Quality Assurance Requirements for Nuclear Facility Applications

TENTATIVE
SUBJECT TO REVISION OR WITHDRAWAL
Specific Authorization Required for Reproduction or Quotation
ASME Standards and Certification
|---|---|
| **Section 100: General**  
Controls shall be established to assure that only correct and accepted items are used or installed.  
Identification shall be maintained on the items or in documents traceable to the items, or in a manner that assures that identification is established and maintained. | **Section 100: General**  
Controls shall be established to ensure that only correct and accepted item are used or installed.  
Identification shall be maintained on the items or in documents traceable to the items, or in a manner that ensures identification is established and maintained. |
| **Section 200: Identification Methods**  
**201 Item Identification**  
Items of production (batch, lot, component, part) shall be identified from the initial receipt and fabrication of items up to and including installation and use. This identification shall relate an item to an applicable design or other pertinent specifying document. | **Section 200: Identification Methods**  
**201 Item Identification**  
Items of production (batch, lot, heat, component, computer program\[^1\], part) shall be identified from the initial receipt and fabrication of items up to and including installation and use. This identification shall relate an item to an applicable design or other pertinent specifying document. |
| **Section 200: Identification Methods**  
**202 Physical Identification**  
Physical identification shall be used to the maximum extent possible. Physical identification methods include, but are not limited to, written markings, etching, affixing stickers with bar or quick response (QR) codes, stamping, and tags. Where physical identification on the item is either impractical or insufficient, physical separation, procedural control, or other appropriate means shall be employed. Identification markings shall be applied using materials and methods that provide a clear and legible identification and do not degrade the function or service life of the item. Markings shall be transferred to each part of an identified item when subdivided and shall not be obliterated or hidden by surface treatment or coating unless other means of identification are substituted. | **Section 200: Identification Methods**  
**202 Physical Identification**  
Physical identification shall be used to the maximum extent possible. Physical identification methods include, but are not limited to, written markings, etching, affixing stickers with bar code or quick response (QR) codes, stamping, and tagging, including Radio Frequency Identification tags. Where physical identification on the item is either impractical or insufficient, physical separation, procedural control, or other appropriate means shall be employed. Identification markings shall be applied using materials and methods that provide a clear and legible identification and do not degrade the function or service life of the item. Markings shall be transferred to each part of an identified item when subdivided and shall not be obliterated or hidden by surface treatment or coating unless other means of identification are substituted. |
| **Section 300: Specific Requirements**  
**301 Identification and Traceability of Items**  
When codes, standards, or specifications include specific identification or traceability requirements (such as identification or traceability of the | **Section 300: Specific Requirements**  
**301 Identification and Traceability of Items**  
When codes, standards, or specifications include specific identification or traceability requirements (such as identification or traceability of the item |
item to applicable specification and grade of material; heat, batch, lot, part, or serial number; or specified inspection, test, or other records, the program shall provide such identification and traceability control.

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<tr>
<th>Section 300: Specific Requirements</th>
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<tr>
<td>Section 303 Limited Life Items</td>
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<td>Items having limited calendar or operating life or cycles shall be identified and controlled to preclude use of items whose shelf life or operating life has expired.</td>
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<td>Section 304 Maintaining Identification of Stored Items</td>
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<td>Provisions shall be made for the control of item identification consistent with the planned duration and conditions of storage, such as: (a) provisions for maintenance or replacement of markings and identification records due to damage during handling or aging; (b) protection of identifications on items subject to excessive deterioration due to environmental exposure; (c) provisions for updating existing plant records.</td>
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</table>

* To the extent that computer programs are a physical part of plant systems (e.g., digital reactor protection systems, digital instrumentation), they are included in the term *item*. Refer to Part II, Subpart 2.7, Paragraphs 203, 300, and 407.
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<tr>
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<tr>
<td><strong>Part I – Requirement 10: Inspection</strong></td>
<td><strong>100 GENERAL</strong></td>
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<tr>
<td>Inspections required to verify conformance of an item or activity to specified requirements or continued acceptability of items in service shall be planned and executed. Characteristics subject to inspection and inspection methods shall be specified. Inspection results shall be documented. Inspection for acceptance shall be performed by qualified persons other than those who performed or directly supervised the work being inspected.</td>
<td>Inspections required to verify conformance of an item or activity to specified requirements or continued acceptability of items in service shall be planned and executed. Characteristics subject to inspection and inspection methods shall be specified. Inspection results shall be documented. Inspection for acceptance shall be performed by qualified persons other than those who performed or directly supervised the work being inspected.</td>
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<td><strong>200 INSPECTION REQUIREMENTS</strong></td>
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<td>Inspection requirements and acceptance criteria shall include specified requirements contained in the applicable design documents or other pertinent technical documents approved by the responsible design organization.</td>
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<td><strong>300 INSPECTION HOLD POINTS</strong></td>
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<td>If mandatory inspection hold points are required beyond which work shall not proceed without the specific consent of the designated representative, the specific hold points shall be indicated in appropriate documents. Consent to waive specified hold points shall be recorded prior to continuation of work beyond the designated hold point.</td>
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<tr>
<td><strong>400 INSPECTION PLANNING</strong></td>
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<td><strong>401 Planning</strong></td>
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<td>Characteristics to be inspected, methods of inspection, and acceptance criteria shall be identified during the inspection planning process.</td>
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<tr>
<td><strong>402 Sampling</strong> Sampling procedures, when used, shall be based upon standard statistical methods with engineering approval.</td>
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<td><strong>500 IN-PROCESS INSPECTION</strong> Inspection of items under construction or otherwise in process shall be performed as necessary to verify quality. If inspection of processed items is impossible or disadvantageous, indirect control by monitoring of processing methods, equipment, and personnel shall be provided. When process monitoring is used to verify quality, it shall be performed by qualified personnel independent from the personnel performing the process controls or qualified automated means. Both inspection and process monitoring shall be provided when quality verification is inadequate without both.</td>
<td><strong>500 IN-PROCESS INSPECTION</strong> In-process inspection of items under construction or otherwise in process shall be performed as necessary to verify quality. If inspection of processed items is impossible or disadvantageous, indirect control by monitoring of processing methods, equipment, and personnel shall be provided. When process monitoring is used to verify quality, it shall be performed by qualified personnel independent from the personnel performing the process controls, or by qualified automated means. Both inspection and process monitoring shall be provided when quality verification is inadequate without both.</td>
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<td><strong>600 FINAL INSPECTIONS</strong> <strong>601 Resolution of Nonconformances</strong> Final inspections shall include a records review of the results and resolution of nonconformances identified by prior inspections.</td>
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<td><strong>602 Inspection Requirements</strong> Completed items shall be inspected for completeness, markings, calibration, adjustments, protection from damage, or other characteristics as required to verify the quality and conformance of the item to specified requirements.</td>
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<td><strong>603 Modifications, Repairs, or Replacements</strong></td>
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## Part I – Requirement 10: Inspection

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<td><strong>Any modifications, repairs, or replacements of items performed subsequent to final inspection shall require reinspection or retest, as appropriate, to verify acceptability.</strong></td>
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<td><strong>604 Acceptance</strong>&lt;br&gt;The acceptance of the item shall be approved by authorized personnel.</td>
<td><strong>604 Acceptance (NO CHANGE)</strong>&lt;br&gt;The acceptance of the item shall be approved by authorized personnel.</td>
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<td><strong>700 INSPECTIONS DURING OPERATIONS</strong>&lt;br&gt;Periodic inspections (e.g., in-service inspections) or surveillances of structures, systems, or components shall be planned and executed to ensure the continued performance of their required functions.</td>
<td><strong>700 INSPECTIONS DURING OPERATIONS</strong>&lt;br&gt;Periodic inspections (e.g., in-service inspections) or surveillances of structures, systems, or components shall be planned and executed to ensure the continued performance of their required functions.</td>
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| **800 RECORDS**<br>Appropriate records shall be established, maintained, and, as a minimum, identify the following:  
(a) item inspected  
(b) date of inspection  
(c) inspector  
(d) type of observation  
(e) results or acceptability  
(f) reference to information on action taken in connection with nonconformances | **800 RECORDS**<br>Appropriate records shall be established, maintained, and, as a minimum, identify the following:  
(a) item inspected  
(b) date of inspection  
(c) inspector  
(d) type of observation  
(e) results or acceptability  
(f) reference to any nonconformances identified information on action taken in connection with nonconformances |
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<tr>
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<td><strong>Part I, Requirement 11</strong></td>
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<td>Tests required to collect data such as for siting or design input, to verify conformance of an item or computer program to specified requirements, or to demonstrate satisfactory performance for service shall be planned and executed. Characteristics to be tested and test methods to be employed shall be specified. Test results shall be documented and their conformance with test requirements and acceptance criteria shall be evaluated.</td>
<td>Tests required to collect data such as for siting or design input, to verify conformance of an item or computer program to specified requirements, or to demonstrate satisfactory performance for service shall be planned and executed. Characteristics to be tested and test methods to be employed shall be specified. Test results shall be documented and their conformance with test requirements and acceptance criteria shall be evaluated. Requirements for computer program test requirements, procedures, results, and records are defined in Part II, Subpart 2.7.</td>
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<th>200 TEST REQUIREMENTS</th>
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<td>(a) Test requirements and acceptance criteria shall be provided or approved by the responsible design organization. Required tests (other than for computer programs) including, as appropriate, prototype qualification tests, production tests, proof tests prior to installation, construction tests, preoperational tests, and operational tests shall be controlled. Computer program tests including, as appropriate, software design verification, factory acceptance tests, site acceptance tests, and in use tests shall be controlled. Required tests shall be controlled under appropriate environmental conditions using the tools and equipment necessary to conduct the test in a manner to fulfill test requirements and acceptance criteria. The tests performed shall obtain the necessary data with sufficient accuracy for evaluation and acceptance.</td>
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<td>(b) Test requirements and acceptance criteria shall be based upon specified requirements contained in applicable design documents or other pertinent technical documents that provide approved requirements.</td>
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<td>(c) If temporary changes to the approved configuration of a facility are required for testing purposes, approval by the design authority is required prior to performing the test.</td>
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<td>(a) Test procedures shall include or reference the test configuration and test objectives. Test procedures shall also include provisions for assuring that prerequisites and suitable environmental conditions are met, adequate instrumentation is available and used, appropriate</td>
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tests and equipment are used, and necessary monitoring is performed. Prerequisites shall include the following, as applicable:

1. calibrated instrumentation
2. appropriate equipment
3. trained personnel
4. condition of test equipment and the item to be tested
5. suitable environmental conditions
6. provisions for data acquisition

(b) As an alternative to (a), appropriate sections of related documents, such as ASTM methods, Supplier manuals, equipment maintenance instructions, or approved drawings or travelers with acceptance criteria, may be used. Such documents shall include or be supplemented with appropriate criteria from (a) to assure adequate procedures for the test are used.

### 400 COMPUTER PROGRAM TEST PROCEDURES

Requirements for computer program test procedures are defined in Part II, Subpart 2.7.

### 500 TEST RESULTS

Test results shall be documented and maintained. Test results shall be evaluated by the responsible authority to ensure that test requirements have been satisfied.

### 600 TEST RECORDS

Test records shall be established and maintained to indicate the ability of the item or computer program to satisfactorily perform its intended function or to meet its documented requirements. Test records vary depending on the test type, purpose, and application, but shall contain the following information, as a minimum, for the specified application identified in paras. 601 and 602 of this Requirement.

- item tested
- date of test
- tester or data recorder
- type of observation
- results and acceptability
- action taken in connection with any deviations
- person evaluating test results
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<tr>
<th>602</th>
<th>Computer Program Test Records</th>
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<td>Requirements for computer program test records are defined in <strong>Part II, Subpart 2.7.</strong></td>
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<th>PART I, Req. 13 ASME NQA-1–2022</th>
<th>New Proposed changes</th>
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<td><strong>100 GENERAL</strong> Handling, storage, cleaning, packaging, shipping, and preservation of items shall be controlled to prevent damage or loss and to minimize deterioration. These activities shall be conducted in accordance with established work and inspection instructions, drawings, specifications, shipment instructions, or other pertinent documents or procedures specified for use in conducting the activity.</td>
<td><strong>100 GENERAL</strong> Handling, storage, cleaning, packaging, shipping, and preservation of items shall be controlled to prevent damage or loss and to minimize deterioration. These activities shall be conducted in accordance with established work and inspection instructions, drawings, specifications, shipment instructions, or other pertinent documents or procedures specified for use in conducting the activity.</td>
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<td><strong>200 SPECIAL REQUIREMENTS</strong> When required, special equipment (such as containers, shock absorbers, and accelerometers) and special protective environments (such as inert gas atmosphere, specific moisture content levels, and temperature levels) shall be specified and provided and their existence verified.</td>
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<td><strong>300 PROCEDURES</strong> When required for critical, sensitive, perishable, or high-value items, specific procedures for handling, storage, packaging, shipping, and preservation shall be used.</td>
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<td><strong>400 TOOLS AND EQUIPMENT</strong> Special handling tools and equipment shall be utilized and controlled where necessary to ensure safe and adequate handling. Special handling tools and equipment shall be inspected and tested in accordance with procedures at specified time intervals or prior to use.</td>
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<td><strong>500 OPERATORS</strong> Operators of special handling and lifting equipment shall be experienced or trained in the use of the equipment.</td>
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<td><strong>600 MARKING OR LABELING</strong> Marking or labeling shall be utilized as necessary to adequately maintain and preserve the item, including indication of the presence of special environments or the need for special controls.</td>
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### 100 GENERAL

Audits shall be performed to verify compliance to quality assurance program requirements, to verify that performance criteria are met, and to determine the effectiveness of the program. These audits shall be performed in accordance with written procedures or checklists by personnel who do not have direct responsibility for performing the activities being audited. Audit results shall be documented and reported to and reviewed by responsible management. Follow-up actions shall be taken where indicated.

