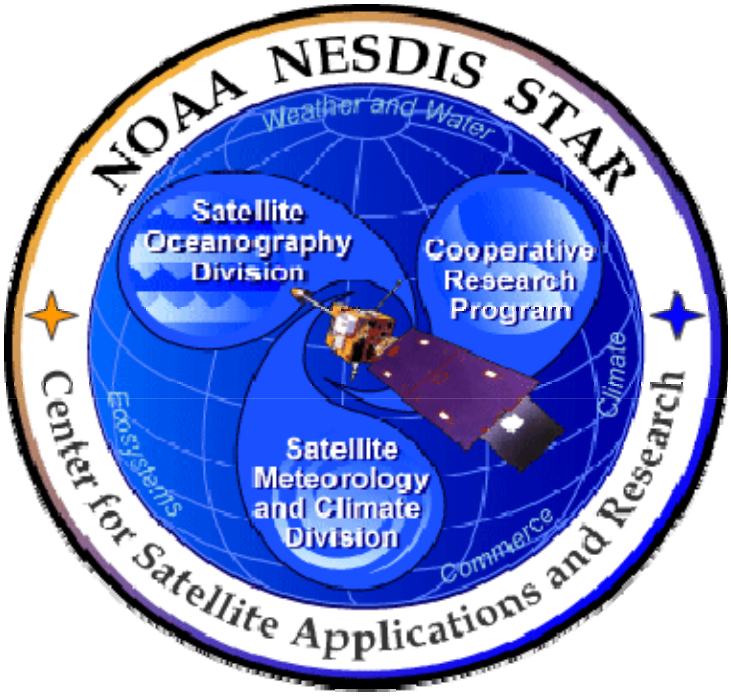

NOAA NESDIS
CENTER for SATELLITE APPLICATIONS and RESEARCH

DOCUMENT GUIDELINE

DG-8.2
CRITICAL DESIGN DOCUMENT GUIDELINE
Version 3.0

TITLE: DG-8.2: CRITICAL DESIGN DOCUMENTGUIDELINE VERSION 3.0

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CRITICAL DESIGN DOCUMENT GUIDELINE
VERSION HISTORY SUMMARY

Version	Description	Revised Sections	Date
1.0	New Document Guideline (DG-11.2) by Ken Jensen (Raytheon Information Solutions)	New Document	12/29/2006
2.0	Revised by Ken Jensen (Raytheon Information Solutions) for version 2.	All	10/31/2007
3.0	Renamed DG-8.2 and revised by Ken Jensen (Raytheon Information Solutions) for version 3.	All	10/1/2009

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LIST OF ACRONYMS

ATBD	Algorithm Theoretical Basis Document
CDD	Critical Design Document
CDR	Critical Design Review
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
CM/DM	Configuration Management/Data Management
CREST	Cooperative Remote Sensing and Technology Center
DDD	Detailed Design Document
DG	Document Guideline
DPP	Development Project Plan
EPL	Enterprise Product Lifecycle
IPT	Integrated Product Team
LUT	Look Up Table
NESDIS	National Environmental Satellite, Data, and Information Service
NOAA	National Oceanic and Atmospheric Administration
O&M	Operations and Maintenance
OCD	Operations Concept Document
PAR	Process Asset Repository
PBR	Project Baseline Report
PDD	Preliminary Design Document
PDR	Preliminary Design Review
PDRR	Preliminary Design Review Report

PG	Process Guideline
PPS	Product Processing System
PRG	Peer Review Guideline
QA	Quality Assurance
RAD	Requirements Allocation Document
SG	Stakeholder Guideline
SOW	Statement Of Work
STAR	Center for Satellite Applications and Research
SWA	Software Architecture Document
TBD	To Be Determined
TD	Training Document
TG	Task Guideline
VVP	Verification and Validation Plan

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 (CICS, CIMSS, CIOSS, CIRA, CREST) distributed throughout the US, multiple support contractors, and NESDIS Operations.

NESDIS/STAR is implementing an increased level of process maturity to support the exchange of these software systems from one location or platform to another. The Critical Design Document (CDD), a Microsoft PowerPoint file, is one component of this process.

1.1. Objective

The objective of this Document Guideline (DG) is to provide STAR standards for the CDD. The intended users of this DG are the personnel assigned by the Development Lead to the task of creating a CDD for the project.

1.2. The Critical Design Document

The CDD is the presentation document for a project's Critical Design Review (CDR)[1]. The CDR is an important milestone of each project's product lifecycle.

The CDD should build on the Preliminary Design Document (PDD), adding design detail, updating the status of the requirements and requirements allocation, and updating the status of actions from the Preliminary Design Review (PDR). It should accomplish the following objectives:

- Identify relevant stakeholders and document their involvement according to the project plan.
- Identify requirements changes since PDR
- Provide an updated allocation of product requirements to product components for the selected solution

[1] Refer to the STAR EPL Process Guidelines (PG-1 and PG-1.A) for a description of the STAR EPL gates and reviews.

- » Provide the description of the product that supports the development phase of the product lifecycle
- » Include the definition of the required design configuration
- » Provide all applicable technical data for the selected solution, including:
  - Operations concept
  - Theoretical Basis
  - Architecture, specifications, interfaces, detailed design description
  - Performance requirements, quality assurance (QA) procedures, test data requirements
  - Verification and validation plans
- » Provide an updated allocation of product requirements to product components for the selected solution
- » Identify and evaluate risks. Provide risk mitigation plans.
- » Document the closing of all action items since PDR. Make recommendations for open actions and new actions.

The intended target audience is the CDR reviewers. Typically, the CDD is prepared by the project's development team under the direction of the Development Lead.

The CDD should be developed as a Microsoft PowerPoint document. Upon approval, the approved version of the CDD may be converted to an Adobe pdf file for storage in the project artifact repository.

1.3. Background

This DG defines standards and guidelines for producing a CDD. It contains all information needed for a project's development team to produce a CDD that enables the CDR reviewers to confirm that the project is in compliance with all CDR requirements.

