
DESIGN REQUIREMENTS COMPLIANCE MATRIX	Manual Document Page Issue Date	TFC-ENG-DESIGN-C-42, REV A-6	Engineering 1 of 13 November 8, 2016
--	--	-------------------------------------	---

TABLE OF CONTENTS

1.0 PURPOSE AND SCOPE2
2.0 IMPLEMENTATION3
3.0 RESPONSIBILITIES.....3
4.0 PROCEDURE.....3
 4.1 General Requirements.....3
 4.2 Organization of the DRCM.....3
 4.3 Prepare the Preliminary DRCM during the Preliminary/Conceptual Design Phase.....4
 4.4 Preparing and Issuing the DRCM During the Final Design Phase5
 4.5 Preparing and Issuing the Completed DRCM with All Verifications Included.....5
5.0 DEFINITIONS6
6.0 RECORDS6
7.0 SOURCES.....7
 7.1 Requirements7
 7.2 References.....7

TABLE OF FIGURES

Figure 1. Design Requirements Compliance Matrix Process.8

TABLE OF ATTACHMENTS

ATTACHMENT A – WRPS DRCM TABLE INFORMATION9
ATTACHMENT B – DRCM REQUIRED AND SUGGESTED INFORMATION FIELDS10
ATTACHMENT C – REQUIREMENTS SELECTION GUIDANCE12

1.0 PURPOSE AND SCOPE

This procedure describes the steps for developing, updating, reviewing, and issuing the Design Requirements Compliance Matrix (DRCM). The DRCM is a table consisting of design requirements or criteria by row, and compliance information by column.

A DRCM also references Inspections, Tests, Analysis, and Acceptance Criteria that are used to confirm that both design and project requirements are fulfilled. Completion of a DRCM provides confidence that all relative requirements have been fulfilled and that the project may be considered complete (or ready to close). A DRCM contains columns that are used for planning how each requirement will be met by addressing inspections, tests, and analyses as potential methodologies. A DRCM also includes requirements that are more project related than design criteria related. It also tracks various project or design assumptions to verification. The DRCM is a linking or connecting document to track design and project requirements from their inception to completion.

As a minimum, these requirements and/or criteria are developed using TFC-ENG-DESIGN-D-55.1. Implementation of this procedure will require tracking requirements, along with verification methods and acceptance criteria through the engineering, construction, testing, and commissioning stages of a project. Completion of the DRCM table, including the verification input, confirms that the design meets the requirements and has been demonstrated to do so via a structured acceptance methodology.

Full completion of the DRCM table requires integrated project activity extending beyond the engineering discipline. Combined activities among several organizations (engineering, construction, operations, testing, and commissioning) are needed to confirm the functionality of the engineered system or product.

The criteria for determining the need to develop or modify a DRCM shall be as follows unless waived by the concurrence of the Chief Engineer, the Construction & Commissioning Manager, and the Manager of Projects. DRCMs shall be developed for designs/projects that:

- Are Design Types 1 or 2, in accordance with TFC-ENG-DESIGN-C-52
- Add, modify, or delete a technical safety requirement (TSR), limiting condition of operation (LCO), or other safety basis requirements as defined in the Tank Farm Authorization Basis
- Add, modify, or delete multiple operational parameters or interlocks
- Involve significantly different equipment (this includes significantly different interface with the operator or significantly different method to accomplish an objective)
- Add, modify, or delete design features as described in the documented safety analysis (DSA)/TSRs
- Involve multiple engineered systems or disciplines (i.e., piping, instruments, controls, electrical power) with system interactions.
- Involve a DOE O 413.3 project covered by TFC-PRJ-PM-C-02 regardless of safety classification (this excludes maintenance activities and operations' replacement in-kind activities).

- Require Design Verification.

DRCMs may also be developed for any other reason, with concurrence from the Chief Engineer and the Manager of Projects. The intent to prepare a DRCM is to be documented in an execution plan (e.g., Team Execution Plan, Engineering Work Plan) and/or other criteria documentation.