### 200 Scheduling

Audits shall be scheduled in a manner to provide coverage and coordination with ongoing activities, based on the status and importance of the activity. Scheduled audits shall be supplemented by additional audits of specific subjects when necessary to provide adequate coverage.

A grace period of 90 days may be applied to scheduled audits and annual evaluations of supplier performance. When the grace period is used, the next scheduled date for the activity shall be based on the activity schedule date and not on the date the activity was actually performed. If the activity is performed early, the next schedule date shall be based on the date the activity was actually performed.

### 201 Internal Audits

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Except where specific regulatory guidance exists or code restrictions apply, organizations shall audit internal activities at the following intervals.

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<tr>
<th>Section</th>
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<tr>
<td>201.1</td>
<td><strong>Nuclear Facilities Prior to Placing the Facility into Operation.</strong>&lt;br&gt;All applicable quality assurance program elements shall be audited at least once each year or at least once during the life of the activity, whichever is shorter.</td>
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<tr>
<td>201.2</td>
<td><strong>Nuclear Facilities After Placing the Facility into Operation.</strong>&lt;br&gt;All applicable quality assurance program elements for each functional area shall be audited within a period of 2 yr. For well-established activities, the period may be extended 1 yr at a time beyond the 2-yr interval based on the results of an annual evaluation of the applicable functional area and objective satisfactorily accomplished. However, the internal audit interval shall not exceed a maximum of 4 yr.</td>
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<tr>
<td>201.3</td>
<td><strong>Supplier and Other Nuclear Support Organizations.</strong>&lt;br&gt;All applicable quality assurance program elements shall be audited at least once each year or at least once during the life of the activity whichever is shorter. This interval may be extended up to 2 yr based on the results of an annual evaluation and objective evidence that the activities are being satisfactorily accomplished in accordance with the applicable quality assurance program elements.</td>
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<td>202</td>
<td><strong>External Audits</strong></td>
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No Change
External audits (e.g., Supplier Audits) shall be performed on a triennial basis and supplemented by annual evaluations of the Supplier’s performance to determine if the regular schedule audit frequency shall be maintained or decreased or if other corrective action is required. A continuous or ongoing evaluation of the Supplier’s performance may be conducted in lieu of the annual evaluations, provided that the results are reviewed in order to determine if corrective action is required.

### 300 PREPARATION

#### 301 Audit Plan

The auditing organization shall develop an audit plan for each audit. This plan shall identify the audit scope, requirements, audit personnel, activities to be audited, organizations to be notified, applicable documents, schedule, and written procedures or checklists.

The plan shall be approved by the Lead Auditor or responsible management.

#### 302 Personnel

Audit personnel shall have sufficient authority and organizational freedom to make the audit process meaningful and effective.

No Change

#### 303 Selection of Audit Team

An audit team shall be identified prior to the beginning of each audit. This team shall contain one or more Auditors, one being designated Lead Auditor who organizes and directs the audit. The audit team shall have experience or training commensurate with the scope, complexity, or special nature of the activities to be audited.

No Change

### 400 PERFORMANCE

No Change
Elements selected for audit shall be evaluated against specified requirements. Objective evidence shall be examined to the depth necessary to determine if these elements are being implemented effectively. Conditions requiring prompt corrective action shall be reported immediately to management of the audited organization.

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| The audit report shall be signed or otherwise endorsed by the Lead Auditor and issued to the audited organization. The contents of the report shall  
  (a) describe the audit scope  
  (b) identify Auditors and persons contacted  
  (c) summarize audit results, including a statement on the effectiveness of the elements audited.  
  (d) describe each audit finding |

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<th>600 RESPONSE</th>
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<td>Management of the audited organization or activity shall investigate audit findings, schedule corrective action, including measures to prevent recurrence of significant conditions adverse to quality, and notify the appropriate organizations in writing of action taken or planned. Audit responses shall be evaluated by or for the auditing organization.</td>
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<th>700 FOLLOW-UP ACTION</th>
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<td>Follow-up action shall be taken to verify that corrective action is accomplished as scheduled.</td>
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| 800 RECORDS                  | No Change                |
Audit records shall include audit plans, audit reports, written replies, and the record of completion of corrective action.
### 100 GENERAL

This Subpart provides amplified requirements for packaging, shipping, receiving, storage, and handling of nuclear facility items. Controls identified within this Subpart shall be applied to maintain acceptable equipment condition. This Subpart supplements the requirements of Part I and shall be used in conjunction with applicable sections of Part I when and to the extent specified by the organization invoking this Subpart.

### 101 Definitions

The following definitions are provided to ensure a uniform understanding of unique terms as they are used in this Subpart.

- **barrier**: a material designed to withstand the penetration of water, water vapor, grease, or harmful gases.
- **carrier**: the transporting agency.
- **classification**: the organization of items according to their susceptibility to damage during shipping, receiving, and storage only. It does not relate to the function of the item in the completed system.
- **dynamic load test**: a test wherein designated loads are hoisted, rotated, or transported through motions and accelerations required to simulate handling of the intended item.
- **storage**: the act of holding items in storage facilities.
- **storage facilities**: warehouse, yard, or other areas designated and prepared for holding of items.
- **transportation mode**: a method identified by the conveyance used for transportation of items and includes any motor vehicles, ships, railroad cars, or aircraft. Each cargo-carrying body (trailer, van, boxcar, etc.) is a separate vehicle.
- **wrap**: a flexible material formed around the item or package to exclude solid contaminants and to facilitate handling, marking, or labeling.

### 200 GENERAL REQUIREMENTS

Measures shall be established and implemented for the packaging, shipping, receiving, storage, and handling of specified items to be incorporated in nuclear facilities.

### New Proposed changes

This Subpart provides amplified requirements for packaging, shipping, receiving, storage, and handling of nuclear facility items. Controls identified within this Subpart shall be applied to maintain acceptable equipment condition. This Subpart supplements the requirements of Part I and shall be used in conjunction with applicable sections of Part I when and to the extent specified by the organization invoking this Subpart.

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The following definitions are provided to ensure a uniform understanding of unique terms as they are used in this Subpart.

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- **carrier**: the transporting agency.
- **classification**: the organization of items according to their susceptibility to damage during shipping, receiving, and storage only. It does not relate to the function of the item in the completed system.
- **dynamic load test**: a test wherein designated loads are hoisted, rotated, or transported through motions and accelerations required to simulate handling of the intended item.
- **storage**: the act of holding items in storage facilities.
- **storage facilities**: warehouse, yard, or other areas designated and prepared for holding of items.
- **transportation mode**: a method identified by the conveyance used for transportation of items and includes any motor vehicles, ships, railroad cars, or aircraft. Each cargo-carrying body (trailer, van, boxcar, etc.) is a separate vehicle.
- **wrap**: a flexible material formed around the item or package to exclude solid contaminants and to facilitate handling, marking, or labeling.

### 200 GENERAL REQUIREMENTS

Measures shall be established and implemented for the
and for the inspection, testing, and documentation to verify conformance to specified requirements.

### 201 Classification of Items

Requirements are divided into four levels with respect to protective measures to prevent damage, deterioration, or contamination of the items based upon the important physical characteristics, and not upon the important functional characteristics of the item with respect to safety reliability.

It should be recognized however, that within the scope of each level there may be a range of controls, and that the detailed requirements for an item are dependent on the importance of the item to safety reliability.

For example, even though a reactor vessel and structural steel are classified as Level D, the degree of protection and control over the reactor vessel should exceed that of the structural steel. Each of the specific items governed by this Subpart shall be classified into one of these four levels by the buyer or the contractor.

The manufacturer’s documented standard or minimum requirements shall be considered when classifying the items. Items, once classified at a level, shall be restricted to that level or a higher level for each of the packaging, shipping, receiving, storage, and handling operations. Any package unit or assembly made up of items of different levels shall be classified to the highest level designated for any of the respective items. If the unit is disassembled, a level shall be indicated for each part. Items covered by this Subpart shall be categorized under the following levels.

| Packaging, shipping, receiving, storage, and handling of specified items to be incorporated in nuclear facilities, and for the inspection, testing, and documentation to verify conformance to specified requirements. |

<table>
<thead>
<tr>
<th>201 Classification of Items</th>
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201.1 Level A. Items classified to Level A are those that are exceptionally sensitive to environmental conditions and require special measures for protection from one or more of the following effects: temperatures outside required limits; sudden temperature changes; humidity and vapors; accelerating forces; physical damage; airborne contamination (e.g., rain, snow, dust, dirt, salt spray, fumes).

Types of items to be categorized under this classification level are
(a) special electronic/electrical equipment and instrumentation
(b) special materials, such as chemicals, that are sensitive to environmental conditions
(c) special nuclear material and sources
The requirements of the NRC fuel license and conditions and of other governmental agencies shall be met.

201.2 Level B. Items classified to Level B are those that are sensitive to environmental conditions and require measures for protection from the effects of temperature extremes, humidity and vapors, accelerating forces, physical damage, and airborne contamination, and do not require special protection required for Level A items.

Types of items to be categorized under this classification level are
(a) electronic equipment and instrumentation
(b) electrical equipment
(c) batteries
(d) welding electrode and wire (welding electrodes hermetically sealed in metal containers may be stored under conditions described for Level C, unless other storage requirements are specified by the manufacturers)
(e) control rod drives
(f) motor control centers, switchgear, and control panels
(g) motors and generators
(h) precision machine parts
(i) spares, such as gaskets, O-rings
(j) air-handling filters
(k) computers

Items covered by this Subpart shall be categorized under the following levels.

201.1 Level A. Items classified to Level A are those that are exceptionally sensitive to environmental conditions and require special measures for protection from one or more of the following effects: temperatures outside required limits; sudden temperature changes; humidity and vapors; accelerating forces; physical damage; airborne contamination (e.g., rain, snow, dust, dirt, salt spray, fumes).

Types of items to be categorized under this classification level are
(a) special electronic/electrical equipment and instrumentation
(b) special materials, such as chemicals, that are sensitive to environmental conditions
(c) special nuclear material and sources
The requirements of the NRC fuel license and conditions and of other governmental agencies shall be met.

201.2 Level B. Items classified to Level B are those that are sensitive to environmental conditions and require measures for protection from the effects of temperature extremes, humidity and vapors, accelerating forces, physical damage, and airborne contamination, and do not require special protection required for Level A items.

Types of items to be categorized under this classification level are
(a) electronic equipment and instrumentation
(b) electrical equipment
(c) batteries
(d) welding electrode and wire (welding electrodes hermetically sealed in metal containers may be stored under conditions described for Level C, unless other storage requirements are specified by the manufacturers)
(e) control rod drives
(f) motor control centers, switchgear, and control panels

(g) motors and generators
(h) precision machine parts
(i) spares, such as gaskets, O-rings
(j) air-handling filters
(k) computers
**201.3 Level C.** Items classified to Level C are those that require protection from exposure to the environment, airborne contamination, acceleration forces, and physical damage. Protection from water vapor and condensation is not as important as for Level B items.

Types of items to be categorized under this classification level are:
- (a) pumps
- (b) valves
- (c) fluid filters
- (d) reactor internals
- (e) compressors
- (f) auxiliary turbines
- (g) instrument cable (unjacketed)
- (h) refueling equipment
- (i) thermal insulation
- (j) fans and blowers
- (k) cement
- (l) fabricated fuel rods and assemblies

**201.4 Level D.** Items classified to Level D are those that are less sensitive to the environment than those for Level C. These items require protection against the weather, acceleration forces, airborne contamination, and physical damage.

Types of items to be categorized under this classification level are:
- (a) tanks
- (b) heat exchangers and parts
- (c) accumulators
- (d) demineralizers
- (e) reactor vessel
- (f) evaporators
- (g) steam generators
- (h) pressurizers
- (i) piping
- (j) electrical cable (jacketed)
- (k) structural items
- (l) reinforcing steel
- (m) aggregates

**300 PACKAGING**

**301 General**

This section contains the requirements for packaging of items for protection against corrosion, contamination, physical damage, or any effect that would lower the quality or cause the items to deteriorate during the time they are shipped, handled, and stored. The degree of protection specified will vary according to conditions.
and duration of storage, shipping environment, and handling conditions. Implementation of this section is accomplished by identifying the item and the appropriate packaging level, and then applying the appropriate criteria contained herein concerning cleaning, preservatives, desiccants, inert gas blankets, cushioning, caps and plugs, barrier and wrapping materials, tapes, blocking and bracing, containers, marking, other quality assurance provisions, and documentation. When more than one type of item is included in a package (such as equipment shipped with related parts like seals, gaskets, lubricants, or mounting hardware), precautions shall be taken to ensure smaller items are not introduced into openings or cavities of larger parts or equipment.

302 Levels of Packaging
The packaging requirements shall be based on the protection that is necessary during shipping, handling, and storage of the item to satisfy Levels A, B, C, and D protection requirements set forth below. The requirements herein are intended to be in addition to industry classifications or tariff rules for rail, truck, air, and water shipments and regulatory agency rules already established in the transportation industry; and in no way are they intended to reduce the minimum standards established by these regulatory agency rules.