1.4. Benefits

A CDD developed in accordance with the standards in this DG enables the CDR reviewers to confirm that the project is in compliance with all CDR requirements. It is therefore a requirement that a CDD be developed in accordance with the guidelines in this document

before obtaining CDR approval. The CDD will be reviewed at the CDR to determine whether a project proceeds to the Build phase of the STAR Enterprise Product Lifecycle (EPL)[2].

1.5. Overview

This DG contains the following sections:

Section 1.0	-	Introduction
Section 2.0	-	References
Section 3.0	-	Standard Sections
Section 4.0	-	Section Guidelines
Appendix A	-	Template File

[2] A description of the STAR EPL can be found in STAR EPL process asset PG-1 (c.f. Section 2 of this document).

2. REFERENCE DOCUMENTS

PDD: Preliminary Design Document is a Microsoft PowerPoint file that contains the PDR presentation slides. It is often convenient for the CDD developer to adopt or adapt these slides for inclusion in the CDD. This document will be available to approved users in a project artifact repository.

DPP: Development Project Plan is an artifact for the CDR. It should include the project plan, schedule, and resources, identify stakeholders, identify CDR entry and exit criteria, provide the CDR Check List Items (CLI), and include the project objectives, tasks, milestones, stakeholders, and schedule. This information will be useful for the CDD developer in completing Sections 1 and 2 of the CDD. The CDD developers should check with the Development Lead and STAR CM/DM to determine the latest approved version of the DPP. If a DPP update is being developed concurrently with the CDD, the CDD developers should consult with the DPP developers to ensure consistency of information in the CDD and the DPP. This document will be available to approved users in a project artifact repository.

PDRR: Preliminary Design Review Report is an artifact for the CDR. It is the reviewer's report from the PDR. This information will be useful for the CDD developer in completing Section 2 of the CDD. This document will be available to approved users in a project artifact repository.

OCD: Operations Concept Document is an artifact for the CDR. It contains the timeline scenarios for product operation and user interaction for the project algorithm. This information will be useful for the CDD developer in completing Section 3 of the CDD. This document will be available to approved users in a project artifact repository. This version of the OCD may be developed in parallel with the CDD. In that case, the CDD developer should be in contact with the OCD developers to ensure that changes since PDR are captured in the CDD.

RAD: Requirements Allocation Document is an artifact for the CDR. It contains the basic and derived requirements for the work products and the allocation of the requirements to system components and product components. This information will be useful for the CDD developer in completing Sections 4 and 9 of the CDD. This document will be available to approved users in a project artifact repository. This version of the RAD may be developed in parallel with the CDD. In that case, the CDD developer should be in contact with the RAD developers to ensure that changes since PDR are captured in the CDD.

ATBD: Algorithm Theoretical Basis Document is an artifact for the CDR. It contains the requirements and theoretical basis for the project algorithm. This information will be useful for the CDD developer in completing Section 5 of the CDD. This document will be available to approved users in a project artifact repository. This version of the ATBD may be developed in parallel with the CDD. In that case, the CDD developer should be in contact with the ATBD developers to ensure that changes since PDR are captured in the CDD.

SWA: Software Architecture Document is an artifact for the CDR. It contains the software architecture and data flows for the project algorithm. This information will be useful for the CDD developer in completing Section 6 of the CDD. This document will be available to approved users in a project artifact repository. This version of the SWA may be developed in parallel with the CDD. In that case, the CDD developer should be in contact with the SWA developers to ensure that changes since PDR are captured in the CDD.

DDD: Detailed Design Document is an artifact for the CDR. It describes the product design at a level of detail that is sufficient for the development programmers to write fully functional pre-operational code. This information will be useful for the CDD developer in completing Section 7 of the CDD. A separate Detailed Design Document (DDD) is produced for each software unit that is part of the product processing system. The software units are the Layer-2 elements that are defined in the system level product software architecture, as described in the SWA. These documents will be available to approved users in a project artifact repository. This version of the DDD may be developed in parallel with the CDD. In that case, the CDD developer should be in contact with the DDD developers to ensure that relevant DDD information is captured in the CDD.

PBR: Project Baseline Report is an artifact for the CDR. It provides a listing of all items in the project's baseline. This information will be useful for the CDD developer in providing pointers to the project artifacts. This document will be available to approved users in a project artifact repository. This version of the PBR will include all of the other CDR artifacts, and therefore should be the last CDR artifact to be finalized. The CDD developer should be in contact with the PBR developer to obtain the correct pointers to the project artifacts prior to the finalization of the PBR.

VVP: Verification and Validation Plan is an artifact for the CDR. It describes the work products to be verified and validated, the requirements for each selected work product and the verification and validation methods for each selected work product. This information will be useful for the CDD developer in completing Section 8 of the CDD. This document will be available to approved users in a project artifact repository. This version of the VVP may be

developed in parallel with the CDD. In that case, the CDD developer should be in contact with the VVP developers to ensure that changes since PDR are captured in the CDD.

All of the following references are STAR EPL process assets that are accessible in a STAR EPL Process Asset Repository (PAR) on the STAR web site:

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

PG-1: STAR EPL Process Guideline provides the definitive description of the standard set of processes of the STAR EPL.

PG-1.A: STAR EPL Process Guideline Appendix, an appendix to PG-1, is a Microsoft Excel file that contains the STAR EPL process matrix (Stakeholder/Process Step matrix), listings of the process assets and standard artifacts, descriptions of process gates and reviews, and descriptions of stakeholder roles and functions.

PRG-8.1: Critical Design Review Guidelines are the guidelines for the CDR. It is useful for the CDD developers to understand what the reviewers will expect when reviewing the CDD.

DG-8.2.A: Critical Design Document Guideline Appendix is an Appendix to DG-8.2 (this document). It contains Microsoft PowerPoint slide templates for the CDD slides described in DG-8.2.

