordance with STAR standards. When a project artifact has been approved at a Technical Review or Gate Review, it is placed in the project artifact repository under CM.

Responsibility for producing project artifacts is assigned to stakeholders during the Plan phase, and may be tailored from the standard assignment. The project artifacts that are usually the responsibility of **Research Programmers** are listed in Table 4.1.

TABLE 4.1 – Relevant Artifacts

Artifact	Type
Basic Research Code	Code
R&D Code	Code

Basic Research Code: Basic Research Code (RCOD v1) is research code that implements the algorithm. It should use input data and produce output data that is described in the ATBD and SWA. It should include the processing functionality described in the ATBD and SWA.

R&D Code: Research & Development (R&D) Code (RCOD v2) is research code that implements the algorithm. It should use input data and produce output data that is described in the ATBD and SWA. It should include the processing functionality described in the ATBD and SWA. R&D code is expected to be an upgrade over Basic Research code. Code may include additional functionality to reflect upgraded software architecture and may be revised to comply with SPSRB coding standards. If the project is approved for development, this version of the code will be built into the initial project baseline, It is therefore expected that SPSRB coding standards will begin to be applied to the code. Currently, coding standards exist for Fortran, C, and C++ code, and general programming standards exist for all code. These standards are found on the SPSRB web site at http://projects.osd.noaa.gov/spsrb/standards_prog.htm

5. TASK DESCRIPTION

Research Programmers participate in the following process steps:

- Step 1 - Basic Research (TG-1)
- Step 2 - Focused R & D (TG-2)

The standard tasks for each of these steps are described below. Research Leads may also refer to the relevant TGs for a complementary task description.

5.1 Basic Research Tasks

Figure 5.1 shows the process flow for step 1.

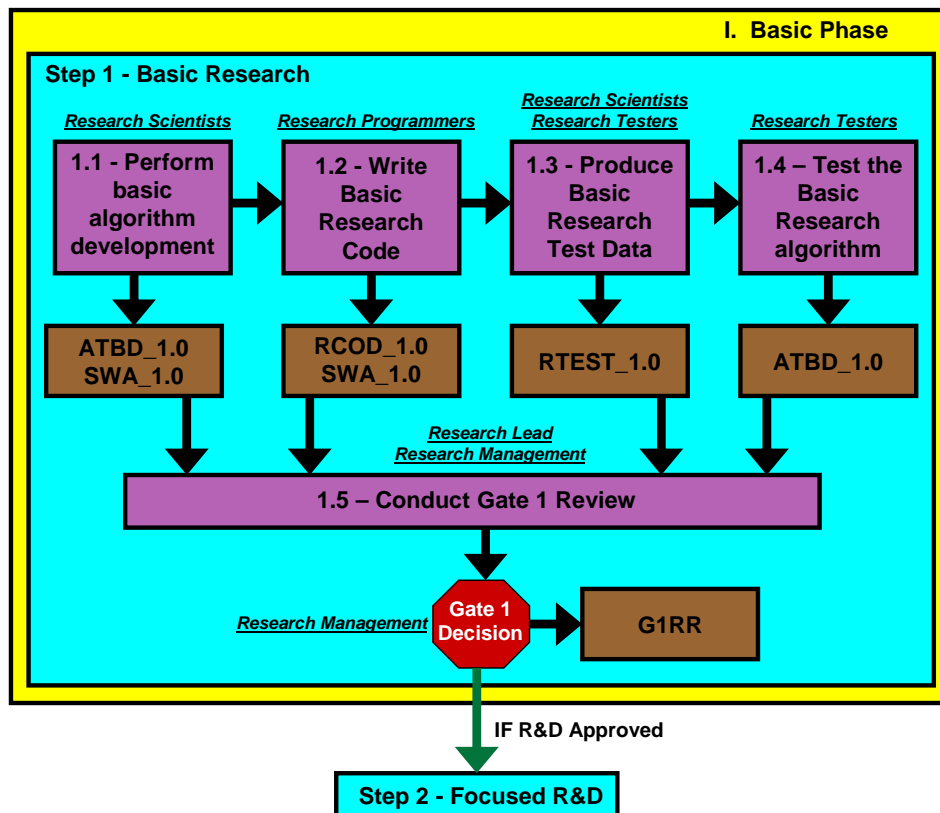


Figure 5.1 – STEP 1 Process Flow

5.1.1 Expected BEGIN State

- Research Scientists are prepared to perform basic research to develop an algorithm that may have operational potential.
- Research Management is aware of this effort, and has provided the resources needed for basic research coding and testing
- A Research Lead has been identified.
- If needed, Research Testers and Research Programmers have been identified
- Step 1 stakeholders understand and accept their tasks