The following packaging criteria are divided into four levels corresponding to the classification categories of para. 201 of this Subpart.

302.1 Level A Items. Level A items require the highest degree of protection and shall conform to the following...
### 302.1 Level A Items. Level A items require the highest degree of protection and shall conform to the following criteria:

<table>
<thead>
<tr>
<th>Criteria</th>
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<tr>
<td>(a) Package design requirements shall be for extraordinary environmental protection to avoid the deleterious effects of shock and vibration, to control temperature or humidity within specified limits, or for any other special requirements.</td>
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<tr>
<td>(b) Items shall have been inspected for cleanliness immediately before packaging. Dirt, oil residue, metal chips, or other forms of contamination shall have been removed by approved cleaning methods. Any entrapped water shall have been removed.</td>
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<tr>
<td>(c) Items that are not immediately packaged shall be protected from contamination.</td>
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<tr>
<td>(d) Items requiring protection from water vapor, salt air, dust, dirt, and other forms of contamination penetrating the package shall be packaged with a barrier.</td>
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<tr>
<td>(e) Items that can be damaged by condensation trapped inside the package shall be packaged with approved desiccant inside the sealed waterproof and vaporproof barrier or by an equivalent method.</td>
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<tr>
<td>(f) All openings into items shall be capped, plugged, or sealed. Weld end preparations shall be protected against corrosion and physical damage.</td>
</tr>
<tr>
<td>(g) Items packed in containers shall be blocked, anchored, braced, or cushioned to prevent physical damage to the item or barrier.</td>
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<tr>
<td>(h) Items and their container shall be identified by marking.</td>
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</table>

### 302.2 Level B Items. Level B items require a high degree of protection, and the package shall be designed to avoid the deleterious effects of shock, vibration, physical damage, water vapor, salt spray, condensation, and weather during shipping, handling, and storage. This packaging shall be equivalent to that for Level A, except that the package design requirements need not be as stringent.
302.3 Level C Items. Level C items require protection from exposure to salt spray, rain, dust, dirt, and other contaminants. Protection from water vapor and condensation is less important than for Level B items. The following criteria shall apply:

(a) Criteria (b), (c), (e), (g), (h), and (i) for Level A items (para 302.1 of this Subpart) shall apply to Level C items.

(b) Items shall be packaged with a waterproof barrier so that water, salt spray, dust, dirt, and other forms of contamination do not penetrate the item.

(c) Items subject to detrimental corrosion, either internal or external, shall be suitably protected.

302.4 Level D Items. Level D items require protection from physical and mechanical damage. The following criteria shall apply:

(a) Items, just before packaging, shall have been inspected for cleanliness according to the requirements specified in the purchasing document. Dirt, oil residue, metal chips, or other forms of contamination shall have been removed by approved cleaning methods. Any entrapped water shall have been removed.

(b) All openings into items shall be capped, plugged, and sealed. Weld end preparations shall be protected from corrosion and physical damage.

(c) Items subject to detrimental contamination or to avoid the deleterious effects of shock, vibration, physical damage, water vapor, salt spray, condensation, and weather during shipping, handling, and storage. This packaging shall be equivalent to that for Level A, except that the package design requirements need not be equivalent to satisfy the level of extraordinary environmental protection indicated in para. 302.1(a) of this Subpart where such protection is not justified. Shipment of Level B items in fully enclosed vehicles or equivalent protective enclosure or packaging is acceptable, provided the above-stated high degree of protection for Level B items is maintained throughout shipment, and the shipment goes through to destination in the original vehicle and Level B storage facilities are available on site. If transfer becomes necessary to transit, transfer procedures shall be subject to purchaser acceptance.
corrosion, either internal or external, shall be suitably protected.  
(d) Items packed in containers shall be blocked, braced, or cushioned to prevent damage.  
(e) The identity of the item shall be maintained by marking or other appropriate means.

<table>
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<th>303 Cleaning</th>
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| Cleaning includes the preparation of items for preservation or packaging, or both, to minimize the requirements for site cleaning. Items shall be inspected for cleanliness immediately before packaging according to the cleaning requirements specified in the procurement documents. Any dirt, oil residue, metal chips, or other forms of contamination shall be removed by documented cleaning methods. Any entrapped water shall be removed. The following general criteria shall apply as part of the manufacturing specifications for cleaning procedures:  
(a) The cleaning process, including cleaning compounds chosen, shall in no way damage the item during cleaning or subsequent service when considering the composition, surface finish, complexity, or other inherent features, or other interface equipment after installation.  
(b) The cleaning process or processes chosen shall remove loose mill and heat scale, oil, rust, grease, paint, welding fluxes, chalk, abrasives, carbon deposits, coatings used for nondestructive testing processes, and other contaminants that would render ineffective the specified in the purchasing document. Dirt, oil residue, metal chips, or other forms of contamination shall have been removed by approved cleaning methods. Any entrapped water shall have been removed.  
(b) All openings into items shall be capped, plugged, and sealed. Weld end preparations shall be protected from corrosion and physical damage.  
(c) Items subject to detrimental contamination or corrosion, either internal or external, shall be suitably protected.  
(d) Items packed in containers shall be blocked, braced, or cushioned to prevent damage.  
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(b) The cleaning process or processes chosen shall remove loose mill and heat scale, oil, rust, grease, paint, welding fluxes, chalk, abrasives, carbon deposits, coatings used for nondestructive testing processes, and
method or preservation and packaging or other specified requirements.

(c) Item surfaces after cleaning shall be free of cleaning media, such as aluminum oxide, silica, grit, cleaning cloth residual, chemical cleaning residue, and petroleum solvent residue, etc.

(d) After cleaning, the item shall be protected from contamination until preservation or packaging is complete.

304 Methods of Preservation
Items subject to deleterious corrosion shall be protected by using either contact preservatives, inert gas blankets, or vaporproof barriers with desiccants.

304.1 Contact Preservations. Contact preservatives are compounds applied to bare metal surfaces to prevent surface corrosion during shipping and storage and generally require removal prior to installation. The following criteria shall be used when considering the type of contact preservative to be used:

(a) The contact preservative shall be compatible with the material on which it is applied.

(b) Contact preservatives that are nondrying shall require a neutral greaseproof protective wrap when packaged.

(c) The procedure for applying contact preservatives shall not require disassembly of the item nor shall it be necessary to disassemble the item at the site for complete removal. An exception would be for long-term storage protection to be agreed upon by the Owner, Buyer, and Manufacturer.

(d) The method of contact preservative removal shall be accomplished with approved solvents and wiping cloths, or by flushing internal cavities with solvents that are not deleterious to the item or other interconnecting material. However, preservatives for inaccessible inside surfaces of pumps, valves, and piping for systems containing reactor coolant water shall be the water-flushable type.

(e) The name of the preservative used shall be provided to facilitate touch-up.

(f) When motors, pumps, turbines, etc., are shipped with oil reservoirs and bearing cavities filled with preservative oil, the item shall be so tagged and instructions for draining, flushing, refilling, and periodic rotation shall be included with the item.

(g) When it is anticipated that the item might require an extended storage period (6 months or longer), a preservative needed for the long-term protection of the item shall be applied or arrangements shall be made to periodically other contaminants that would render ineffective the method or preservation and packaging or other specified requirements.

(c) Item surfaces after cleaning shall be free of cleaning media, such as aluminum oxide, silica, grit, cleaning cloth residual, chemical cleaning residue, and petroleum solvent residue, etc.

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(d) The method of contact preservative removal shall be accomplished with approved solvents and wiping cloths, or by flushing internal cavities with solvents that are not deleterious to the item or other interconnecting material.
304.2 Inert Gas Blankets. Purging and pressurizing the interior of an item or its container, or both, with a dry inert gas provides a means of preventing moisture or corrosive atmospheres from acting on sensitive, bare metal surfaces or other materials. The item or its container shall be either evacuated prior to filling with the inert gas or adequately purged with the same gas prior to applying the gas blanket. When inert gas blankets are used, the following criteria shall apply:

(a) Inert gas blankets shall be used only when the exterior shell of the item or its container can be tightly sealed or an inert gas blanket can otherwise be maintained.
(b) Only dry, oil free, inert gas shall be used.
(c) Provisions shall be made for measuring and maintaining the blanket pressure within the required range and within each pressurized purged item or container. Closures and seals, when used to maintain a static pressure, shall be tightly secured so that the absolute pressure (by mass) after final seal is maintained for 24 hr, without adding gas, prior to shipping the item from the manufacturer’s plant.
(d) The item or container shall be marked in bold letters cautioning that an inert gas blanket has been used. The required pressure range also shall be marked on the item or container.

(e) The name of the preservative used shall be provided to facilitate touch-up.
(f) When motors, pumps, turbines, etc., are shipped with oil reservoirs and bearing cavities filled with preservative oil, the item shall be so tagged and instructions for draining, flushing, refilling, and periodic rotation shall be included with the item.
(g) When it is anticipated that the item might require an extended storage period (6 months or longer), a preservative needed for the long-term protection of the item shall be applied or arrangements shall be made to periodically reapply the preservatives.
305 Caps, Plugs, Tapes, and Adhesives
These items shall be of materials that enable them to perform their intended function adequately, without causing deleterious effects on the items or system operation.

305.1 Caps and Plugs. Caps and plugs shall be used to seal openings in items having sensitive internal surfaces and to protect threads and weld end preparations. Caps and plugs shall conform to the following criteria:
(a) Nonmetallic plugs and caps shall be brightly or contrastingly colored. Clear plastic closures are not to be used except when specified for a special purpose, e.g., as a window for humidity indicator cards. Special attention shall be given in the control of these closures.
(b) Metallic plugs and caps contacting metal surfaces shall not cause galvanic corrosion at the contact areas. Gasketing or other nonmetallic materials used in conjunction with metallic caps or plugs shall exhibit no corrosive effect on the material.
(c) Simplicity of installation, inspection, and removal without damage to the item shall be considered.
(d) Provisions shall be made to preclude the plug or cap from falling into or being pushed into the opening after its installation.
(e) All plugs and caps shall be clean and free of visible contamination such as, but not limited to, dust, dirt, stains, rust, discoloration, or scale.
(f) Plugs and caps used in contact with austenitic stainless steel or nickel alloys shall be made from nonhalogenated materials or stainless steel.

(by mass) after final seal is maintained for 24 hr, without adding gas, prior to shipping the item from the manufacturer’s plant.
(d) The item or container shall be marked in bold letters cautioning that an inert gas blanket has been used. The required pressure range also shall be marked on the item or container.

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(c) Simplicity of installation, inspection, and removal without damage to the item shall be considered.
(d) Provisions shall be made to preclude the plug or cap from falling into or being pushed into the opening after its installation.
(e) All plugs and caps shall be clean and free of visible contamination such as, but not limited to, dust, dirt, stains, rust, discoloration, or scale.
(g) Plugs and caps used in contact with austenitic stainless steel or nickel alloys shall be made from nonhalogenated materials or stainless steel.
(h) Caps and plugs shall be clearly visible, e.g., not painted over, during production processes. Caps and plugs that have been painted over shall be replaced or otherwise be made clearly visible.

305.2 Tapes and Adhesives. Pressure-sensitive, removable tape shall be used in lieu of adhesives in contact with bare metal surfaces. Tapes or adhesives that could have damaging effects on the item or system shall not be used. Tapes near a weld shall be removed completely, immediately prior to performing a weld. Tapes used for identification rather than sealing that are not near a welding operation may remain until system testing is complete, but shall be removed before facility operations unless qualified for operating conditions. Tapes and adhesives shall conform to the following criteria:

(a) When contacting austenitic stainless steel and nickel alloy surfaces
   (1) tapes shall not be compounded from, or treated with chemical compounds containing elements in such quantities that harmful concentrations are leachable, or that they could be released by breakdown under expected environmental conditions and could contribute to intergranular cracking or stress corrosion cracking, such as those containing fluorides, chlorides, sulfur, lead, zinc, copper, and mercury [paperbacked (masking) tape shall not be used]
   (2) upon removal of tape, all residual adhesive shall be removed by wiping with a nonhalogenated solvent (acetone, alcohol, or equal)
   (3) starch, silicone, and epoxy tape material may be used for tape adhesive

(b) When contacting other surfaces and containers
   (1) tapes and adhesives used to seal nonaustenitic materials, nickel alloys, or containers are not subject to the above restrictions
   (2) tape shall be impervious to water and not subject to cracking or drying out if exposed to sunlight, heat, or cold
   (3) When used on surfaces of items, tapes shall be visibly distinguishable from the materials on which they are used.

(g) Plugs and caps used in contact with austenitic stainless steel or nickel alloys shall be made from nonhalogenated materials or stainless steel.

(h) Caps and plugs shall be clearly visible, e.g., not painted over, during production processes. Caps and plugs that have been painted over shall be replaced or otherwise be made clearly visible.
Material thickness shall be selected on the basis of type, size, and weight of equipment or item to be protected, such that the barrier or wrap will not easily be damaged by puncture, abrasion, weathering, cracking, temperature extremes, wind conditions, and the like. Barrier and wrap materials shall be noncorrosive and shall not be otherwise harmful to the item packaged. When barrier and wrap materials are used in direct contact with austenitic stainless steels, the total and water leachable content of halogen shall not be harmful to the item packaged. Also, barrier and wrap materials shall not readily support combustion. Vaporproof barrier materials used with desiccants constitute another preservation system that protects against potential damage by water vapor condensate.