SG-13: STAR EPL Development Lead Guidelines provides a description of standard tasks for Development Leads, including development of the CDD.

SG-14: STAR EPL Development Scientist Guidelines provides a description of standard tasks for Development Scientists, including development of the CDD.

SG-15: STAR EPL Development Tester Guidelines provides a description of standard tasks for Development Testers, including development of the CDD.

SG-16: STAR EPL Development Programmer Guidelines provides a description of standard tasks for Development Programmers, including development of the CDD.

TG-8: STAR EPL Detailed Design Task Guidelines provides a description of standard tasks for process step 8, during which the CDD is developed.

3. STANDARD SECTIONS

The CDD slides are organized into sections. The standards sections are:

1.0 INTRODUCTION
- 1.1 Development Project Plan
- 1.2 Project Objectives
- 1.3 Project Stakeholders
- 1.4 Project Timeline
- 1.5 Project Plan Changes
- 1.6 Stakeholder Involvement
- 1.7 CDR Guidelines and Check List
- 1.8 CDR Report
- 1.9 Review Objectives

2.0 PDR REPORT
- 2.1 PDR Report
- 2.2 CDR Entry Criteria
- 2.3 CDR Exit Criteria

3.0 OPERATIONS CONCEPT
- 3.1 Operations Concept Overview
- 3.2 Customer/User Needs
- 3.3 Customer/User Expectations
- 3.4 Operational Scenario

4.0 REQUIREMENTS
- 4.1 Requirements Development Process
- 4.2 Requirements Documentation
- 4.3 New Requirements Since PDR
- 4.4 Requirements Changes Since PDR

4. SECTION GUIDELINES

This section contains the STAR guidelines for each section of the CDD. CDD developers will benefit greatly from using the slide templates contained in the "STAR_DG-8.2.A_CDD_ v3r0.ppt" file, hereafter referred to as DG-8.2.A. DG-8.2.A is considered to be an Appendix to this document.

Note that the slides in DG-8.2.A include figures, tables, and bulleted text. All figures, tables and bulleted text should be adopted as they appear in these slides, except for text between delimiters, like this:

<Text>

Text between delimiters consists of guidelines. The CDD developer should replace this text with appropriate text, as suggested by the guidelines.

4.1. Slide Master

It is recommended, but not required, that CDD developers use the Slide Master from DG-8.2.A as the Slide Master for the CDD. A development team may wish to tailor its Slide Master. For example, a different slide background color that has been established as a "team color" may be used. Whether or not the Slide Master is tailored, the slide master shall include the STAR logo in the upper left corner of the slide, following the Slide Master in DG-8.2.A. The STAR logo should be identical to the Picture on the cover page of this document. Another example of tailoring is to add organization logos to the upper right corner of the slide, if the development team is non-STAR (e.g. a Cooperative Institute or Contractor). The Slide Master for DG-8.2.A includes the Raytheon logo as an example. This should be replaced by the appropriate logos, or no logo if the development team consists of STAR personnel.

4.2. Title Slide

The first slide shall be a Title Slide, labeled "Title Slide"[3] in DG-8.2.A. The Title Slide shall include the Project and/or Product Name[4] and the Preparer's Names and Organizations.

[3] The slide templates in DG-8.2.A are labeled in text boxes located in one of the lower corners of each slide.

[4] In the slide templates, unspecified (generic) fields are indicated by the <generic name> convention. The CDD developer should fill these in with the appropriate information specific to the project's CDR.

4.3. Review Agenda Slide

The second slide shall be a *Review Agenda* Slide, labeled ”Review Agenda Slide” in DG-8.2.A. The Review Agenda Slide shall list each section of the presentation, the scheduled time interval for the presentation of the section, and the name of the presenter(s) for that section. It is not required that the locations of the Break and Lunch periods be exactly where they are indicated in this slide. The development team should tailor its schedule to fit the contents of each section. If the scope of a project’s CDR requires a review that extends for more than one day, each day’s agenda should be presented on separate slides, as shown on slides labeled “Review Agenda Slide Alternative – Day 1” and “Review Agenda Slide Alternative – Day 2” in DG-8.2.A.

4.4. Section 1 – Introduction

The CDD shall include an Introduction Section. This section shall include:

- A setup slide, labeled “Section 1 Setup Slide” in DG-8.2.A. This slide is a bulleted list of all 11 sections, with Section 1 highlighted, as shown.

- A Section Title slide, labeled “Slide 1.0” in DG-8.2.A.

- Section 1.1: *Development Project Plan*, labeled “Section 1.1” in DG-8.2.A, introduces the Development Project Plan (DPP), a standard STAR EPL artifact for the CDR. Provide a pointer to the project’s DPP and to the DPP Document Guideline (DG-5.1).

- Section 1.2: *Project Objectives*, labeled “Section 1.2” in DG-8.2.A. These should be derived from customer needs and expectations and should have been captured in the project’s Statement of Work (SOW). Match the main bullets of this slide to the main sections of the SOW. One level of sub-bullets can be used at the discretion of the development team. These would add some high-level information typically derived from the explanatory text in each section of the SOW.

- Section 1.3: *Project Stakeholders*, labeled “Section 1.3” in DG-8.2.A. Identify relevant stakeholder roles and personnel. Each distinct stakeholder role should be listed as a main bullet. Stakeholder roles are identified in the “Stakeholders” sheet of

STAR EPL process asset PG-1.A. Stakeholders should be named when known. There may be more than one name for a stakeholder role. Unspecified stakeholders should be identified by role with a TBD. The ensemble of roles and named personnel constitutes the Integrated Product Team (IPT). Sub-bullets can be used to add a high-level description of the tasks expected for a given stakeholder. The level of detail of these descriptions is at the discretion of the development team, but should be sufficient to give the reviewers a good sense of the IPT. The development team may prefer to present the stakeholder information as a table. See "Section 1.3 – Table Alternative" in DG-8.2.A for an example. A project organization chart is recommended. This chart should include all stakeholders that have been identified in this section. See "Section 1.3 – Option" in DG-8.2.A as an example.