2.0 IMPLEMENTATION

This procedure is effective on the date shown in the header. DRCM Documents that have been prepared or are in process may continue according to the previous revision. Refer to TFC-ENG-DESIGN-C-25 for other implementation considerations such as document numbers, reviews, approvals and document release.

3.0 RESPONSIBILITIES

Responsibilities are contained within Section 4.0.

4.0 PROCEDURE

See Figure 1 for the DCRM process.

4.1 General Requirements

The requirements in the DRCM apply to all DOE O 413.3 projects covered by TFC-PRJ-PM-C-02, regardless of safety classification. (This excludes maintenance activities and operations' replacement in-kind activities.)

The DRCM provides a single point of reference for design requirements which may come from a number of sources such as design specifications that are prepared in accordance with TFC-ENG-DESIGN-C-01. Requirements may come from several sources including Modification Travelers (TFC-ENG-DESIGN-C-56), specifications, standards, and existing Documented Safety Assessment (DSA) assumptions or limits when the design may potentially affect these parameters. Environmental permitting requirements should also be considered. If the design may affect other existing project technical assumptions or limits, these should also be included in the DRCM.

See Attachment C for guidance on how to determine requirements for inclusion into a DRCM.

4.2 Organization of the DRCM

The DRCM is allocated as described in the following bullets, which represent the columns of the matrix (table); however the table may include additional fields and information as needed to assist in organization and tracking of requirements. Attachment A provides an example of the required fields which are:

- Requirement ID: Provides a unique identification tag for each requirement.
- Requirement Source: Provides the specific reference to the requirement in a source document.

- Requirement text: Provides the specific text of the requirement as extracted from the source. When the requirement text is not suitable for extraction, a summary may be made, or reference made as necessary to figures or tables in the source document. This section should include any design assumptions made regarding the requirement.
- Category: To assist in review and planning for project activities needed to verify requirements are met, each requirement should be organized into one of the following categories:
 - Structural systems
 - Piping systems and components
 - Instrumentation and controls
 - Electrical systems
 - Heating, ventilation, and control (HVAC)
 - Chemical processes
 - Radiation protection
 - Emergency planning
 - Environmental compliance
 - Safety and health.
- Inspections, Tests, and Analyses (Verification Method): Identification of the proposed method (inspection, testing, analysis, or some combination of all three) by which the design commitment will be verified. If the analysis method is a design review or calculation include in the table, include the organization(s) which will perform the work.
- Verification Status: Indicates if the verification has been completed.
- Acceptance Criteria: Identify the specific acceptance criteria and basis for the inspections, tests, or analyses used for each requirement that when met will confirm the design requirement/commitment has been demonstrably satisfied.
- Requirement Flowdown: This field is used to document how requirements from upper tier documents are passed down into lower tier requirements document, as well as to subcontractor documents when applicable.
- Verification Documents: This field references the documents and evaluations that contain the information demonstrating the requirements were satisfied; these documents may be items such as test reports, inspection reports, engineering calculations, design reviews, etc. This field should also include the confirmation or closure of design assumptions made for the requirement.

4.3 Prepare the Preliminary DRCM during the Preliminary/Conceptual Design Phase

The preliminary DRCM is prepared during the Preliminary or Conceptual Design Phase and used for project planning for engineering, testing, inspection, and procurement activities as needed to verify the completed design. Thus, it shall be identified as an early deliverable in the Statement of Work. The preliminary DRCM is intended as a tool for project planning among several organizations involved in the overall verification: Engineering, Testing, Commissioning. See Attachment B for more information on populating the DRCM.

- Project Engineer
1. Using the guidance in Attachment C, populate the DRCM with requirements. Organize the requirements into the categories from Section 4.2.
 - Specific and applicable requirements from TOC design standards, level 2 specifications, or other applicable specifications should be extracted and entered into the DRCM.
 2. For each requirement, identify the method or methods that will be used to confirm verification of the design to meet the requirement
 - These methods may be multiple for an individual requirement. A verification method may be an engineering activity such as an analysis; however, verification methods may be produced by other project organizations such as Procurement, Construction, Test Program, and Commissioning. The engineer should engage other project organizations as necessary when defining appropriate verification methods.
 3. For each requirement’s verification method, identify acceptance criteria and document them in the DRCM
 - In developing the acceptance criteria, the engineer should engage other organizations as needed to delineate the acceptance criteria necessary to confirm the design verification method adequately verifies that the design requirement is confirmed in the designed system.
 4. Issue the preliminary DRCM as a document in accordance with TFC-ENG-DESIGN-C-25.