306.1 Waterproof Barrier Material. Waterproof barrier material shall be resistant to grease and water; it shall protect items from airborne and windblown soils.

306.2 Vaporproof Barrier Material. Vaporproof barrier materials shall be sealable, and the edge of the barrier that normally will be opened at destination shall be of sufficient area to permit at least two subsequent sealing operations. When maximum vapor protection is required, barrier material shall meet the maximum water vapor transmission rate of 0.05 g/100 in.2 per (acetone, alcohol, or equal)

(3) starch, silicone, and epoxy tape material may be used for tape adhesive

(b) When contacting other surfaces and containers

(1) tapes and adhesives used to seal nonaustenitic materials, nickel alloys, or containers are not subject to the above restrictions

(2) tape shall be impervious to water and not subject to cracking or drying out if exposed to sunlight, heat, or cold

(c) When used on surfaces of items, tapes shall be visibly distinguishable from the materials on which they are used.

306 Barrier and Wrap Materials and Desiccants

Material thickness shall be selected on the basis of type, size, and weight of equipment or item to be protected, such that the barrier or wrap will not easily be damaged by puncture, abrasion, weathering, cracking, temperature extremes, wind conditions, and the like. Barrier and wrap materials shall be noncorrosive and shall not be otherwise harmful to the item packaged. When barrier and wrap materials are used in direct contact with austenitic stainless steels, the total and water leachable content of halogen shall not be harmful to the item packaged.

Also, barrier and wrap materials shall not readily support combustion. Vaporproof barrier materials used with desiccants constitute another preservation system that protects against potential damage by water vapor condensate.
5 Year Review of Subpart 2.2

24 hr required by ASTM E96, Test Methods for Water Vapor Transmission of Materials, Procedure E, and shall be packaged with an approved desiccant. Vaporproof barrier material should be colored to contrast with the material on which it is used.

306.3 Desiccants. Desiccants shall be used within a vaporproof barrier when condensation or high humidity could damage an item by corrosion, mold, or mildew. Desiccants shall consist of nondeliquescent, nondusting, chemically inert, dehydrating agents. The following criteria shall apply:

(a) The desiccant bag shall be made of puncture-, tear-, and burst-resistant material.
(b) When used with austenitic stainless steel and nickel alloy materials, tapes, desiccants, and the materials for the desiccant bag shall not be compounded from or treated with chemical compounds containing elements in such quantities that harmful concentrations are leachable, or they could be released by breakdown under expected environmental conditions and could contribute to intergranular cracking or stress corrosion cracking, such as those containing fluorides, chlorides, sulfur, lead, zinc, copper, and mercury.
(c) The reactivation temperature and time shall be marked on the desiccant container.
(d) Canisters used to contain desiccants shall be placed so as to cause no deleterious effects such as galvanic corrosion, even when the desiccant has reached its absorptive capacity for water vapor.
(e) Desiccant bags and canisters, when used, shall be securely to prevent movement, rupture of the bags, or damage to the item being protected.
(f) Waterproof and vaporproof barriers shall be used to seal items containing desiccants. The included air volume within the barrier shall be kept to a minimum.
(g) Items that contain desiccants shall have all openings securely sealed. When flange connections are a part of the barriers, O-rings or gaskets shall be used with all bolts in place and tightened sufficiently to ensure a waterproof and vaporproof seal. Weld end preparations, after barrier that normally will be opened at destination shall be of sufficient area to permit at least two subsequent sealing operations. When maximum vapor protection is required, barrier material shall meet the maximum water vapor transmission rate of 0.05 g/100 in.2 per 24 hr required by ASTM E96, Test Methods for Water Vapor Transmission of Materials, Procedure E, and shall be packaged with an approved desiccant. Vaporproof barrier material should be colored to contrast with the material on which it is used.

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(a) The desiccant bag shall be made of puncture-, tear-, and burst-resistant material.
(b) When used with austenitic stainless steel and nickel alloy materials, tapes, desiccants, and the materials for the desiccant bag shall not be compounded from or treated with chemical compounds containing elements in such quantities that harmful concentrations are leachable, or they could be released by breakdown under expected environmental conditions and could contribute to intergranular cracking or stress corrosion cracking, such as those containing fluorides, chlorides, sulfur, lead, zinc, copper, and mercury.
(c) The reactivation temperature and time shall be marked on the desiccant container.
(d) Canisters used to contain desiccants shall be placed so as to cause no deleterious effects such as galvanic corrosion, even when the desiccant has reached its absorptive capacity for water vapor.
(e) Desiccant bags and canisters, when used, shall be
capping, shall be covered with a waterproof and vaporproof seal.

(h) Packages and items containing desiccants shall be marked. The total number of separate bags or containers of desiccants in the package shall be indicated.

(i) The minimum quantity of desiccant for use in each package shall be determined in accordance with Formula I or Formula II, as applicable.

(1) Formula I: to determine minimum units of desiccant for use with other than sealed rigid metal barrier:

$$U = 1.6A + XD (1)$$

(2) Formula II: to determine minimum units of desiccant for use with sealed rigid metal barrier:

$$U = KV + XD (2)$$

where

- $A$ = area of barrier, ft$^2$ (m$^2 \times 0.0929$)
- $D$ = dunnage (other than metal) within barrier, lb (kg $\times 2.2$)
- $K = 0.0007$ when volume is given in in.$^3$
  \[= 1.2 \text{ when volume is given in ft}^3\]
  \[= 0.0000425 \text{ when volume is given in cm}^3 \text{ (42.5 in m}^3)\]
- $U =$ number of units of desiccant to be used (see Note)
- $V =$ volume within barrier in in.$^3$ or ft$^3$ (cm$^3$ or m$^3$)
- $X =$ for hair felt, cellulosic material (including wood), and other material not categorized below
  \[= 6 \text{ for bound fibers (animal hair, synthetic fiber, or vegetable fiber bound with rubber)}\]
  \[= 2 \text{ for glass fiber}\]
  \[= 0.5 \text{ for synthetic foams and rubber}\]

NOTE: A desiccant unit is that quantity of desiccant, as received, that will absorb at equilibrium with air at 78°F (25°C) at least the following quantities of water vapor: 3.00 g at 20% relative humidity and 6.00 g at 40% relative humidity.

secured to prevent movement, rupture of the bags, or damage to the item being protected.

(f) Waterproof and vaporproof barriers shall be used to seal items containing desiccants. The included air volume within the barrier shall be kept to a minimum.

(g) Items that contain desiccants shall have all openings securely sealed. When flange connections are a part of the barriers, O-rings or gaskets shall be used with all bolts in place and tightened sufficiently to ensure a waterproof and vaporproof seal. Weld end preparations, after
(j) A humidity indicator, shall be included in every waterproof and vaporproof envelope containing desiccant. As applicable, the indicator shall be located behind inspection windows or immediately within the closing edge, face, or cover of the barrier and, as far as practical, from the nearest unit of desiccant to provide an effective warning of excessive moisture.

### 307 Containers, Crating, and Skids

#### 307.1 Containers

Containers shall be used when maximum protection for the item or its barrier is required. Container types shall include, but not be limited to, the following:

- (a) cleated, sheathed boxes [500 lb (227 kg) maximum net weight]
- (b) nailed, screwed, or bolted wood boxes
- (c) wood-cleated solid fiberboard boxes
- (d) metal or fiber drums
- (e) crates
- (f) wire-bound boxes [200 lb (91 kg) maximum net weight]
- (g) other specially designed containers for special equipment
- (h) fiberboard boxes [120 lb (54.5 kg) maximum net weight]. The following criteria shall apply for fiberboard boxes used as exterior containers:
  1. Boxes shall be weather-resistant fiberboard preferably from the grade types (or compliance symbol): V2 s, V3 s, or V3 c (ASTM D5118 and ASTM D1974).
  2. Box style shall be RSC regular slotted box (outer flaps meet, inner flaps and outer flaps are of equal length).
  3. Fiberboard boxes shall be securely closed with a water-resistant adhesive applied to the entire area of contact between the flaps. All seams and joints shall be further sealed with not less than 2 in. (5 cm) wide, water-resistant tape.
  4. Boxes shall be strapped with pressure-sensitive reinforced tape, lengthwise (top, bottom, and ends), girthwise (top, bottom, and sides), and horizontal sides and ends.
  5. Wood cleating on fiberboard boxes shall be fabricated from structurally sound, seasoned or treated lumber. Cleated boxes in excess of 50 lb (22.7 kg) shall
be bound with steel strapping, or equivalent, around the container at not less than two places.

307.2 Crates and Skids. Crates or skids shall be used for equipment in excess of 500 lb (227 kg). Skids or runners shall be used on crates with a gross weight of 100 lb (45.5 kg) or more, allowing a minimum floor clearance for forklift tines as provided by 4 in. (10 cm) lumber.

308 Cushioning, Blocking, Bracing, and Anchoring

308.1 Cushioning. Cushioning shall be used where protection from shock and vibration is required. The cushioning materials shall have sufficient strength to perform this function. Selection of cushioning material shall be based on the following:
(a) It shall exhibit no corrosive effect when in contact with the item being cushioned.
(b) It shall have low moisture content and exhibit low moisture absorption properties, or if the cushioning material has some moisture-absorbing capacity, the item shall be protected with a water-vaporproof barrier.
(c) It shall have negligible dusting characteristics.
(d) It shall not readily support combustion.

308.2 Blocking and Bracing. Blocking and bracing used for protection of the load to be supported shall

(2) Box style shall be RSC regular slotted box (outer flaps meet, inner flaps and outer flaps are of equal length).
(3) Fiberboard boxes shall be securely closed with a water-resistant adhesive applied to the entire area of contact between the flaps. All seams and joints shall be further sealed with not less than 2 in. (5 cm) wide, water-resistant tape.
(4) Boxes shall be strapped with pressure-sensitive reinforced tape, lengthwise (top, bottom, and ends), girthwise (top, bottom, and sides), and horizontal sides and ends.
(5) Wood cleating on fiberboard boxes shall be fabricated from structurally sound, seasoned or treated lumber. Cleated boxes in excess of 50 lb (22.7 kg) shall be bound with steel strapping, or equivalent, around the container at not less than two places.

308.2 Crates and Skids. Crates or skids shall be used for equipment in excess of 500 lb (227 kg). Skids or runners shall be used on crates with a gross weight of 100 lb (45.5 kg) or more, allowing a minimum floor clearance for forklift tines as provided by 4 in. (10 cm) lumber.

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(5) Wood cleating on fiberboard boxes shall be fabricated from structurally sound, seasoned or treated lumber. Cleated boxes in excess of 50 lb (22.7 kg) shall be bound with steel strapping, or equivalent, around the container at not less than two places.
be compatible with the size, shape, and strength of bearing areas of the shipment. The blocking and bracing used to prevent item movement shall withstand thrust and impact applied in any direction. Blocking and bracing used in direct contact with the item being blocked shall not have a corrosive effect on the item. (c) It shall have negligible dusting characteristics. (d) It shall not readily support combustion.

308.2 Blocking and Bracing. Blocking and bracing used for protection of the load to be supported shall be compatible with the size, shape, and strength of bearing areas of the shipment. The blocking and bracing used to prevent item movement shall withstand thrust and impact applied in any direction. Blocking and

308.3 Anchoring. Anchoring of the item within a crate or on a skid shall adequately fasten the item during shipment and protect the item from potential damage due to rough handling. When bolts are used for anchoring, the following criteria shall apply:
(a) If precision bolt holes in the item are used for anchoring, precaution shall be taken to ensure that properly fitting bolts of the correct dimension and characteristics are used to prevent marring or elongation of the holes.
(b) Holes bored through containers or mounting bases shall provide a snug fit.
(c) When mounting items to container bases equipped with skids, bolts shall be extended through the skids whenever practical. In such instances, countersinking of the bolts in the sliding surface of the skid shall be done.
(d) Washers shall be used under the nuts to decrease the possibility of the bolt pulling through the wood.
(e) Nuts shall be properly tightened. To prevent their loosening during shipment, locknuts, lock washers, cotter pins, or staking shall be employed.
Temporary cushioning, blocking, bracing, or anchoring placed on an item for shipping protection that needs to be removed prior to operation of the item shall be identified by warnings placed in a conspicuous manner to affect proper removal of the packing material.
309 Marking

(a) To maintain proper identification and instructions, or both, during shipping, receiving, and storage and to provide for identification after the outside of the container has been removed, the item and the outside of the containers shall be marked. If equipment does not lend itself to marking, records shall be maintained that are uniquely identifiable to the item.

(b) Items shall be marked to preserve identity in accordance with the following criteria:

1. The specified identification shall be stamped, etched, stenciled, or otherwise marked on the item or on tags to be affixed securely to the item in plain, unobstructed view. When metal stamps are employed, low stress stamps shall be used when the item proper is marked. When vibrating marking tools are used, they shall be fitted with carbide marking tip or its equivalent, and shall be designed to provide a rounded impression not to exceed 0.010 in. (0.25 mm) in depth. Etching, including electrochemical etching on nickel alloys, weld areas, or sensitized areas of stainless steel, may only be used, provided appropriate cleaning is performed of etching solutions. Electric-arc marking pencils shall not be used.

2. The marking shall neither be deleterious to the material nor violate any other section of this Subpart.

3. When tags are employed, they shall be of a material that will retain the marking, withstand weathering deterioration, and other normal shipping and handling effects, and shall not be detrimental to the item.