- Section 1.4: *Project Timeline,* labeled "Section 1.4" in DG-8.2.A, should include a listing of project milestones and a schedule of tasks leading up to the milestones. Milestones should include the project reviews (with the CDR highlighted) and associated review dates. The STAR EPL standard reviews are shown in Section 1.4 of DG-8.2.A. Refer to the DPP for the project-specific reviews. Milestones may also include key deliveries (e.g. pre-operational code). See Section 1.4 of DG-8.2.A for an example. Show the project plan as an object or objects taken from a Microsoft Project file of the project plan. Use superimposed text boxes to highlight notable accomplishments leading up to CDR. Note the CDR milestone. See Section 1.4 of DG-8.2.A for an example. Use more than one slide if necessary to make the objects visually presentable. For example, the project timeline could be partitioned into the major STAR EPL phases. See "Section 1.4 – Timeline Partition" in DG-8.2.A for an example.

- Section 1.5: *Changes To Project Plan*, labeled "Section 1.5" in DG-8.2.A. Describe any changes to the project plan – objectives, stakeholders, tasks, schedule and milestones – that have occurred since the PDR. Use multiple slides as necessary for clarity. If there have been no changes, state this.

- Section 1.6: *Stakeholder Involvement*, labeled "Section 1.6" in DG-8.2.A. Document the involvement of the stakeholders according to the project plan. Use a bullet for each type of stakeholder. Sub-bullets should describe the involvement in a way that shows the project plan is being followed. Section 1.6 of DG-8.2.A shows examples.

- Section 1.7: *CDR Guidelines and Check List*, labeled "Section 1.7 Alternative 1" and "Section 1.7 Alternative 2" in DG-8.2.A. This section provides the reviewers with pointers to the CDR Peer Review Guidelines (PRG-8.1) and CDR Check List that

they will need to prepare for and dispose of the review. Use Alternative 1 or Alternative 2, depending on whether the standard CDR Check List (CL-8.1) is to be used (Alternative 1) or a tailored Check List has been documented in the DPP (Alternative 2).

- Section 1.8: *CDR Report*, labeled "Section 1.8" in DG-8.2.A. This section provides the reviewers with pointers to the CDR Report Document Guidelines (DG-8.3) that they will need to produce the CDR Report.

- Section 1.9: *Review Objectives*, labeled "Section 1.9" in DG-8.2.A should provide a clear presentation of the Review Objectives. These should include STAR EPL standard objectives for a CDR and may include project-unique objectives at the discretion of the development team. Refer to the DPP to determine this. The review objectives should correspond to the major sections of the review (c.f. Section 3 of this DG). Match the main bullets of this slide to the main sections. One level of sub-bullets can be used at the discretion of the development team. These would add some high-level descriptive information.

4.5. Section 2 – PDR Report

The CDD shall include a PDR Report Section. This section shall include:

- A setup slide, labeled "Section 2 Setup Slide" in DG-8.2.A. This slide is a bulleted list of all 11 sections, with Section 2 highlighted, as shown.

- A Section Title slide, labeled "Slide 2.0" in DG-8.2.A.

- Section 2.1: *Preliminary Design Review Report (PDRR)*, labeled "Section 2.1" in DG-8.2.A. The first bullet should be a pointer to the PDRR, so that reviewers can obtain access to it. The remainder of the slide should be as shown in Section 2.1 of DG-8.2.A.

- Section 2.2: *CDR Entry Criteria*, labeled "Section 2.2" in DG-8.2.A. This section lists the CDR entry criteria. Present as bullets. Use multiple slides as necessary for clarity. The CDR entry criteria should have been established at the PDR and documented in the PDRR.
    - Section 2.2 of DG-8.2.A shows the standard STAR EPL entry criteria for the CDR. These should be used if the standard CDR entry criteria, documented

in STAR EPL Check List CL-8.1, are used. If the entry criteria for a particular project have been tailored, revise these slides as necessary to capture the tailored entry criteria. Refer to the DPP Appendix C to determine this.

- o If applicable, list CDR entry criteria that are non-standard (added or revised from the standard set of entry criteria in STAR EPL Check List CL-8.1), explain the deviation, provide a rationale, and assess the risk, usually by reference to a risk # to be discussed in Section 10. Follow the instructions in Section 2.2 of DG-8.2.A.
- o If applicable, list any standard entry criteria that have been waived for this CDR, provide a rationale, and assess the risk, usually by reference to a risk # to be discussed in Section 10. Follow the instructions in Section 2.2 of DG-8.2.A.

- Section 2.3: *CDR Exit Criteria*, labeled “Section 2.3” in DG-8.2.A. This section lists the CDR exit criteria. Present as bullets. Use multiple slides as necessary for clarity. The CDR exit criteria should have been established at the PDR and documented in the PDRR.
  - o Section 2.3 of DG-8.2.A shows the standard STAR EPL exit criteria for the CDR. These should be used if the standard CDR exit criteria, documented in STAR EPL Check List CL-8.1, are used. If the exit criteria for a particular project have been tailored, revise these slides as necessary to capture the tailored exit criteria. Refer to the DPP Appendix C to determine this.
  - o If applicable, list CDR exit criteria that are non-standard (added or revised from the standard set of exit criteria in STAR EPL Check List CL-8.1), explain the deviation, provide a rationale, and assess the risk, usually by reference to a risk # to be discussed in Section 10. Follow the instructions in Section 2.3 of DG-8.2.A.
  - o If applicable, list any standard exit criteria that have been waived for this CDR, provide a rationale, and assess the risk, usually by reference to a risk # to be discussed in Section 10. Follow the instructions in Section 2.3 of DG-8.2.A.