4.4 Preparing and Issuing the DRCM During the Final Design Phase

- Project Engineer
1. Update the DRCM with any additional requirements or information arising during the final design phase.

NOTE: Additional project DRCM updates should be performed as determined by the project engineer or the project engineering manager. Upon decision to update the DRCM, it should be issued as a revision to the engineering document established in Section 4.4.2 in accordance with TFC-ENG-DESIGN-C-25.

2. Issue the DRCM as a revision of the engineering document from Section 4.3.4 in accordance with TFC-ENG-DESIGN-C-25.

4.5 Preparing and Issuing the Completed DRCM with All Verifications Included

- Design Agent
1. Upon completion of the verification activities listed in the DRCM, update the DRCM “Verification” field to include for each

requirement the assessment of results as compared to the acceptance criteria, confirmation that the acceptance criteria were satisfied, and reference to the appropriate documents such as test reports, inspection reports, engineering analyses, etc., where the verification results are documented.

2. Issue the completed DRCM (with confirmed verifications in the “Verification” field) as a revision in accordance with TFC-ENG-DESIGN-C-25. Any “TBDs” or “Holds” necessary on the DRCM should be tracked and managed per TFC-ENG-DESIGN-C-25.

5.0 DEFINITIONS

Acceptance criteria. Refer to the performance, physical condition, or analysis result for a structure, system, or component (SSC), which demonstrates that the design requirement/commitment is met.

Analysis. A calculation, mathematical computation, or engineering/technical evaluation. This definition also includes design review and alternate calculation from the design verification process in TFC-ENG-DESIGN-P-17.

Design requirement/commitment. That portion of the detailed design information provided in the design basis documents that is verified by ITAAC Program as implemented in the DRCM procedure.

Design Requirements Compliance Matrix (DRCM). The design document that contains, for an engineering design, the table of design requirements along with fields (columns) for source document reference, requirement text, verification methods (ITAAC), acceptance criteria for verifications (ITAAC), and documented information and references that the acceptance criteria were met. The DRCM shall contain additional fields to assist in tracking and management of the design verification process. The DRCM is the engineering document that implements the ITAAC program. The DRCM is not a design document.

Inspect or inspection. Visual observations, physical examinations, or reviews of records that compare the SSC condition to one or more design commitments/requirements. Examples include walkdowns, configuration checks, measurements of dimensions, or NDEs.

Test. Actuation or operation, or establishment, of specified conditions to evaluate the performance or integrity of as-built SSCs. Tests included in the DRCM as part of verification of requirements may include technology demonstration tests, factory acceptance tests, construction acceptance tests, qualification tests, component-level, system-level or integrated tests.

6.0 RECORDS

The following records are generated by the performance of this procedure:

- Design Requirements Compliance Matrix (DRCM).

The record custodian identified in the Company Level Records Inventory and Disposition Schedules (RIDS) is responsible for record retention in accordance with TFC-BSM-IRM_DC-C-02.