4. The English language shall be used. Duplicate marking may be made in other languages.

5. References to weights shall be in avoirdupois or System International (SI) units. Duplicate markings in other systems may also be indicated.

6. Markings on the outside container shall be in accordance with the following criteria:

   1. Container markings shall appear on a minimum of two sides of a container, preferably on one side and one end.

   2. The English language shall be used. Duplicate marking may be made in other languages or in pictorial marking according to ISO Recommendation R780, Pictorial Markings for Handling of Goods (General Symbols) or ASTM D5445.

   3. References to weights shall be in avoirdupois or System International (SI) units. Duplicate markings in other systems may also be indicated.

   4. Container markings shall be applied with waterproof ink or paint in characters that are legible. When information relative to handling and special instructions is required, such information shall be preceded by the word CAUTION in letters that are at least 1/2 in. (12.7 mm), as permitted by container size.

   5. Where tags or labels are used, they shall be affixed to the container using a waterproof adhesive, tacks where practical, or a corrosion-resistant wire.

   6. Container markings shall include the following:

      - Temporary cushioning, blocking, bracing, or anchoring placed on an item for shipping protection that needs to be removed prior to operation of the item shall be identified by warnings placed in a conspicuous manner to affect proper removal of the packing material.

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3. When tags are employed, they shall be of a material that will retain the marking, withstand weathering deterioration, and other normal shipping and handling effects, and shall not be detrimental to the item.

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5. References to weights shall be in avoirdupois or System International (SI) units. Duplicate markings in other systems may also be indicated.

6. Markings on the outside container shall be in accordance with the following criteria:

   1. Container markings shall appear on a minimum of two sides of a container, preferably on one side and one end.

   2. The English language shall be used. Duplicate marking may be made in other languages or in pictorial marking according to ISO Recommendation R780, Pictorial Markings for Handling of Goods (General Symbols) or ASTM D5445.

   3. References to weights shall be in avoirdupois or System International (SI) units. Duplicate markings in other systems may also be indicated.

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   5. Where tags or labels are used, they shall be affixed to the container using a waterproof adhesive, tacks where practical, or a corrosion-resistant wire.

   6. Container markings shall include the following:

      - Temporary cushioning, blocking, bracing, or anchoring placed on an item for shipping protection that needs to be removed prior to operation of the item shall be identified by warnings placed in a conspicuous manner to affect proper removal of the packing material.
information:

- (a) destination
- (b) return address
- (c) package numbers showing the purchase order number, followed by the package number and the total number of packages
- (d) material identification number
- (e) handling instructions (e.g., Fragile, Center of Gravity, Keep Dry, This Side Up, Sling Here, Do Not Freeze)

and stacking limitations, as appropriate

- (f) weight of package [in excess of 100 lb (45.5 kg)]
- (g) special instructions (Desiccant Inside, Remove Items Packaged Inside Prior to Installation, Remove Caps and Plugs Prior to Installation, Special Inspection, Storage, Unpacking Restrictions, etc.) as appropriate; if items are repackaged for storage, provisions shall be made for retention or transfer of the special instructions

(d) Marking of items not within a container, such as pipe, tanks, and heat exchangers, shall exhibit specified information in a location that is in plain unobstructed view. Marking may be applied directly to bare metal surfaces, provided it has been established that the marking material is not deleterious to the item.

(4) The English language shall be used. Duplicate marking may be made in other languages.
(5) References to weights shall be in avoirdupois units. Duplicate markings in other systems may also be indicated.

(c) Markings on the outside container shall be in accordance with the following criteria:

(1) Container markings shall appear on a minimum of two sides of a container, preferably on one side and one end.
(2) The English language shall be used. Duplicate marking may be made in other languages or in pictorial marking according to ISO Recommendation R780, Pictorial Markings for Handling of Goods (General Symbols) or ASTM D5445.
(3) References to weights shall be in avoirdupois or System International (SI) units. Duplicate markings in other systems may also be indicated.
(4) Container markings shall be applied with waterproof ink or paint in characters that are legible. When information relative to handling and special instructions is required, such information shall be preceded by the word CAUTION in letters that are at least 1/2 in. (12.7 mm), as permitted by container size.
(5) Where tags or labels are used, they shall be affixed to the container using a waterproof adhesive, tacks where practical, or a corrosion-resistant wire.

(6) Container markings shall include the following information:

- (a) destination
- (b) return address
- (c) package numbers showing the purchase order number, followed by the package number and the total number of packages
- (d) material identification number
- (e) handling instructions (e.g., Fragile, Center of Gravity, Keep Dry, This Side Up, Sling Here, Do Not Freeze)

and stacking limitations, as appropriate

- (f) weight of package [in excess of 100 lb (45.5 kg)]
400 SHIPPING

401 General
This section covers the requirements for loading and shipment of items as defined in para. 201 of this Subpart. The mode of transportation used shall be consistent with the protection classification of the item and with the packaging methods employed. Special shipping instructions from the manufacturer, approved alternatives should be addressed while meeting the requirements of section 400 of this Subpart.

402 Transportation Requirements

402.1 Open Carriers. For shipment on open carriers where items may be exposed to adverse environmental conditions, the following shall apply:
(a) Levels A, B, and C items shall be covered for protection from environmental conditions. Tarpaulins, when used, shall be fire retardant, and they shall be installed in a manner to provide drainage and to ensure air circulation to prevent condensation.
(b) Barrier and wrapped materials subject to transportation damage shall be covered with waterproof shrouds, such as tarpaulins, so that they are not exposed directly to the environment.

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This section covers the requirements for loading and shipment of items as defined in para. 201 of this Subpart. The mode of transportation used shall be consistent with the protection classification of the item and with the packaging methods employed. Special shipping instructions from the manufacturer, approved alternatives should be addressed while meeting the requirements of section 400 of this Subpart.

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(a) Levels A, B, and C items shall be covered for protection from environmental conditions. Tarpaulins, when used, shall be fire retardant, and they shall be installed in a manner to provide drainage and to ensure air circulation to prevent condensation.
402.2 Closed Carriers. For shipment on closed carriers, the following shall apply:
When Levels A, B, and C items cannot be adequately protected from weather or environment on open carriers, closed carriers or fully enclosed vehicles shall be used.

402.3 Special Shipments. Items that exceed established weight or size limitations for railroads or highways or require special handling shall be given additional consideration in the following areas:
(a) The type of bracing and tie-down methods to be used with the mode of transportation selected for special shipments shall be specified.
(b) NO HUMPING shall be specified on rail shipments of these items, and NO HUMPING signs shall be prominently displayed.
(c) Use of impact recording devices shall be specified on shipments of heavy or relatively large items incorporating delicate factory-installed instrumentation. Devices, when specified, shall be installed prior to loading (to record any rough handling during loading). Procedures shall be established to interpret recorded data and to thoroughly check the integrity of an item when there is evidence of rough handling. A notice that impact recording devices are being used shall be prominently displayed.
(d) For special shipments, the conveyance used for transport shall be certified to be structurally adequate to take the loads imposed during loading, while en route, and during unloading. Prior to shipment, the route shall have been investigated to ensure safe transit.

(b) Barrier and wrapped materials subject to transportation damage shall be covered with waterproof shrouds, such as tarpaulins, so that they are not exposed directly to the environment.

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(d) For special shipments, the conveyance used for transport shall be certified to be structurally adequate to take the loads imposed during loading, while en route, and during unloading. Prior to shipment, the route shall have been investigated to ensure safe transit.
403 Precautions During Loading and Transit

403.1 Loading. The weight, lifting points, or center of gravity indicated by the shipper on the crate, skid, or package by the shipper shall be utilized to ensure proper handling during loading, transfer between carriers, and unloading.

403.2 Rigging. Carbon steel rigging equipment shall not come in direct contact with stainless steel, except when attached to lifting lugs, eyes, or pads in order to avoid surface damage.

403.3 Handling Precautions. All austenitic stainless steel and nickel-base alloy materials shall be handled in such a manner that they are not in contact with lead, zinc, copper, mercury, or other low melting point elements, carbon steel, alloys, or halogenated material having a water-leachable content harmful to the material.

403.4 Package and Preservative Coatings. Package or preservative coatings shall be visually inspected after loading and damaged areas repaired prior to shipment. Items shipped with desiccants shall be inspected after loading to ensure that sealed areas are intact.

403.5 Sealed Openings. Sealed openings shall be visually inspected after loading to ensure closures are intact. Materials used for resealing shall be in accordance with section 300 of this Subpart.

403.6 Stacking. Where special care is deemed necessary to avert damage, written instructions concerning the location or stacking limits for crates or boxes shall be marked on the containers.

403.7 Theft and Vandalism. Precautions shall be taken to minimize the possibility of theft and vandalism during shipment of items.
404 Identification and Markings
Identification and markings on the outside of all packages, skids, or protective covering shall be maintained.

405 Nuclear Material Shipments
Special nuclear material and sources shall be shipped as specified in the NRC fuel license and by other regulatory agencies.

500 RECEIVING
501 General
This section covers the requirements that shall be fulfilled by the organization(s) responsible for the receiving of items. Receiving starts when the items arrive at a storage facility or construction site before unloading or unpacking.

502 Receiving Inspection Requirements
502.1 Shipping Damage Inspection. Preliminary visual inspection shall be performed prior to or immediately after unloading to determine if any damage occurred during shipping. Observations for unusual conditions shall include the following:
(a) fire: charred paper, wood, or paint, indicating exposure to fire or high temperature
(b) excessive exposure: weather-beaten, frayed, rusted, or stained containers, indicating prolonged exposure during transit
(c) environmental damage: water or oil marks, damp conditions, dirty areas, or salt film, indicating exposure to sea water or winter road salt chemicals
(d) tie-down failure: shifted, broken, loose, or twisted shipping ties, and worn material under ties, indicating improper blocking and tie down during shipment
(e) rough handling: splintered, torn, or crushed containers, indicating improper handling
(f) review of impact recording device readings against established criteria
(g) review of humidity recording data against established criteria

403.7 Theft and Vandalism. Precautions shall be taken to minimize the possibility of theft and vandalism during shipment of items.

404 Identification and Markings
Identification and markings on the outside of all packages, skids, or protective covering shall be maintained.

405 Nuclear Material Shipments
Special nuclear material and sources shall be shipped as specified by the Regulatory Authority having jurisdiction.
502.2 Item Inspection

(a) Unless the package marking prohibits unpacking, the contents of all shipments shall be visually inspected to verify that the specified packaging and shipping requirements have been maintained. When items are contained in transparent, separate, moistureproof bags or envelopes, visual inspection without unpacking the contents shall be acceptable. Where specific inspection requirements can be achieved, statistical sampling methods may be used for groups of similar items. Care shall be taken to avoid contamination of the items during inspection. The inspection shall be performed in an area equivalent to the level of storage requirement for the item. If an appropriate area is not available, the inspection shall be performed in a manner and environment that does not endanger the required quality of the item. These inspections and examinations shall include the following, as appropriate:

(1) identification and marking: verification that identification and markings are in accordance with applicable codes, specifications, purchase orders, and drawings, and with requirements in this Part (Part II).

(2) manufacturing documentations: assurance that the item received was fabricated, tested, and inspected prior to shipment in accordance with applicable code, specification, purchase order, or drawings.

(3) protective covers and seals: visual inspection to ensure that covers and seals meet their intended function.

(4) coatings and preservatives: verification that coatings and preservatives are applied in accordance with specifications, purchase orders, or manufacturer’s instructions.

(5) inert gas blanket: verification that the inert gas blanket pressure is within the acceptable limits.

(6) desiccant: verification that the desiccant is not saturated, as indicated, through the use of humidity indicators. Desiccants shall be regenerated or replaced as necessary in accordance with special instructions.

(7) physical damage: visual inspection to ensure that parts of items are not broken, cracked, missing, deformed, or misaligned, and that rotating parts turn without binding. Accessible internal and external areas shall be free of detrimental gouges, dents, scratches, and burrs.

(8) cleanness: visual inspection to ensure that accessible internal and external areas are within the specification requirements for dirt, soil, mill scale, weld splatter, oil, grease, or stains. If inspection for cleanness was performed prior to sealing and shipping, and inspection upon receipt indicates that there has been no penetration of the sealed boundary, then inspection for internal cleanness is optional.

improper blocking and tie down during shipment

e rough handling: splintered, torn, or crushed containers, indicating improper handling

(f) review of impact recording device readings against established criteria

(g) review of humidity recording data against established criteria

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(1) identification and marking: verification that identification and markings are in accordance with applicable codes, specifications, purchase orders, and drawings, and with requirements in this Part (Part II).

(2) manufacturing documentations: assurance that the item received was fabricated, tested, and inspected prior to shipment in accordance with applicable code, specification, purchase order, or drawings.

(3) protective covers and seals: visual inspection to ensure that covers and seals meet their intended function.

(4) coatings and preservatives: verification that coatings and preservatives are applied in accordance with specifications, purchase orders, or manufacturer’s instructions.
(b) Unless the completed item was inspected at the source it shall be inspected upon receipt to verify that the following characteristics conform to the specified requirements.