4.6. Section 3 – Operations Concept

The CDD shall include an Operations Concept Section. Most of the content for this section should either be adopted from the PDD, with updates to address any changes since PDR, or obtained directly from the OCD. This section shall include:

- A setup slide, labeled “Section 3 Setup Slide” in DG-8.2.A. This slide is a bulleted list of all 11 sections, with Section 3 highlighted, as shown.

- A Section Title slide, labeled “Slide 3.0” in DG-8.2.A.

- Section 3.1: *Operations Concept Overview*, labeled “Section 3.1” in DG-8.2.A. Present an overview of what the operations concept is. Use the DG-8.2.A Section 3.1 slide templates as is, without tailoring. Introduce the Operations Concept Document (OCD).

- Section 3.2: *Customer/User Needs*, labeled “Section 3.2” in DG-8.2.A. Explain why the products are being produced. Itemize customer/user needs. Refer to a customer ConOps document, if one exists. If a customer ConOps does not exist, explain how customer/user needs were determined. Use text, figures, tables from the OCD. Use multiple slides as necessary for clarity.

- Section 3.3: *Customer/User Expectations*, labeled “Section 3.3” in DG-8.2.A. Explain how the products will be used, Itemize customer/user expectations. Refer to a customer ConOps document, if one exists. If a customer ConOps does not exist, explain how customer/user expectations were determined. Use text, figures, tables from the OCD. Use multiple slides as necessary for clarity.

- Section 3.4: *Operational Scenario*, labeled “Section 3.4” in DG-8.2.A. Explain how the products should be produced. Describe the production environments that are available for the product lifecycle, including development, transition, operations and delivery. Describe production scenarios, consistent with the level of detail in the customer's concept of operations, the production environment constraints, and operator needs and expectations. Use text, figures, tables from the OCD. Use multiple slides as necessary for clarity.

4.7. Section 4 – Requirements

The CDD shall include a Requirements Section. This section shall include:

- A setup slide, labeled “Section 4 Setup Slide” in DG-8.2.A. This slide is a bulleted list of all 11 sections, with Section 4 highlighted, as shown.

- A Section Title slide, labeled “Slide 4.0” in DG-8.2.A.

- Section 4.1: *Requirements Development Process*, labeled “Section 4.1” in DG-8.2.A. These slides illustrate the iterative development of the requirements during the Design phase of the STAR EPL process (“Section 4.1 - Figure 1” and “Section 4.2 – Figure 2” of DG-8.2.A), thereby providing a context for the remainder of the CDR. It is recommended that the presenter use the graphic depiction of the iterative (spiral) development of requirements and requirements allocation. Note the similarity to the figure in Section 9.1 of DG-8.2.A. The essence of “Section 4.1 - Figure 2” is that the development of Solutions, Design, Requirements, and Requirements Allocation occurs iteratively in a closed loop with continual feedback between the four. The placement of the four components of the Design phase is meant to show that Requirements (Section 4) drive the Solutions and Design (Sections 5 – 8), which in turn develop the Requirements Allocation (Section 9). The connection between Requirements Allocation and Requirements is caused by the need to maintain consistency between the two components.

- Section 4.2: *Requirements Documentation*, labeled “Section 4.2” in DG-8.2.A. This section introduces the Requirements Allocation Document (RAD) and provides a pointer to the project RAD.

- Section 4.3: *New Requirements Since PDR*, labeled “Section 4.3” in DG-8.2.A. This section describes each new requirement since PDR in sufficient detail to allow the reviewers to determine the proper disposition of the new requirement. Follow the instructions in Section 4.3 of DG-8.2.A.

- Section 4.4: *Requirements Changes Since PDR*, labeled “Section 4.4” in DG-8.2.A. This section describes each changed requirement since PDR in sufficient detail to allow the reviewers to determine the proper disposition of the changed requirement. Follow the instructions in Section 4.3 of DG-8.2.A.

4.8. Section 5 – Algorithm Theoretical Basis

The CDD shall include an Algorithm Theoretical Basis Section. Most of the content for this section should be obtained directly from ATBD v2r1. Refer to relevant sections of the ATBD when presenting this material. This section shall include:

- A setup slide, labeled “Section 5 Setup Slide” in DG-8.2.A. This slide is a bulleted list of all 11 sections, with Section 5 highlighted, as shown.

- A Section Title slide, labeled “Slide 5.0” in DG-8.2.A.

- Section 5.1: *Algorithm Theoretical Basis*, labeled “Section 5.1” in DG-8.2.A. This section introduces the algorithm theoretical basis and the ATBD, with specific pointers to the ATBD Document Guidelines (DG-1.1) and the project’s ATBD provided as indicated.

- Section 5.2: *Algorithm Objectives*, labeled “Section 5.4” in DG-8.2.A. This section describes the objectives of the algorithm, including the intended output data products and their intended use. Show how the algorithm objectives are derived from the operations concept.

- Section 5.3: *Sensor Inputs*, labeled “Section 5.5” in DG-8.2.A. This section describes the attributes of the sensing system(s) used to supply data for the algorithm. These are usually obtained from a Sensor Specification, which should be referred to. Often, there has been a formal presentation of sensor attributes made by the sensor development team. In that case, it may be possible to use slides from that presentation. The sensor description in this section should be at a relatively high level, but should at least provide the spatial and spectral attributes and the estimates for sensor errors.

- Section 5.4: *Ancillary Inputs*, labeled “Section 5.6” in DG-8.2.A. This section describes the attributes of all input data used by the algorithm, including ancillary data, forward models and look-up tables.

- Section 5.5: *Retrieval Strategy*, labeled “Section 5.7” in DG-8.2.A. This section describes the fundamental approach for retrieval at a level of detail sufficient for

- Section 5.6: *Processing Outline*, labeled “Section 5.8” in DG-8.2.A. This section describes the processing outline of the retrieval algorithm. All key elements and sub-elements needed to convey a comprehensive sense of the algorithm should be included. A process flow chart is recommended.