7.0 SOURCES

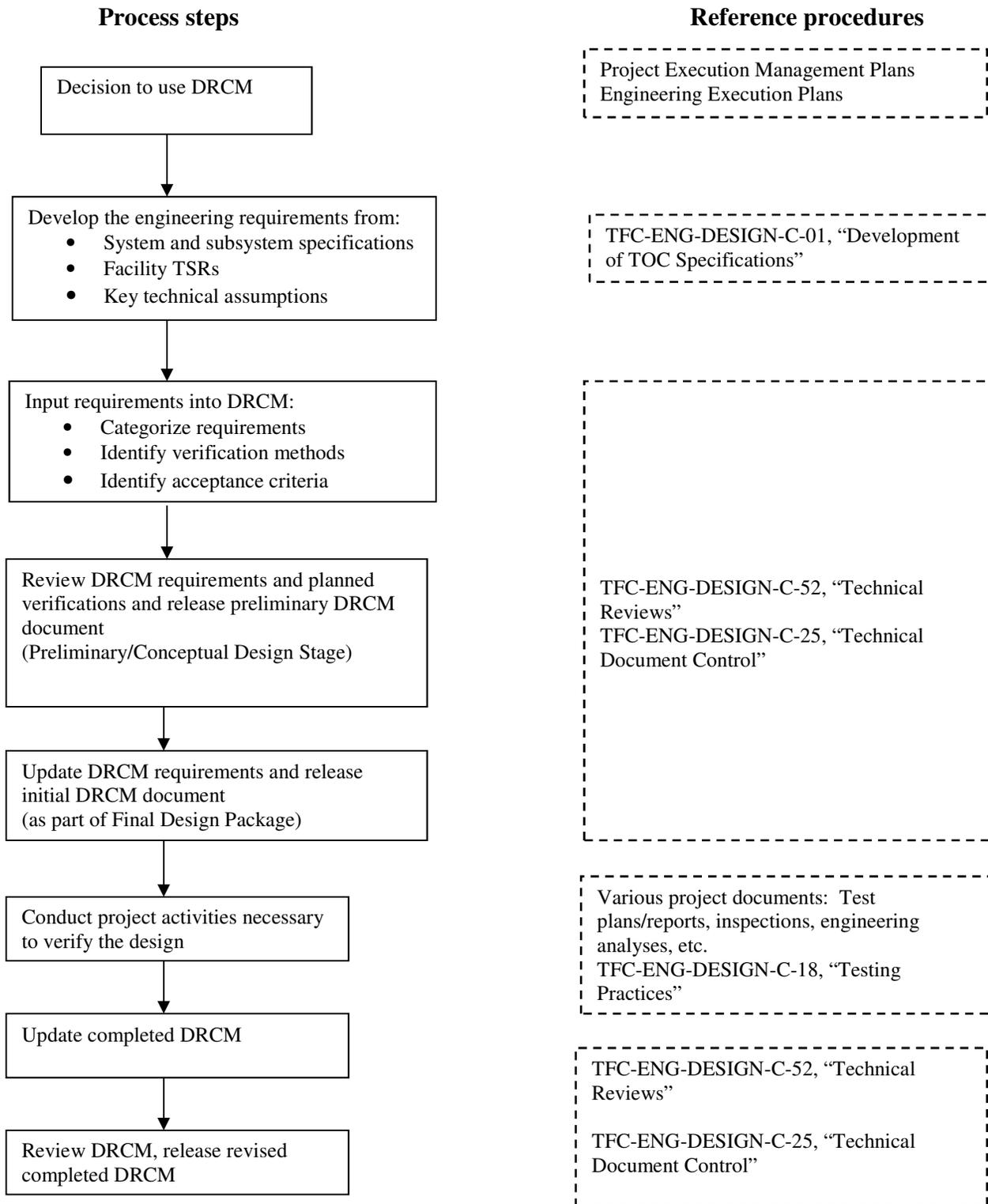
7.1 Requirements

No documents external to this procedure are required for performance.

7.2 References

1. TFC-ENG-DESIGN-C-01, "Development of System and Subsystem Specifications."
2. TFC-ENG-DESIGN-C-18, "Testing Practices."
3. TFC-ENG-DESIGN-C-25, "Technical Document Control."
4. TFC-ENG-DESIGN-C-52, Technical Reviews."
5. TFC-ENG-DESIGN-C-56, "Modification Traveler."
6. TFC-ENG-DESIGN-D-13.2, "Guidance for Applying Engineering Codes and Standards to Design."
7. TFC-ENG-DESIGN-P-17, "Design Verification."
8. TFC-ENG-SB-C-03, "Unreviewed Safety Question Process."
9. TFC-ENG-SB-C-06, "Safety Basis Development."
10. TFC-PRJ-CM-C-02, "Project Management."
11. TFC-PRJ-CM-C-05, "Construction Meetings."
12. TFC-PLN-84, "Tank Operations Contract Project Execution Management Plan."
13. TFC-PLN-98, "Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC) Program Plan."