5.1.2 Task Inputs

None

5.1.3 Desired END State

- An algorithm has been developed and documented in an ATBD.
- A software architecture has been developed and documented in a SWA.
- Research code has been written that implements the algorithm well enough to produce prototype data products.
- Research code has been run with research test data to produce data products.
- Research code test results, documented in the ATBD, demonstrate whether or not the algorithm has operational potential.
- A Gate 1 Review decision has been made and documented in a G1RR.

5.1.4 Task Outputs

- Algorithm Theoretical Basis Document v1.0
- Software Architecture Document v1.0
- Basic Research Code
- Basic Research Test Data
- Gate 1 Review Report

5.1.5 Stakeholder Activities

The Basic Research algorithm may be developed in one of three venues:

- STAR. **Research Managers** include STAR Division Chiefs and Branch Chiefs. **Research Lead** is a STAR scientist. **Research Scientists** are STAR scientists. **Research Testers** are STAR scientists. **Research Programmers** may be STAR scientists, or **Research Managers** may designate contractor personnel for these tasks.
- A Cooperative Institute (CI). **Research Managers** are provided by the CI. **Research Lead** is a CI Scientist. **Research Scientists** are CI scientists. **Research Testers** are CI scientists. **Research Programmers** may be CI scientists, or **Research Managers** may designate contractor personnel for these tasks.
- A research organization other than STAR and the CIs (PUSH User). Compliance with STAR EPL standards is at the discretion of the research organization, but the organization should understand that Gate 2 approval shall depend on a demonstration that the algorithm can be developed according to STAR EPL standards.

In this step, the **Research Lead** and **Research Scientists** begin the development of new or improved algorithms that may have operational potential. The objective is to develop the algorithm theoretical basis to a maturity sufficient for reviewers at the algorithm developer's organization to make an assessment that its operational potential warrants additional research and development.

The initiating event for this step will vary, depending on the internal practices of the research organization and external influences. Internal drivers are of the PUSH User type, determined primarily by the scientists' awareness of new or improved algorithm technology or of new data sources. External influences are of the PULL User type, determined primarily by emerging operational needs of the user community. Communication between PULL Users and the **Research Lead** is strongly encouraged.

The **Research Lead** should notify **Research Managers** when the algorithm is ready to be presented at a Gate 1 Review. The Gate 1 Review guidelines (PRG-1) and checklist (CL-1) should be consulted to help decide what must be done to prepare the algorithm for the next phase.

At a minimum, initial versions of an Algorithm Theoretical Basis Document (ATBD) and a Software Architecture Document (SWA) should be produced for the Gate 1 Review. The

purpose is to demonstrate to the Gate 1 reviewers that the algorithm has operational potential and should be further developed. ATBD v1r0 should include results of limited testing of the algorithm, using prototype code and a number of regional scenes. SWA v1r0 should document the algorithm inputs and outputs and at least one level of processing flow. The **Research Lead** and **Research Scientists** should produce these documents, using DG-1.1 and DG-1.2 as assets.

Basic research code and test data may be developed to help demonstrate an operational potential. In that case, **Research Programmers** and **Research Testers** at the research organization may be assigned to the project by **Research Managers** and/or the **Research Lead**. The extent and maturity of this code and test data is at the discretion of the organization that is developing the Basic algorithm, as it is their decision whether to approve the project for the next phase at the Gate 1 Review.

Although there is no coding standard for the code at this early phase of the EPL, the **Research Programmers** should refer to the appropriate pre-operational coding standard and code training documents (TD-11.1 and TD-11.1.A for Fortran code and TD-11.2 for C code) if they intend for their Basic Research code to be used for subsequent code development. The reason for this recommendation is that compliance with the coding standards will be required to satisfy code review requirements and it is more efficient to incorporate these standards into the code at the beginning.