- Section 5.7: *Physical Description*, labeled “Section 5.9” in DG-8.2.A. This section describes the physics and associated phenomenology key to the retrieval. Note whether any part of the physical description is not based on proven algorithm heritage – in that case, evaluate the risk of new algorithm physics.

- Section 5.10: *Mathematical Description*, labeled “Section 5.10” in DG-8.2.A. This section describes the mathematics used by the retrieval, including all simplifications, approximations, and numerical methods.

- Section 5.11: *Algorithm Output*, labeled “Section 5.11” in DG-8.2.A. This section describes the algorithm output, mapping output characteristics to product requirements.

- Section 5.12: *Performance Estimates*, labeled “Section 5.12” in DG-8.2.A. This section describes, to the extent possible at the CDR stage of development, the predicted algorithm performance and quality of the products derived from analysis and tests with simulated and/or proxy test data. Note verification methods and assumptions, referring to the Quality Assurance section of this presentation (Section 8) and the Verification and Validation Plan (VVP). Extensive use of figures and tables from the ATBD is recommended to provide a convincing demonstration that the selected solution will meet requirements and to identify performance risks.

- Section 5.13: *Practical Considerations*, labeled “Section 5.13” in DG-8.2.A. This section describes how the algorithm is numerically implemented, including any possible issues with computationally intensive operations (e.g., large matrix inversions), and describes any important programming and procedural aspects related to implementing the numerical model into operating code.

4.9. Section 6 – Software Architecture

The CDD shall include a Software Architecture Section. Most of the content for this section should be obtained directly from SWA v2r1. This section shall include:

- A setup slide, labeled “Section 6 Setup Slide” in DG-8.2.A. This slide is a bulleted list of all 11 sections, with Section 6 highlighted, as shown.

- A Section Title slide, labeled “Slide 6.0” in DG-8.2.A.

- Section 6.1: *Software Architecture Overview*, labeled “Section 6.1” in DG-8.2.A. This section introduces the software architecture and the Software Architecture Document (SWA).
    - Explain the software architecture concept and function, as shown in Section 6.1 of DG-8.2.A.
    - Explain the software architecture documentation, as shown in Section 6.1 of DG-8.2.A. Provide a pointer to the project SWA.
    - Illustrate the software architecture layers, indicating the preliminary design layers that were presented at PDR (“Section 6.1 – Figure 1” in DG-8.2.A) and showing the detailed design expansion of the software architecture to four layers (“Section 6.1 – Figure 2” in DG-8.2.A).

- Section 6.2: *Context-Layer*, labeled “Section 6.2” in DG-8.2.A. This section describes the flows between the system and its external interfaces.
    - Explain the concept of the Context-Layer, defining the interfaces between the software system and external sources and sinks, as shown in Section 6.2 of DG-8.2.A.
    - State the criteria for the design of interfaces, using multiple slides as necessary for clarity. Note and explain any deviations from STAR standard criteria.
    - Show all external inputs and outputs to and from the software system, including a context diagram (“Section 6.2 – Figure 1” of DG-8.2.A shows an example). The context diagram slide may be obtained from PDD Section 6, unless there have been changes since PDR; in that case, obtain the updated diagram from the revised SWA.
    - Discuss each interface item at a level of detail that is warranted for the item. Adopt PDD Section 6 slides, if the external interfaces have not been changed since PDR. If there have been changes, revise the PDR slides as needed.

- Include a table if that adds clarity ("Section 6.2 – Table 1" of DG-8.2.A shows an example). Alternatively, use a bulleted list.
- Demonstrate that each interface meets acceptance criteria. This demonstration can include analysis, simulation, security certification, past practices, etc. Use figures and tables for clarity. Adopt PDD Section 6 slides, if the external interfaces have not been changed since PDR. If there have been changes, revise the PDR slides as needed.

- Section 6.3: *System-Layer*, labeled "Section 6.3" in DG-8.2.A. This section expands upon the Context-Layer data flow of Section 6.2, showing the next layer of decomposition to the System-Layer. Include a System-Layer data flow diagram ("Section 6.3 – Figure 1" of DG-8.2.A shows an example). This diagram should be adopted from SWA v2r1. Discuss each System-Layer data item at a level of detail that is warranted for the item. Use multiple slides as necessary for clarity. Adopt PDD Section 6 slides, if the external interfaces have not been changed since PDR. If there have been changes, revise the PDR slides as needed.

- Section 6.4: *Unit-Layer*, labeled "Section 6.4" in DG-8.2.A. This is the next layer of decomposition to the Unit-Layer. At this layer, the data flows within units are described. Include a Unit-Layer data flow diagram ("Section 6.4 – Figure 1" of DG-8.2.A shows an example). Adopt the PRD Section 6 diagram, if the data flows are unchanged since PDR, or revise the PRD diagram as necessary. The diagram should be found in SWA v2r1. For each unit in turn, discuss its Unit-Layer data items at a level of detail that is warranted for the item. Use multiple slides as necessary for clarity.

- Section 6.5: *Sub-Unit-Layer*, labeled "Section 6.5" in DG-8.2.A. This is the final layer of decomposition to the Sub-Unit-Layer. At this level, the data flows within each sub-unit are described. Show the Sub-Unit-Layer data flows for each unit as a series of data flow diagrams. These should be adopted from SWA v2r1. Sub-Unit-Layer descriptions are usually too numerous to be effectively presented in the CDD slides. Instead, refer the reviewers to the complete description in the SWA.

4.10. Section 7 – Detailed Design Description

The CDD shall include a Detailed Design Description Section. This section shall include:

- A setup slide, labeled “Section 7 Setup Slide” in DG-8.2.A. This slide is a bulleted list of all 11 sections, with Section 7 highlighted, as shown.

- A Section Title slide, labeled “Slide 1.0” in DG-8.2.A.

- Section 7.1: *Detailed Design Description*, labeled “Section 7.1” in DG-8.2.A. This section explains the concept of detailed design, serving as an overview for the sections to follow.