These inspections shall include such items as

1. Physical properties: assurance that physical properties conform to the specified requirements and that chemical and physical test reports, if required, meet the requirements
2. Dimensions: random visual inspection to ensure that important dimensions conform with drawings and specifications, i.e., baseplate mounting holes, overall external size, and configuration and orientation of parts
3. Weld preparations: random verification that weld preparations are in accordance with applicable drawings and specifications
4. Workmanship: visual inspection of accessible areas to ensure that the workmanship is satisfactory to meet the intent of the requirements
5. Lubricants and oils: verification of presence of proper lubricants and oils, if required, by either specification, coatings and preservatives are applied in accordance with specifications, purchase orders, or manufacturer’s instructions.
6. Inert gas blanket: verification that the inert gas blanket pressure is within the acceptable limits.
7. Desiccant: verification that the desiccant is not saturated, as indicated, through the use of humidity indicators. Desiccants shall be regenerated or replaced as necessary in accordance with special instructions.
8. Physical damage: visual inspection to ensure that parts of items are not broken, cracked, missing, deformed, or misaligned, and that rotating parts turn without binding. Accessible internal and external areas shall be free of detrimental gouges, dents, scratches, and burrs.
9. Cleanness: visual inspection to ensure that accessible internal and external areas are within the specification requirements for dirt, soil, mill scale, weld splatter, oil, grease, or stains. If inspection for cleanness was performed prior to sealing and shipping, and inspection upon receipt indicates that there has been no penetration of the sealed boundary, then inspection for internal cleanness is optional.

(b) Unless the completed item was inspected at the source by the purchaser or the purchaser’s representative, it shall be inspected upon receipt to verify that the following characteristics conform to the specified requirements.

These inspections shall include such items as

1. Physical properties: assurance that physical properties conform to the specified requirements and that chemical and physical test reports, if required, meet the requirements
2. Dimensions: random visual inspection to ensure that important dimensions conform with drawings and specifications
502.3 Special Inspection. Where receiving inspection in addition to that described above is required, the special inspection procedure, complete with documentation instructions, shall be attached to the item or container. This is in addition to the copy sent through normal channels. The special inspection shall be performed, and the results of the inspection shall be documented.

503 Disposition of Received Items

503.1 Acceptable. Containers and items inspected and found in conformance with specified requirements shall be identified as acceptable and placed in a storage area for acceptable items, or moved to the final location for installation or use.

503.2 Nonconforming. Items that do not conform to the specified requirements shall be controlled in accordance with Part I, Requirement 15 of this Standard.

503.3 Conditional Release. If the nonconformance that caused the item to be classified unacceptable can be corrected after installation, the item may be released for installation on a conditional release basis. A statement documenting the authority and technical justification for the Conditional Release of the item for installation shall be prepared and made part of the documentation.
### 504 Status-Indicating System

A status-indicating system is a system or method for identifying the status of items (e.g., an inventory management system, tagging, labeling, color coding, etc.) that clearly indicates whether items are acceptable or unacceptable for installation.

A controlled physical separation is an acceptable equivalent method. The system shall provide for indication of the date the item was placed in the acceptable or unacceptable installation status and the conditional release of the items for installation pending the subsequent correction of the nonconformance.

When tags are used, the stock shall be made from material that will not deteriorate during storage. The stock used shall not be deleterious to the item. Tags shall be securely affixed to the items and displayed in an area that is readily accessible.

### 505 Marking

Changing, correcting, or any other marking on nameplates shall be prohibited, unless authorized by the manufacturer of the item.

### 506 Documentation

A written record of the receiving inspection, package identification, tagging, corrective actions, and justification for conditional acceptance shall be prepared.

### 600 STORAGE

#### 601 General

601.1 Scope. This section contains requirements that shall be fulfilled by the organization responsible for performing the storage of items. Levels and methods of storage are defined to minimize the possibility of damage or lowering of quality due to corrosion, contamination, deterioration, or physical damage from the time an item is stored upon receipt until the time the item is for installation on a conditional release basis. A statement documenting the authority and technical justification for the Conditional Release of the item for installation shall be prepared and made part of the documentation.

A status-indicating system **shall be used for identifying the status of items** (e.g., an inventory management system, tagging, labeling, color coding, etc.). **The system shall clearly indicate** whether items are acceptable or unacceptable for installation.

A controlled physical separation is an acceptable equivalent method. The system shall provide for indication of the date the item was placed in the acceptable or unacceptable installation status and the conditional release of the items for installation pending the subsequent correction of the nonconformance.

When tags are used, the stock shall be made from material that will not deteriorate during storage. The stock used shall not be deleterious to the item. Tags shall be securely affixed to the items and displayed in an area that is readily accessible.

### 505 Marking

Changing, correcting, or any other marking on nameplates shall be prohibited, unless authorized by the manufacturer of the item.

### 506 Documentation

A written record of the receiving inspection, package identification, tagging, corrective actions, and justification for conditional acceptance shall be prepared.

### 600 STORAGE

#### 601 General
removed from storage and placed in its final location. Special storage instructions from the manufacturer, if specified, shall be addressed as part of the storage process for both short- and long-term storage of items.

601.2 Levels of Storage. Environmental conditions for items classified as Levels A through D shall meet the requirements as described in the following paragraphs:

(a) Level A items shall be stored under special conditions similar to those described for Level B items but with additional requirements such as temperature and humidity control within specified limits, a ventilation system with filters to provide an atmosphere free of dust and harmful vapors, and any other appropriate requirements.

(b) Level B items shall be stored within a fire-resistant, tear-resistant, weather-tight, and well-ventilated building or equivalent enclosure. Precautions shall be taken against vandalism. This area shall be situated and constructed so that it will not be subject to flooding; the floor shall be paved or equal, and well drained. Items shall be placed on pallets or shoring to permit air circulation. The area shall be provided with uniform heating and temperature control or its equivalent to prevent condensation and corrosion. The minimum temperature shall be 40°F (5°C), and the maximum temperature shall be 140°F (60°C) or less if so stipulated by the manufacturer.

(c) Level C items shall be stored indoors or in an equivalent environment with all provisions and requirements as set forth for Level B items, except that heat and temperature control is not required.

(d) Level D items may be stored outdoors in an area marked and designated for storage that is well drained, preferably gravel covered or paved, and reasonably removed from the actual construction area and traffic so that the possibility of damage from construction equipment is minimized. Items shall be stored on cribbing or equivalent to allow for air circulation and to avoid trapping water.

601.1 Scope. This section contains requirements that shall be fulfilled by the organization responsible for performing the storage of items. Levels and methods of storage are defined to minimize the possibility of damage or lowering of quality due to corrosion, contamination, deterioration, or physical damage from the time an item is stored upon receipt until the time the item is removed from storage and placed in its final location. Special storage instructions from the manufacturer, if specified, shall be addressed as part of the storage process for both short- and long-term storage of items.

601.2 Levels of Storage. Environmental conditions for items classified as Levels A through D shall meet the requirements as described in the following paragraphs:

(a) Level A items shall be stored under special conditions similar to those described for Level B items but with additional requirements such as temperature and humidity control within specified limits, a ventilation system with filters to provide an atmosphere free of dust and harmful vapors, and any other appropriate requirements.

(b) Level B items shall be stored within a fire-resistant, tear-resistant, weather-tight, and well-ventilated building or equivalent enclosure. Precautions shall be taken against vandalism. This area shall be situated and constructed so that it will not be subject to flooding; the floor shall be paved or equal, and well drained. Items shall be placed on pallets or shoring to permit air circulation. The area shall be provided with uniform heating and temperature control or its equivalent to prevent condensation and corrosion. The minimum temperature shall be 40°F (5°C), and the maximum temperature shall be 140°F (60°C) or less if so stipulated by the manufacturer.

(c) Level C items shall be stored indoors or in an equivalent environment with all provisions and requirements as set forth for Level B items, except that heat and temperature control is not required.

(d) Level D items may be stored outdoors in an area marked and designated for storage that is well drained, preferably gravel covered or paved, and reasonably removed from the actual construction area and traffic so that the possibility of damage from construction equipment is minimized. Items shall be stored on cribbing or equivalent to allow for air circulation and to avoid trapping water.
602 Storage Areas
Periodic inspections shall be performed to ensure that storage areas are being maintained in accordance with applicable requirements.

602.1 Access to Storage Areas. Access to storage areas for Levels A, B, and C items shall be controlled and limited only to personnel designated by the responsible organization. Access to storage areas involving Level D items shall be controlled as designated by the responsible organization.

602.2 Cleanliness and Housekeeping Practices. Cleanliness and good housekeeping practices shall be enforced at all times in the storage areas. The storage areas shall be cleaned as required to avoid the accumulation of trash, discarded packaging materials, and other detrimental soil.

602.3 Fire Protection. Fire protection commensurate with the type of storage area and the material involved shall be provided and maintained.

602.4 Storage of Food and Associated Items. The use or storage of food, drinks, and salt tablet dispensers in controlled storage areas shall not be permitted.

602.5 Measures to Prevent Entrance of Animals. Measures shall be taken to prevent the entrance of rodents and other animals into indoor storage areas or equipment to minimize possible contamination and mechanical damage to stored material.

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603 Storage Methods
Storage methods and procedures shall comply with the requirements described in paras. 603.1 through 603.6 of this Subpart.

603.1 Ready Access to Stored Items. All items shall be stored in such a manner as to permit ready access for inspection or maintenance without excessive handling to minimize risk of damage.

603.2 Arrangement of Items. Items stacked for storage shall be arranged so that racks, cribbing, or crates are bearing the full weight without distortion of the item.

603.3 Storage of Hazardous Material. Hazardous chemicals, paints, solvents, and other materials of a like nature shall be stored in well-ventilated areas and not in close proximity to important nuclear facility items.

603.4 Identification. Items and their containers shall be plainly marked so that they are easily identified without excessive handling or unnecessary opening of crates and boxes.

603.5 Coverings. Weatherproof coverings, when used for outdoor storage, shall be the flame-resistant type of sheeting or tarpaulins. They shall be placed so as to provide drainage and to ensure air circulation to minimize condensation. They shall be tied down to prevent moisture from entering laps and to protect the coverings from wind damage.

603.6 Outdoor Storage. Items stored outdoors shall be positioned or covered to avoid trapping moisture in pockets or internally. For example, valves shall be positioned such that water does not collect under the bonnet but can drain from the valve packing area.

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5 Year Review of Subpart 2.2

604 Control of Items in Storage
Control of items in storage is described in paras. 604.1 through 604.3 of this Subpart.

604.1 Inspections. Inspections shall be performed and documented on a periodic basis to ensure that the integrity of the item and its container, as provided for under section 300 of this Subpart, is being maintained. Deficiencies noted shall be corrected and documented. The characteristics verified during this inspection shall include such items as:
(a) identification and marking
(b) protective covers and seals
(c) coatings and preservatives
(d) desiccants and inert gas blankets
(e) physical damage
(f) cleanliness

604.2 Care of Items. Requirements for proper maintenance during storage shall be documented. Care of items in storage (includes storage in place) shall be exercised in accordance with the following:
(a) Items in storage shall have all covers, caps, plugs, or other closures intact. Methods used to seal openings shall be in accordance with section 300 of this Subpart. Covers removed for internal access shall be immediately replaced and resealed after completion of the purpose for removal.
(b) Temporary preservatives shall be left intact during storage. Should reapplication of preservatives be required at the site, only those previously approved shall be used.
(c) Items pressurized with inert gas shall be monitored at such a frequency as to ensure that the gas pressure is maintained within specified limits during storage. Desiccant humidity indicators shall also be monitored, and desiccants shall be changed or reprocessed when specified.
(d) Instrumentation racks shall be energized as specified by the manufacturer.
(e) Space heaters enclosed in electrical items shall be energized.
(f) Rotating electrical equipment shall be given insulation resistance tests on a scheduled basis.
(g) The shafts of rotating equipment shall be rotated on a periodic basis. The degree of turn shall be established so that the parts receive a coating of lubrication, where applicable, and so that the shaft does not come to rest in a previous position (90-deg and 450-deg rotations are examples).
(h) Other maintenance requirements specified by the manufacturer’s instructions for the item shall be

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5 Year Review of Subpart 2.2

604.3 Post-Fire Evaluation. In the event that a fire should occur in the storage area at any time, each item known to have been heated to an ambient temperature of over 150°F (65°C) or subjected to smoke contamination shall be withheld from installation or use until it has been thoroughly examined, and the item has been verified to be in conformance with specified requirements.

605 Removal of Items From Storage
Only items that have been inspected and are considered acceptable for installation or use in accordance with the receiving inspection procedure shall be removed from storage for installation or use (see section 500 of this Subpart). Items released from storage and placed in their final locations and items stored in place within the nuclear facility shall be inspected and cared for in accordance with the requirements of paras. 604.1 and 604.2 of this Subpart and other standards, as applicable.

606 Storage Records
Written records shall be prepared that include such pertinent information as storage location, results of inspections, results of in-storage maintenance to include the results of configuration control activities for the item while in storage, protection requirements, changes in item ownership including (if applicable) certificates of conformance, and personnel authorized access to the storage location(s).

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606 Storage Records
### 700 HANDLING
The requirements that shall be fulfilled by the organizations responsible for handling items are contained in Part II, Subpart 2.15.

### 800 RECORDS
Record copies of procedures, reports, personnel qualification records, test equipment calibration records, test deviation or exception records, storage and maintenance records, and inspection records shall be prepared as required by this Subpart. These records shall be retained with other project or operations records as required by code, standard, specification, or project procedures.

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Planning includes documenting the activities to be performed (e.g., software requirements identification, software design definition, software design implementation, verification and validation), the systematic progression of those activities, and the overall measures to be performed during software development, acquisition, and operations and maintenance to ensure the quality of the software deliverables. The planning documentation shall be approved by the responsible organization and shall be sufficient to accomplish the work. This documentation may provide additional information such as schedules, resources, and training.