The **Research Scientists**, **Research Programmers**, and **Research Testers** should collaborate to run tests on the Basic Research algorithm. The tests shall meet Gate 1 requirements as given in PRG-1 and CL-1. Gate 1 requirements may be tailored to meet the research organization's standards.

Each stakeholder who performed activities during step 1 is encouraged to document an assessment of the experience in a personal record. This assessment should include: what was good, what was bad, what worked, what did not work, what can be improved, how it can be improved. At the conclusion of Development (step 11), the **Development Lead** will collect the final edited personal stakeholder records and incorporate them into a Development Project Report (DPR).

5.2 Focused R&D Tasks

Figure 5.2 shows the process flow for step 2.

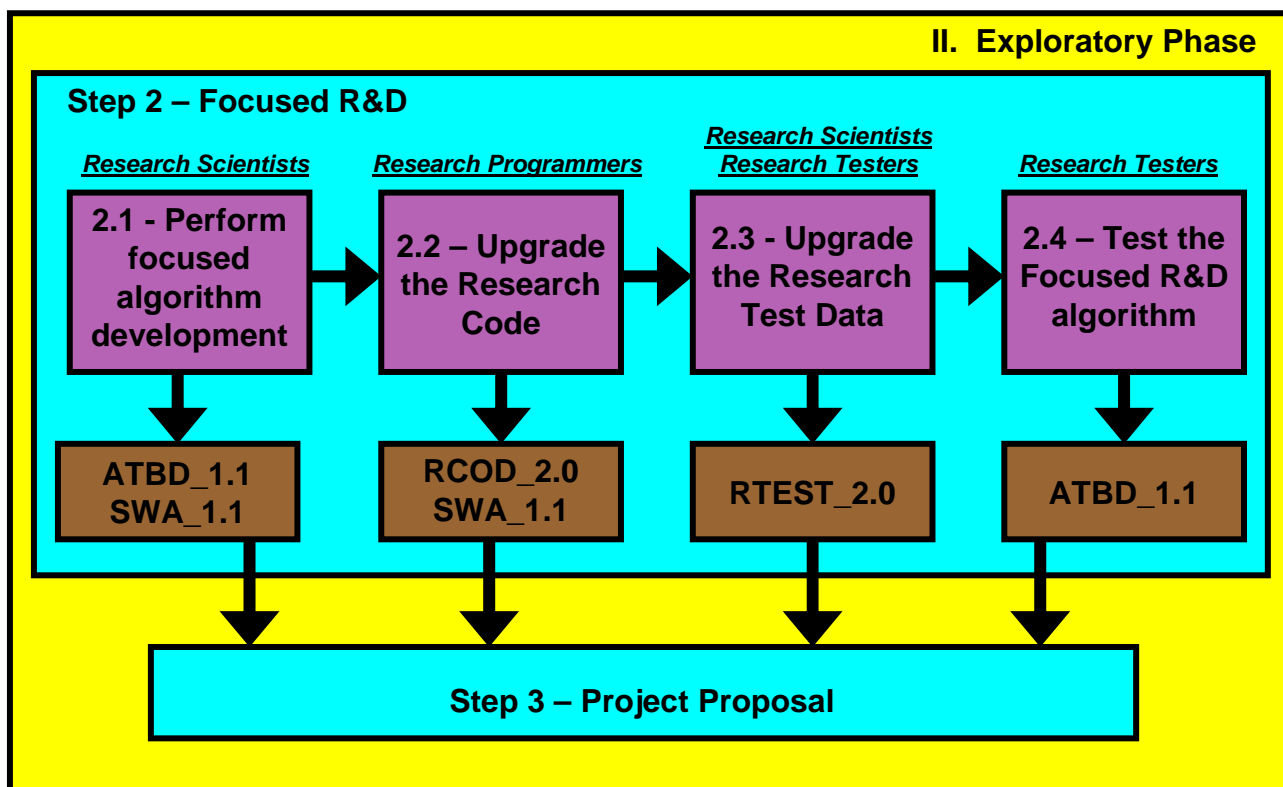


Figure 5.2 – STEP 2 Process Flow

5.2.1 Expected BEGIN State

Algorithm and supporting artifacts have passed a Gate 1 Review.