Figure 1. Design Requirements Compliance Matrix Process.



ATTACHMENT A – WRPS DRCM TABLE INFORMATION

Example DRCM table

Reference: Appendix B, 241-C-200-Series Waste Retrieval System DRCM (Actual DRCM table entries have been modified to include ITAAC fields and format.)

Req ID	Requirement Source	Requirement Text	Category	Verification method (Inspection, test, analyses, design review, or calculation)	Verification status	Acceptance Criteria	Requirement Flowdown	Verification Documents
101	OSD-T-151-0013	Maintain vapor space within limits defined in SST operating specification.	HVAC systems	Design review of report section	Verified	per SST operating specification	NOC AIR 03-704 RPP-15470, Sec 4.2.2.1 RPP-16525	RPP-15252, Sec 2.1 & 2.4 (exhauster set points)
				Qualification testing	Verified	per SST operating specification		C-200-OAT-1.0.1 Rev 0-A
102	RPP-14075, 3.1.2.1	200 Series Tanks in 241-C Tank Farm. The C 200 WRS shall interface with each of the 241-C 200 Series Tanks by means of risers (see drawing H-14-010613, Sheet 3). Risers not in the pit are accessed above grade. The interface point with the risers is generally a standard flange or is defined in the applicable drawings. The C-200 WRS existing risers may be off vertical and/or out of round.	Structural systems	Design review of drawings	Verified	As stated in requirement text	Req # 96812, Sec 16.0	H-14-105283-2 (Riser 011, C-201 thru C-204) H-14-105284-1 (Riser 005, C-201 thru C-204) H-14-105978-1 (Riser 007, C-201 thru C-204) H-14-105995-1,2 (Riser 006, C-201) H-14-105996-1,2 (Riser 006, C-202) H-14-105997-1,2,3,4 (Riser 006, C-203) H-14-105998-1,2 (Riser 006, C-204) H-14-106126-3,4,5,6 (P&IDs for C-201 thru C-204) H-14-106132-1 (Interface Control)
203	TFC-ENG-STD-06	The minimum roof design live load shall be 20 lb/ft ² .	Structural systems	Design review of calculations	Verified	Calculation specifies requirement text as input	N/A	RPP-CALC-200014 Rev. 3

Categories

- | | |
|-------------------------------|--|
| Structural Systems | Heating, Ventilation, and Control (HVAC) |
| Piping Systems and Components | Chemical Processes |
| Instrumentation and Controls | Radiation Protection |
| Electrical Systems | Environmental Compliance |
| | Safety and Health |

ATTACHMENT B – DRCM REQUIRED AND SUGGESTED INFORMATION FIELDS

The following list contains required and suggested table fields (columns) that should be considered for inclusion in the DRCM table, along with supporting information for some of the fields.

Items in Bold are required for the DRCM table:

- **Requirement number:** It is recommended that requirements be uniquely numbered as a standard practice which makes referring to them easier. Unique identification is required if using in a database format which may become desirable for some projects.
- **Requirement source document & section identifier:** Identify the source document of the requirement and the section identifier. (If desired, these can be placed in separate fields.)
- **Requirement text:** Extract the text of the requirement. Include a description of any design assumptions made for this requirement.
- **Categorization:** Identify the relevant engineering discipline to assist in design verification activities.
 - Structural systems
 - Piping systems and components
 - Instrumentation and controls
 - Electrical systems
 - Heating, ventilation, and control (HVAC)
 - Chemical processes
 - Radiation protection
 - Safety and health
 - Emergency planning
 - Environmental compliance.
- **Verification method (analyses, tests, inspections):** Method(s) used to confirm requirement is met. A single requirement may have multiple methods of verification.
- **Verification status:** Provide status whether the verification of the requirement is complete.
- **Acceptance criteria for verification:**
 - In some cases the acceptance criteria is implicitly the same as the requirement wording itself. In such instances it may be appropriate to word that the acceptance criteria is that a document or drawing will be produced and will conclude (or will be confirmed by design review to show) that the requirement has been satisfied. For example a piping requirement may be that a piping system must conform to ASME B31.3 which is a code embodying a substantial body of individual requirements. In such a case, a document is typically produced that provides background analyses for piping and support design. This document may also need to contain, or be supplemented by other documents, that provide documentation that the pipe welds have been inspected per code, that installed piping has been hydro-tested, etc.