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...Part II, Subpart 2.7 users should consider establishing a software categorization method that includes (a) software engineering methods applicable to given categories of software (b) assurance that the results of the categorization are documented

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If the organization implementing Part II, Subpart 2.7 has a software quality assurance program that is compliant with other industry standards, a review should be performed to ensure consistency with the requirements of Part II, Subpart 2.7.

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The purpose of software verification activities is to ensure at defined control points the activities are complete and provide confidence that no defects have been inserted. The extent of verification and methods chosen are a function of the complexity of the software, degree of standardization, the risk of potential impact on safety and/or operation, and similarity with previously proven software.

{n.b.: change comma to period}
**Published 2022 Edition**

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- **acceptance testing, also known as software validation**: a manual or automated process for exercising or evaluating a system or system component to ensure that specified requirements are satisfied in the operating environment and to determine if it performs satisfactorily.

- **baseline**¹ : a specification or product that has been formally reviewed and agreed upon, that thereafter serves as the basis for use and further development, and that can be changed only by using an approved change control process.

- **change control, also known as configuration control**¹ : an element of configuration management consisting of the evaluation, coordination, approval or disapproval, and implementation of changes to configuration items after formal establishment of their configuration identification.

- **computer program unit**¹,² : a logically separable part of a computer program.

- **configuration item**¹ : a collection of hardware or software elements treated as a unit for the purpose of configuration control.

- **configuration management (software)** : the process of identifying and defining the configuration items in a system (i.e., software and hardware), controlling the release and change of these items throughout the system's life cycle, and recording and reporting the status of configuration items and change requests.

- **control point**¹ : a point in the software life cycle at which specified agreements or controls (typically a test or review) are applied to the
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| software development cycle: period of time that begins with the decision to develop a software product and ends when the software is delivered. The software development cycle typically includes:
(a) software requirements
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These phases may overlap or be performed iteratively, depending upon the software development approach used. |
| software engineering: the application of a systematic, disciplined, quantifiable approach to the development, operation, and maintenance of software; that is, the application of engineering to software. |
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retirement phase. These phases may overlap or be performed iteratively, depending on the software development approach used.

software tool: a computer program used to support development, testing, analysis, or maintenance of a program or its documentation.

source code: computer instructions and data definitions expressed in a form suitable for input to an assembler, compiler, or other translator.

system software: software designed to facilitate the operation and maintenance of a computer system and its associated computer programs.

test case: a set of test inputs, execution conditions, and expected results developed for a particular objective, such as to exercise a particular program path or to verify compliance with a specific requirement.

testing (software): the process of
(a) operating a system (i.e., software and hardware) or system component under specified conditions
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The scope of software engineering activities includes the following elements, as appropriate:
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| 102 Definitions | 102 Software Engineering Definitions |

ASME Record No: 22-1514
Part II, Subpart 2.7, Part III Subpart 3.2-2.7.1 and Subpart 3.2-2.14
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**configuration management (software)**: the process of identifying and defining the configuration items in a system (i.e., software and hardware), controlling the release and change of these items throughout the system's life cycle, and recording and reporting the status of configuration items and change requests.

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**ASME Record No:** 22-1514  
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### 203.1 Configuration Identification

(a) A labeling system for configuration items shall be implemented that
1. uniquely identifies each configuration item
2. identifies changes to configuration items by revision
3. provides the ability to uniquely identify each configuration of the revised software available for use

(b) The appropriate software engineering elements, described in para. 101 of this Subpart, shall identify when configuration baselines are to

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(a) A labeling system for configuration items shall be implemented that
1. uniquely identifies each configuration item
2. identifies changes to configuration items by revision
3. provides the ability to uniquely identify each configuration of the revised software available for use

(b) The appropriate software engineering elements, described in para. 1021 of this Subpart, shall identify when configuration baselines are to
be established. At a minimum, a baseline shall be established prior to acceptance testing. A baseline shall define an approved software configuration. Configuration items to be controlled as part of the baseline shall include, as appropriate 

1. documentation (e.g., software requirement, software design description, instructions for computer program use, test plans, and results)  
2. computer program(s) (e.g., source and object)  
3. support software  

Approved changes implemented to configuration items subsequent to the baseline shall be added to the baseline.

601 Software Tools

Software tools shall be evaluated, reviewed, tested, accepted for use, and placed under configuration control as part of the software development cycle of a new or revised software product. Software tools that do not affect the performance of the software need not be placed under configuration control. Changes to a software tool that is under configuration control shall be evaluated for impact on the software product to determine the level of reviews and retesting that will be required.

700 REFERENCE

The following publication is referenced in this Subpart: ISO/IEC/IEEE 24765:2010(E), Systems and software engineering — Vocabulary  
Publisher: Institute of Electrical and Electronics Engineers, Inc. (IEEE), 445 Hoes Lane, Piscataway, NJ 08854 (www.ieee.org)

700 REFERENCE

The following publication is referenced in this Subpart: ISO/IEC/IEEE 24765:2010(E), Systems and software engineering — Vocabulary  
Publisher: Institute of Electrical and Electronics Engineers, Inc. (IEEE), 445 Hoes Lane, Piscataway, NJ 08854 (www.ieee.org)
## INTRODUCTION

This Subpart structure is based on the main sections (e.g., 100, General; 200, General Requirements) and paragraphs (e.g., 201, Documentation and Records) of Part II, Subpart 2.7. In most cases, the paragraphs (e.g., 203.1, Configuration Identification) contained in Subpart 2.7 are provided as a one-to-one correspondence in this Subpart. Deviations may occur when additional paragraphs have been incorporated within Part II, Subpart 2.7 or this guidance.

### 100 GENERAL

This Subpart has been developed to provide organizations invoking NQA-1 with a discussion of the requirements and how those requirements may apply in various situations where software is used. Part II, Subpart 2.7 is applicable to software when a failure or error in the software could adversely affect the quality of structures, systems, or components of nuclear facilities. Possible exceptions will be detailed in this Subpart. Applicability of Part II, Subpart 2.7 is not dependent upon the type of computer equipment (e.g., mainframe, personal computer, workstations, servers) that is installed.

The requirements of Part II, Subpart 2.7 should be applied in a manner to meet the requirements of IEEE Std 7-4.3.2-2003, IEEE Standard Criteria for Digital Computers and Safety Systems of Nuclear Power Generating Stations. This Subpart provides guidance to support meeting the requirements of that standard.

### 101 Software Engineering

A variety of software engineering methods may exist within an organization that implement the Quality Assurance requirements.
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<td>contained within NQA-1. The extent of application of the software engineering activities should be commensurate with the risk associated with the failure of the software. Factors affecting this risk include the potential impact on safety and/or operation, complexity of computer program design, degree of standardization, the state of the art, and similarity to previously proven computer programs. Part II, Subpart 2.7 users should consider establishing a software categorization method that includes (a) software engineering methods applicable to given categories of software (b) assurance that the results of the categorization are documented The software categorization method should consider safety significance and the relative importance of the software. Paragraphs 101.1 through 101.7 of this Subpart provide additional considerations in developing a categorization method and determining software applicability.</td>
<td>should be considered in the use of this Subpart. To enhance understanding and ensure consistency in this Subpart, the characteristics of several common software-related terms are discussed. integration testing: testing in which computer program units, hardware components, or both are combined and tested to evaluate the interaction among them. reusable code: a computer program unit that can be used in more than one computer program to provide the same functionality. software library: a collection of computer program units, data, and related documentation that may be used in software development, use, or maintenance to provide functionality. These may include configuration data, help data, message templates, classes, functions, subroutines, and data values or type specifications. system testing: testing conducted on a complete, integrated system to evaluate the system's compliance with its specified requirements. unit testing: testing of individual hardware or computer program units.</td>
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<td>101.1 Simple and easily understood computer programs (e.g., computer programs whose results can be easily confirmed through hand calculations) that are used in the design of systems, structures, and components, may be excluded from the controls of Part II, Subpart 2.7, if designs using these computer programs are individually verified (see Part I, Requirement 3, para. 401). Design verification documentation should include design inputs, the computer program-generated results, and computer-generated evidence of the programmed algorithms or equations (e.g., computer program listings, spreadsheet cell contents). However, frequent use of the computer program may justify the application of Part II, Subpart 2.7 in order to simplify future use.</td>
<td>Software Characteristics. Software [see ISO/IEC/IEEE 24765:2010(E)] can be composed of three elements: (a) a set of instructions that, when executed, provide a specified function or performance (b) data pertaining to the operation of a computer program or computer system (c) documents that describe the operation and use of the program Software, therefore, is an all-inclusive term for the nonhardware elements of a computer-based system. A computer program differs from software in that software can include documents that describe the development, operation and maintenance, and retirement of a computer program. Computer programs do not include documents. Computer programs can be written in programming languages (e.g., C, C++, Java, Python, assembly). Although the more common term is &quot;program,&quot; for clarity, &quot;computer program&quot; is used throughout this Standard.</td>
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<td>101.2 Complex computer programs used in the design of structures, systems, and components should be developed and approved for use in accordance with Part II, Subpart 2.7 unless verification and testing of</td>
<td>Hardware Characteristics. Hardware consists of the physical elements that provide the computing capability and external interface (e.g., central processing units, memory, computer monitors, printers).</td>
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<td>the computer program (or parts thereof) independent of a specific application is not practical. In these cases each application of the computer program must be verified and documented in accordance with the requirements of Part I, Requirement 3, section 400.</td>
<td><strong>Hardware is the physical equipment used to process, store, or transmit computer programs or data</strong> [see ISO/IEC/IEEE 24765:2010(E)]. In contrast, computer programs are characterized as logical rather than physical system elements.</td>
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<td><strong>101.3</strong> Separate verification and tests may not be required for computer programs that are reviewed and tested in conjunction with hardware as a unit, in accordance with Part I or Part II (e.g., Measurement and Test Equipment) of this Standard.</td>
<td><strong>Firmware Characteristics.</strong> Firmware is the combination of a hardware device, computer programs, and data that reside as read-only software on that device. The firmware (sometimes referred to as embedded software) can perform very limited functions such as keypad controls, or can provide significant function and control capabilities for control rod drives or safety systems. In either case, if firmware is supplied under requirements of Part II, Subpart 2.7, the computer program aspect of firmware should be considered in an organization’s software engineering method.</td>
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<td><strong>101.4</strong> Computer programs that have been verified and tested in accordance with other consensus standards may not require any additional verification and tests. However, an evaluation based upon the Part II, Subpart 2.7 verification and testing requirements should be performed to ensure compliance with Part II, Subpart 2.7.</td>
<td><strong>REMOVE</strong> This text will move to section 102.4.</td>
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<td><strong>101.5</strong> Exceptions may also be warranted for support software (see section 600) if this software has a known and acceptable performance history. The basis for accepting the performance history should be documented and approved in conjunction with the software development cycle of the software using the support software. The resulting system, structures, or components should be submitted for design verification in accordance with Part I, Requirement 3, section 500, or the resulting software (application and the support software) should be developed and approved for use in accordance with Part II, Subpart 2.7. If the organization implementing Part II, Subpart 2.7 has a software quality assurance program that is compliant with other industry standards, a review should be performed to ensure consistency with the requirements of Part II, Subpart 2.7.</td>
<td><strong>REMOVE</strong> This text will move to section 102.5.</td>
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<td><strong>101.6</strong> Firmware is dependent on the nature of the computer program and hardware device. Three possible approaches are described as follows: (a) If the computer program can be changed after it is embedded, including at run time, all applicable controls of Part II, Subpart 2.7 should be applied.</td>
<td><strong>REMOVE</strong> This text will move to section 102.6.</td>
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<td><strong>(b)</strong> If the computer program cannot be changed after it is embedded, and testing of the completed device is not adequate for full acceptance, <em>Part II, Subpart 2.7</em> software development controls should be applied. <strong>(c)</strong> If the embedded computer program functions can be adequately verified by testing the completed unit and the computer program cannot be changed, including at run time, without repeating this verification, controls beyond those used for hardware may not be necessary. This approach is the least desirable because it treats the computer program as hardware and does not recognize the need to apply controls to the computer program.</td>
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<td><strong>This text will move to section 102.7.</strong></td>
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| **101.7** Documented evidence (e.g., supplier testing, applicable supplier experience) supporting the acceptance of commercial off-the-shelf software may be used to augment the acceptance requirements of *Part II, Subpart 2.7, para. 302.* |
| **REMOVE** |
| **This text will move to section 102.7.** |

| **101.8** Software libraries and reusable code can be developed or acquired, and the applicable controls of *Part II, Subpart 2.7* should be applied. If the software library or reusable code is acquired, the requirements of *Part II, Subpart 2.7, section 300* should be applied for the acceptance. If the software library or reusable code is not able to stand alone, additional computer code may be developed to facilitate acceptance. If additional code is developed, applicable controls of *Part II, Subpart 2.7* should be applied to this additional code. It may be appropriate for testing to occur when the software library/reusable code is integrated into the final software product. Software engineering activities should specify how computer program units are controlled to ensure that each is under configuration management, appropriately documented and tested, and software life cycle deliverables developed accordingly. |
| **REMOVE** |
| **This text will move to section 102.8.** |