5.2.2 Task Inputs

Algorithm Theoretical Basis Document v1.0: The Algorithm Theoretical Basis Document (ATBD) provides a theoretical description (scientific and mathematical) of the algorithm that is used to create a product that meets user requirements. For v1.0, the algorithm is at a “concept” stage and its operational potential has not been assessed. The purpose of ATBD v1.0 is to demonstrate that the algorithm has operational potential and should be further developed to demonstrate operational capability. Refer to DG-1.1 for detailed ATBD guidelines.

Software Architecture Document v1.0: The Software Architecture Document (SWA) complements the ATBD by providing the software architecture for the processing code that will implement the algorithm. Refer to DG-1.2 for detailed SWA guidelines.

Basic Research Code: Basic Research Code (RCOD v1) is research code that implements the algorithm. It should use input data and produce output data that is described in the ATBD and SWA. It should include the processing functionality described in the ATBD and SWA.

Basic Research Test Data: Basic Research Test Data (RTEST v1) are the data files used to test the Basic Research code, including the input data and output data identified in the ATBD and SWA.

Gate 1 Review Report: Gate 1 Review Report (G1RR) is the report of the Gate 1 Reviewers. The G1RR should consist of an assessment of the Gate 1 Review artifacts and a yes/no decision on proceeding to the next phase of the EPL. Refer to DG-1.3 for G1RR document guidelines.

5.2.3 Desired END State

- The research algorithm has been matured and documented in ATBD v1r1
- A software architecture has been matured and documented in SWA v1r1
- R&D code has been written that implements the algorithm well enough to produce proxy data products to support a PP to STAR and the SPSRB.
- R&D code has been run with research test data to produce the proxy data products
- R&D code test results, documented in ATBD v1r1, demonstrate whether or not the algorithm's operational potential warrants the submission of a PP.

5.2.4 Task Outputs

- Algorithm Theoretical Basis Document v1.1
- Software Architecture Document v1.1
- R&D Code
- R&D Test Data

5.2.5 Stakeholder Activities

The Focused R&D algorithm may be developed in one of three venues:

- STAR. **Research Managers** include STAR Division Chiefs and Branch Chiefs. **Research Lead** is a STAR scientist. **Research Scientists** are STAR scientists. **Research Testers** are STAR scientists. **Research Programmers** may be STAR scientists, or **Research Managers** may designate contractor personnel for these tasks.
- A Cooperative Institute (CI). Research Management is provided by the CI. **Research Lead** is a CI Scientist. **Research Scientists** are CI scientists. **Research Testers** are CI scientists. **Research Programmers** may be CI scientists, or **Research Managers** may designate contractor personnel for these tasks.
- A research organization other than STAR and the CIs (PUSH User). Compliance with STAR EPL standards is at the discretion of the research organization, but the organization should understand that Gate 2 approval shall depend on a demonstration that the algorithm can be developed according to STAR EPL standards.

The initiating event for this step is Gate 1 approval, as documented in the Gate 1 Review Report.

Research code and test data must be developed to help demonstrate an operational potential. **Research Programmers** upgrade the Basic Research code and test data into more mature R&D code and test data. There is no coding standard for the code at this early phase of the EPL, but it is recommended that the appropriate pre-operational coding standard and code training documents (TD-11.1 and TD-11.1.A for Fortran code and TD-11.2 for C code) be consulted if the programmers do not want the R&D code to be discarded and replaced by new code for subsequent code development. The reason for this recommendation is that compliance with the coding standards will be required to satisfy code review requirements and it is more efficient to incorporate these standards into the research code.

Research Scientists, Research Programmers, and Research Testers should collaborate to run tests on the Focused R&D algorithm. The tests shall meet Gate 2 requirements as given in the Gate 2 Review guidelines (PRG-3) and Check List (CL-3).

Each stakeholder who performed activities during step 2 is encouraged to document an assessment of the experience in a personal record. This assessment should include: what

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was good, what was bad, what worked, what did not work, what can be improved, how it can be improved. At the conclusion of Development (step 11), the **Development Lead** will collect the final edited personal stakeholder records and incorporate them into a Development Project Report (DPR).

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