- Section 7.2: *Software Detailed Design*, labeled “Section 7.2” in DG-8.2.A. This section provides an overview of software detailed design. The detailed design of each software unit is described in a Detailed Design Document (DDD). A separate DDD is written for each software unit identified in the System-Layer software architecture that was discussed in Section 6.3 of this CDD. This section of the DDD should provide a pointer to the project DDDs.

- Section 7.3: *Unit and Sub-Unit Descriptions*, labeled “Section 7.3” in DG-8.2.A. This section provides a description of the design of each software unit. For the first unit (Unit 1):
    - Describe the Unit-Layer design, following the instructions in Section 7.3 of DG-8.2.A.
    - List all sub-units that are identified in the unit’s DDD and provide an overview of the Sub-Unit-Layer detailed design description.
    - Describe the detailed design of each of the sub-units, following the instructions in Section 7.3 of DG-8.2.A.
    - Repeat the above three steps for each additional unit in turn.

- Section 7.4: *Look Up Table Descriptions*, labeled “Section 7.4” in DG-8.2.A. This section describes each Look Up Table (LUT) in the system level design. Explain the purpose and function of each LUT. List and describe each LUT entry. The description should include the data format. Refer to the relevant sections of the DDDs for all units that use the LUT. Alternatively, include a table for each LUT. These tables can be obtained from the DDDs. An example is shown as ”Section 7.4 – Figure 1” of DG-8.2.A.

- Section 7.5: *File Descriptions*, labeled “Section 7.5” in DG-8.2.A. This section explains the purpose and function of each file in the algorithm design. Files can be parameter files, system control files, input data files, intermediate data files, output

data files, and ancillary data files. List and describe the contents of each file. The description should include the data format. Refer to the relevant sections of the DDDs for all units that use the file. Alternatively, include tables for each file. These tables can be obtained from the DDDs. An example is shown as ”Section 7.5 – Table 1” of DG-8.2.A.

4.11. Section 8 – Quality Assurance

The CDD shall include a Quality Assurance Section. This section shall include:

- A setup slide, labeled “Section 8 Setup Slide” in DG-8.2.A. This slide is a bulleted list of all 11 sections, with Section 8 highlighted, as shown.

- A Section Title slide, labeled “Slide 8.0” in DG-8.2.A.

- Section 8.1: *Quality Assurance*, labeled “Section 8.1” in DG-8.2.A. This section introduces the concepts of process QA and product QA.

- Section 8.2: *Configuration Management*, labeled “Section 8.2” in DG-8.2.A. This section describes the Configuration Management/Data Management (CM/DM) status of the project.
    - Identify the CM stakeholders for the project and verify their commitment to the plan for CM of requirements and requirements documentation. CM/DM personnel assigned to the project should be identified in the DPP.
    - Describe the CM tools that are in use for the project. This information should be in the project DPP.
    - Explain the purpose and contents of the Project Baseline Report (PBR) and provide a pointer to PBR v2r4.

- Section 8.3: *Verification and Validation Overview*, labeled “Section 8.3” in DG-8.2.A. Use the Section 8.3 slide templates of DG-8.2.A without revision.
    - Explain the concepts of verification and validation.
    - Introduce the project’s Verification and Validation Plan (VVP) and provide a pointer to VVP v1r2.

- Section 8.4: *Verification Plan*, labeled “Section 8.4” in DG-8.2.A. Follow the instructions in Section 8.4 of DG-8.2.A.
    - Identify the work products to be verified and the requirements to be satisfied by each work product selected for verification. The requirements to be satisfied for selected work products are derived requirements that should be consistently documented in the VVP and the RAD. This material should have been presented at the PDR. Adopt the PDR slides and update them to capture updates in VVP v1r2.
    - Describe the verification methods that will be used. The verification methods should be described in as much detail as possible and a rationale for their selection should be provided. Use figures, graphs, examples as warranted. Use multiple slides as necessary for clarity and completeness. Note which verification items will be verified with each method or combination of methods. If feasible, show a matrix obtained from the VVP. This material should have been presented at the PDR. Adopt the PDR slides and update them to capture updates in VVP v1r2.
    - Discuss the inclusion of verification activities in the project plan. These should be documented in the DPP.
        - Show the project plan with verification tasks highlighted.
        - Extract (as bullets) the verification task name, start date, end date, predecessor tasks, and successor tasks from the project plan
        - Note any adjustments in the DPP (usually, schedule and resources) that are needed to accommodate the updated verification plan. Most important: note any risk to milestone dates and impact on successor milestones.
        - This material should have been presented at the PDR. Adopt the PDD slides and update them to capture changes to the verification plan.

- Section 8.5: *Validation Plan*, labeled “Section 8.4” in DG-8.2.A. Follow the instructions in Section 8.5 of DG-8.2.A.
    - Describe the plan for the validation of products. Identify user-driven requirements on the product or products to be validated. These are typically found in the project’s basic requirements, should be documented in the RAD, and should have been discussed in Section 4 of this CDD. For each product component, describe the scope of the validation (e.g., product quality attributes, validation environments, validation campaigns). Distinguish between pre-launch and post-launch plans. This material should have been

presented at the PDR. Adopt the PDR slides and update them to capture updates in VVP v1r2.