ATTACHMENT B – DRCM REQUIRED AND SUGGESTED INFORMATION FIELDS (cont.)

- The previous strategy may apply to other analogous cases. For example, where a design needs to meet structural or seismic codes or requirements, an analysis/calculation may be produced to define mechanical/structural design features, and an inspection may be used to confirm these features exist in the as-built plant as defined on the drawings.
- In other cases, where some items are required to exist or be in some configuration, an acceptance criterion may be identified as being an inspection that confirms the configuration.
- **Requirement flowdown:** This field is used to document how requirements from upper tier documents are passed down into lower tier requirements document, as well as to subcontractor documents when applicable.
- **Verification document(s):** Provide the references to documents where objective evidence is found showing requirements are met per the acceptance criteria.
- **Verification text:** support text providing information regarding the verification.
- **Design review document:** Where applicable, this could contain the design review document number or meeting minutes number for the design review at which the requirement was reviewed and judged to be met.
- Responsible persons or organizations.
- Verification status.
- Closure or confirmation of design assumption.
- Comment/note.

ATTACHMENT C – REQUIREMENTS SELECTION GUIDANCE

The following methodology should be used to select requirements for populating a DRCM. The project engineer should make the determination whether project requirements will be included in the DRCM in addition to design requirements.

1. Select only applicable requirements from all of the following documents if available. Requirements selected from other documents should be “source” requirements; meaning that they do not exist elsewhere in the requirements hierarchy. See Figure C-1 for a description of requirements document hierarchy.
 - a. The A-E Statement of Work (project requirements only)
 - b. The construction/fabrication Statement of Work (project requirements only)
 - c. The Modification Traveler (TFC-ENG-DESIGN-C-56)
 - d. Applicable Level 2 Specification requirements, if not listed in a. or b. (use only low-level requirements that can be directly verified).
 - e. Applicable Standards requirements (TFC-ENG-STD-....)
 - f. Applicable Source Requirements listed in TFC-PLN-98, if not listed in a., b., or c. (project requirements only)

NOTE: There are some non-engineering WRPS standards that contain engineering requirements. Use TFC-ENG-DESIGN-D-13.2 to locate all such standards.

2. Eliminate duplicates by providing multiple references to the requirement source. The engineer may need to make a judgment on whether requirements are duplicate or not since it is possible they may be worded differently.
3. Each requirement should be worded EXACTLY as it is shown in the source document.
4. Each requirement selected should contain words “shall,” “will,” or “must.”
5. Requirements within requirements should NOT be listed (e.g., specific requirements from within B31.3 should not be listed. Only the code itself should be listed as the requirement). Note that there may be multiple methods to confirm a code requirement is met including:
 - a. Inspection of a calculation as having been performed and checked/verified in accordance with the code
 - b. Performance of inspections in accordance with the code.
 - c. Performance of tests (e.g., hydrostatic) in accordance with the code.
 - d. Inspection of weld certifications or procedures in accordance with the code.

6. Do not select requirements that are too high-level. An example of a requirement that is too high level is provided below (from HNF-SD-WM-TRD-007, DST Level 1 Specification).

The DST System shall be capable of transferring waste from one DST to another DST.

While this requirement may be easily verified as stated, it is nearly unusable by a design agent, fabricator, or constructor (e.g., What does “capable” mean?). The specific meaning of this requirement will likely be comprised of many requirements located in lower level specifications or standards and possibly Modification Traveler (TFC-ENG-DESIGN-C-56). This requirement, therefore, cannot be directly verified.