- Describe the plan for the validation of operator needs. Identify operator needs (operations and maintenance, or O&M) to be validated. The product or product component must be maintainable and supportable in its intended operational environment. Operator needs are typically found in the project's derived requirements, should be documented in the RAD, and should have been discussed in Section 4 of this presentation. Most operator needs will be generic. Note which needs are specific to the project. Identify the tools and training available for O&M (e.g. Operations Manual, System Maintenance Manual, and Process Assets). For each operator need, describe the scope of the validation. Usually, this will consist of simulations in the operational environment by the intended O&M personnel with the actual O&M tools and training in place. This material should have been presented at the PDR. Adopt the PDR slides and update them to capture updates in VVP v1r2.
- Describe the plan for the validation of user needs. Identify user needs (training, support, use of products) to be validated. These are typically found in the project's derived requirements, should be documented in the RAD, and should have been discussed in Section 4 of this presentation. Many user needs will be generic. Note which needs are specific to the project. Identify the tools, training, and support services available to the user (e.g. External Users Manual) and the procedure for delivering these to the intended users. For each user need, describe the scope of the validation. Usually, this will consist of simulations in a user environment by the intended users and/or beta testers with the actual User tools and training in place. This material should have been presented at the PDR. Adopt the PDR slides and update them to capture updates in VVP v1r2.

4.12. Section 9 – Requirements Allocation

The CDD shall include a Requirements Allocation Section. This section shall include:

- A setup slide, labeled “Section 9 Setup Slide” in DG-8.2.A. This slide is a bulleted list of all 11 sections, with Section 9 highlighted, as shown.

- A Section Title slide, labeled “Slide 9.0” in DG-8.2.A.

- Section 9.1: *Requirements Allocation Overview*, labeled “Section 9.1” in DG-8.2.A.
    - Explain how the requirements allocation is developed during the Design phase of the STAR EPL process. It is recommended that the presenter use the graphic depiction of the iterative (spiral) development of requirements and requirements allocation as shown in “Section 9.1 – Figure 1” in DG-8.2.A. Note the similarity to “Section 4.1 – Figure 2” in DG-8.2.A. The essence of “Section 9.1 – Figure 1” is that the development of Solutions, Design, Requirements, and Requirements Allocation occurs iteratively in a closed loop with continual feedback between the four. The placement of the four components of design development is meant to show that Requirements (Section 4) drive the Solutions and Design (Sections 5 – 8), which in turn develop the Requirements Allocation (Section 9). The connection between Requirements Allocation and Requirements is caused by the need to maintain consistency between the two components.

- Section 9.2: *Requirements Allocation Changes*, labeled “Section 9.2” in DG-8.2.A.
    - List the requirements allocation changes since PDR. List and describe each change, following the instructions in Section 9.2 of DG-8.2.A.

4.13. Section 10 – Risks and Actions

The CDD shall include a Risks and Actions Section. This section shall include:

- A setup slide, labeled “Section 10 Setup Slide” in DG-8.2.A. This slide is a bulleted list of all 11 sections, with Section 10 highlighted, as shown.
- A Section Title slide, labeled “Slide 10.0” in DG-8.2.A.
- Section 10.1: *PDR Risks and Actions*, labeled “Section 10.1” in DG-8.2.A.
    - A section introduction slide should note the number of risks that were identified at the PDR and that were identified after the PDR, as shown in Section 10.1 of DG-8.2.A.
    - Report the status of the first risk identified at the PDR, as shown in Section 10.1 of DG-8.2.A. Use as many slides as necessary for a clear presentation of the status of each risk.
    - Report the status of each completed action that is associated with the risk, as shown in Section 10.1 of DG-8.2.A.
    - Report the status of each open action that is associated with the risk, as shown in Section 10.1 of DG-8.2.A.
    - Repeat for each additional risk, as shown in Section 10.1 of DG-8.2.A.
- Section 10.2: *New Risks and Actions*, labeled “Section 10.2” in DG-8.2.A.
    - Report the status of each risk that has been identified since the PDR, as shown in Section 10.2 of DG-8.2.A. Use as many slides as necessary for a clear presentation of the status of each risk.
    - Report the status of each completed action that is associated with the risk, as shown in Section 10.2 of DG-8.2.A.
    - Report the status of each open action that is associated with the risk, as shown in Section 10.2 of DG-8.2.A.
    - Repeat for each additional risk, as shown in Section 10.2 of DG-8.2.A.

- Section 10.3: *Risk Summary*, labeled “Section 10.3” in DG-8.2.A.
    - Present a bulleted list of the risk statements for the risks that can be closed. Risks can be closed when all associated actions are closed or withdrawn. For each risk, list the associated actions that can be closed or withdrawn. Each of these should have been presented in Sections 10.1 or 10.2 as a completed or withdrawn action. Use multiple slides as necessary for clarity.
    - Present a bulleted list of the risk statements for the risks that are still open. For each risk, list the actions that must be closed to reduce the risk to an acceptable level, with closure plans and estimated closure dates.

4.14. Section 11 – Summary and Conclusions

The CDD shall include a Summary and Conclusions Section. This section shall include:

- A setup slide, labeled “Section 11 Setup Slide” in DG-8.2.A. This slide is a bulleted list of all 11 sections, with Section 11 highlighted, as shown.

- A Section Title slide, labeled “Slide 11.0” in DG-8.2.A.

- Section 11.1: *Review Objectives Status*, labeled “Section 11.1” in DG-8.2.A. This section explains how each review objective has been addressed. Follow the instructions in Section 11.1 of DG-8.2.A.

- Section 11.2: *Issues, Actions and Risks*, labeled “Section 11.2” in DG-8.2.A. List important issues, actions and risks that require attention. Use multiple slides as necessary for clarity. Use a major bullet for each item, with sub-bullets to note conclusions for that item.

- Section 11.3: *Next Steps*, labeled “Section 11.3” in DG-8.2.A. List recommendations for next steps after the CDR. Follow the instructions in Section 11.3 of DG-8.2.A.

- Section 11.4: *Open Discussion*, labeled “Section 11.4” in DG-8.2.A. Announce that the review is open for free discussion. Note: If you have prepared and conducted the review in accordance with standards and if the reviewers have prepared for the review in accordance with standards, there should be no need for additional discussion.

APPENDIX A – TEMPLATE FILE

The slide templates that are referenced in this DG are available in the Microsoft PowerPoint file “STAR_DG-8.2.A_CDD_v3r0.ppt”. This file will be available to authorized users in the STAR EPL PAR.

END OF DOCUMENT