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<th><strong>102 Definitions</strong></th>
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<td>Terms may have multiple interpretations even within a standard. Therefore, definitions provided in <em>Part II, Subpart 2.7</em> and this Subpart should be considered in the use of this Subpart. To enhance understanding and ensure consistency in this Subpart, the characteristics of several common software-related terms are discussed.</td>
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<td><strong>102 Definitions</strong></td>
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<td><strong>Software Engineering</strong></td>
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<td>A variety of software engineering methods may exist within an organization that implement the Quality Assurance requirements contained within NQA-1. The extent of application of the software engineering activities should be commensurate with the risk associated with the failure of the software. Factors affecting this risk include the potential impact on safety and/or operation,</td>
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<td><strong>integration testing</strong>: testing in which computer program units, hardware components, or both are combined and tested to evaluate the interaction among them. <strong>reusable code</strong>: a computer program unit that can be used in more than one computer program to provide the same functionality. <strong>software library</strong>: a collection of computer program units, data, and related documentation that may be used in software development, use, or maintenance to provide functionality. These may include configuration data, help data, message templates, classes, functions, subroutines, and data values or type specifications. <strong>system testing</strong>: testing conducted on a complete, integrated system to evaluate the system’s compliance with its specified requirements. <strong>unit testing</strong>: testing of individual hardware or computer program units.</td>
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<td><strong>102.1 Software Characteristics.</strong> Software [see ISO/IEC/IEEE 24765:2010(E)] can be composed of three elements: (a) a set of instructions that, when executed, provide a specified function or performance (b) data pertaining to the operation of a computer program or computer system</td>
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<td><strong>102.2 Hardware Characteristics.</strong> Hardware consists of the physical elements that provide the computing capability and external interface (e.g., central processing units, memory, computer monitors, printers). Hardware is the physical equipment used to process, store, or transmit computer programs or data [see ISO/IEC/IEEE 24765:2010(E)]. In contrast, computer programs are characterized as logical rather than physical system elements.</td>
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<td><strong>102.3 Firmware Characteristics.</strong> Firmware is the combination of a hardware device, computer programs, and data that reside as read-only software on that device. The firmware (sometimes referred to as embedded</td>
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<td>software) can perform very limited functions such as keypad controls, or can provide significant function and control capabilities for control rod drives or safety systems. In either case, if firmware is supplied under requirements of Part II, Subpart 2.7, the computer program aspect of firmware should be considered in an organization’s software engineering method.</td>
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<td><strong>NA</strong></td>
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| **NA** | **102.6** Firmware is dependent on the nature of the computer program and hardware device. Three possible approaches are described as follows: 
(a) If the computer program can be changed after it is embedded, including at run time, all applicable controls of Part II, Subpart 2.7 should be applied. 
(b) If the computer program cannot be changed after it is embedded, and testing of the completed device is not adequate for full acceptance, Part II, Subpart 2.7 software development controls should be applied. 
(c) If the embedded computer program functions can be adequately verified by testing the completed unit and the computer program cannot be changed, including at run time, without repeating this verification and testing, the controls of Part II, Subpart 2.7 should be applied. |

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| **ASME Record No:** 22-1514  
Part II, Subpart 2.7, Part III Subpart 3.2-2.7.1 and Subpart 3.2-2.14 |

| NA | 102.7 | Documented evidence (e.g., supplier testing, applicable supplier experience) supporting the acceptance of commercial off-the-shelf software may be used to augment the acceptance requirements of Part II, Subpart 2.7, para. 302. |
| NA | 102.8 | Software libraries and reusable code can be developed or acquired, and the applicable controls of Part II, Subpart 2.7 should be applied. If the software library or reusable code is acquired, the requirements of Part II, Subpart 2.7, section 300 should be applied for the acceptance. If the software library or reusable code is not able to stand alone, additional computer source code may be developed to facilitate acceptance. If additional source code is developed, applicable controls of Part II, Subpart 2.7 should be applied to this additional source code. It may be appropriate for testing to occur when the software library/reusable code is integrated into the final software product. Software engineering activities should specify how computer program units are controlled to ensure that each is under configuration management, appropriately documented and tested, and software life cycle deliverables developed accordingly. |

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<th>300 SOFTWARE ACQUISITION</th>
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<td>Software acquisition includes the subcontracting of software development to the purchaser’s design, purchase of commercial off-the-shelf software, and acquisition of software through other methods (e.g., code centers, company repositories, and user groups). This section provides guidance for software acquired in accordance with Part I and otherwise acquired software that was not developed in accordance with Part I.</td>
<td>Software acquisition includes the subcontracting of software development to the purchaser’s design, purchase of commercial off-the-shelf software, and acquisition of software through other methods (e.g., source code centers, company repositories, and user groups). This section provides guidance for software acquired in accordance with Part I and otherwise acquired software that was not developed in accordance with Part I.</td>
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<td>Otherwise acquired software includes computer programs that perform a safety function and computer programs that perform a function related to quality. Commercial Grade Dedication is required in accordance with Part II, Subpart 2.14, for otherwise acquired computer programs that perform a safety function. Otherwise Acquired Computer Programs that do not perform a safety function, but that perform a function related to quality should be evaluated to assure that the product meets its intended use as described in para. 302.2 of this Subpart.</td>
<td>Otherwise acquired software includes computer programs that perform a safety function and computer programs that perform a function related to quality. Commercial Grade Dedication is required in accordance with Part II, Subpart 2.14, for otherwise acquired computer programs that perform a safety function. Otherwise Acquired Computer Programs that do not perform a safety function, but that perform a function related to quality are evaluated to assure that the product meets its intended use as described in para. 302.2 of this Subpart.</td>
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<td>Design documentation should be completed in a manner that facilitates the software verification process in accordance with Part II, Subpart 2.7. If any requirements are not met in the design activity, then those requirements should be revised to reflect the final product using the same approval process as the original requirements. The design documentation may be combined with the documentation of the software requirements or the source code or equivalent (e.g., ladder logic, calculations, scripts) resulting from implementation of the software design.</td>
<td>Design documentation should be completed in a manner that facilitates the software verification process in accordance with Part II, Subpart 2.7. If any requirements are not met in the design activity, then those requirements should be revised to reflect the final product using the same approval process as the original requirements. The design documentation may be combined with the documentation of the software requirements or the source code or equivalent (e.g., ladder logic, calculations, scripts) resulting from implementation of the software design.</td>
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<td>Software design should result in units that are (a) low in complexity (e.g., lines of source code, number of decision paths) (b) easily testable (c) loosely coupled (i.e., requires little interaction with other units) (d) highly cohesive (i.e., performs a single task) (e) error tolerant (i.e., handles errors adequately and appropriately) Safety components should be isolated from non-safety components. Design considerations should be included to ensure that the software is reliable, secure, and tamper resistant. Performance-monitoring requirements should be analyzed and specified prior to the initial system design.</td>
<td>Software design should result in units that are (a) low in complexity (e.g., lines of source code, number of decision paths) (b) easily testable (c) loosely coupled (i.e., requires little interaction with other units) (d) highly cohesive (i.e., performs a single task) (e) error tolerant (i.e., handles errors adequately and appropriately) Safety components should be isolated from non-safety components. Design considerations should be included to ensure that the software is reliable, secure, and tamper resistant. Performance-monitoring requirements should be analyzed and specified prior to the initial system design.</td>
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<td>Any pre-existing computer program components, e.g., application frameworks or software libraries, should be identified. For analysis and design software, a description of the physical problem and the encoded mathematical model(s) should be documented. The description should include a list of assumptions made in constructing the model and all information necessary to enable verification.</td>
<td>Any pre-existing computer program components, e.g., application frameworks or software libraries, should be identified. For analysis and design software, a description of the physical problem and the encoded mathematical model(s) should be documented. The description should include a list of assumptions made in constructing the model and all information necessary to enable verification.</td>
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404 Software Design Implementation

404.1 Unit Testing

Unit testing is performed by the developer in the development environment and does not require independence. The object of unit testing is to test the lowest level unit of the computer program individually. The unit test effort should use both code execution and source code review. Input and output stubs to mock up the interfaces are usually required for code execution. Source code review can be accomplished using code walkthroughs or more formal inspections. Additional guidance on inspections may be found in IEEE Std 1028-2008, IEEE Standard for Software Reviews and Audits.

Additional guidance on unit testing may be found in IEEE Std 1008, IEEE Standard for Software Unit Testing, and IEC-60880, Nuclear Power Plants—Instrumentation and Control Systems Important to Safety — Software Aspects for Computer-Based Systems Performing Category a Functions.

405.1.5 Factory Acceptance Testing

Acceptance testing may include factory acceptance testing (FAT) performed at the vendor’s or supplier’s facility under the control of the purchaser on the version of the computer program to be delivered. FAT should be considered for computer programs that are custom developed by a vendor. Frequently FAT is performed for acquired integrated hardware and software systems such as control systems or other real-time systems with embedded computer.
## Published 2022 Edition [Subpart 3.2-2.7.1]

Programs. FAT should include exercising the computer program in an environment comparable to the environment in which the computer program will be used. This testing may include testing of associated hardware, and simulation of data inputs or control signals. FAT should provide interim results that acquired software, and if applicable computer hardware, meet contract or purchase order specifications derived from the software requirements prior to delivery to the customer.

## Proposed Changes

**Computer programs.** FAT should include exercising the computer program in an environment comparable to the environment in which the computer program will be used. This testing may include testing of associated hardware, and simulation of data inputs or control signals. FAT should provide interim results that acquired software, and if applicable computer hardware, meet contract or purchase order specifications derived from the software requirements prior to delivery to the customer.

### 601 Software Tools

Examples of types of software tools are integrated development environment (IDE), comparators, cross reference generators, compilers, configuration and code management software, decompilers, disassemblers, test case generators, dynamic analyzers, spreadsheet applications, document preparation, debuggers, and coding editors.

### 601 Software Tools

Examples of types of software tools are integrated development environment (IDE), comparators, cross reference generators, compilers, configuration and source code management software, decompilers, disassemblers, test case generators, dynamic analyzers, spreadsheet applications, document preparation, debuggers, and coding editors.
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<td>SUBPART 3.2-2.7.2 Implementation Guidance on the Requirements of NQA-1, Parts I and II for Software Used for Nuclear Facility Applications</td>
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**INTRODUCTION**

This Subpart provides nonmandatory guidance on identification, flow, and interdependency of the requirements for software used for nuclear facility applications. The Subpart is based on the NQA-1-2008 Edition with the 2009 Addenda of the Standard, but the information has some application to previous and subsequent editions of the Standard. While the Standard includes requirements for assuring quality of the items and services provided to support the overall organizational objectives, the Standard also includes those requirements for acquiring, developing, testing, verifying, validating, operating, maintaining, and retiring computer programs used in nuclear facility applications. These requirements for software are interspersed within the Standard.

**100 GENERAL**

This Subpart provides organizations invoking NQA-1 with information to aid the identification, application flow, and interdependency of the requirements for software used for nuclear facility applications. The Subpart discusses the requirements applicable to software within the 18 requirements of Part I, the supplemental requirements of Part II (Subparts 2.7 and 2.14), and the guidance of Part IV, Subpart 4.1 of the Standard.
<p>| facility applications: The Subpart discusses the requirements applicable to software within the 18 requirements of Part I, the supplemental requirements of Part II (Subparts 2.7 and 2.14), and the guidance of Part IV, Subpart 4.1 of the Standard. |</p>
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| This Subpart provides nonmandatory guidance on applying Part II, Subpart 2.14 requirements to the dedication of commercial grade computer programs and software services as required by Part II, Subpart 2.7, para. 302. This Subpart applies to procured and acquired computer programs not installed in physical plant safety systems that support the performance of a safety function and that were not developed or approved under a program consistent with this Standard. The applicability of this Subpart is not dependent upon the type of computer equipment (e.g., mainframe, PC, networked workstations, controllers, or other digital equipment) on which the computer program resides. As defined in this Standard, computer programs include real-time (e.g., operations or process control) as well as nonreal-time (e.g., design or analysis) computer programs. The application of commercial grade dedication for computer programs included in digital equipment that are installed in physical plant safety systems should be performed as part of the dedication process for that physical plant safety component. For these systems, the requirements of Part II, Subpart 2.14 apply, and existing industry guidance to meet the commercial grade dedication requirements of this Standard includes EPRI TR 106439, Guideline on Evaluation and Acceptance of Commercial Grade Digital Equipment for Nuclear Safety Applications, October 1996; IEEE 7-4.3.2-2010, Criteria for Digital Computers in Safety Systems of Nuclear Power Generating Stations, June 17, 2010; and EPRI TR 107330, Generic Requirements Specification for Qualifying a Commercially Available PLC for Safety-Related Applications in Nuclear Power Plants, December 1996. This Subpart does not provide guidance for real-time computer programs. As described in Part II, Subpart 2.7, para. 302, the dedication process includes the following three criteria: (a) identification of the capabilities and limitations for intended use as critical characteristics. (b) utilization of test plans and cases as the method of acceptance to demonstrate the capabilities within the limitations. (c) instructions for use (e.g., a user’s manual) within the limits of the dedicated capabilities. The dedication process shall be documented, and the performance of the actions necessary to accept the computer program. | This Subpart provides nonmandatory guidance on applying Part II, Subpart 2.14 requirements to the dedication of commercial grade computer programs and software services as required by Part II, Subpart 2.7, para. 302. This Subpart applies to procured and acquired computer programs not installed in physical plant safety systems that support the performance of a safety function and that were not developed or approved under a program consistent with this Standard. The applicability of this Subpart is not dependent upon the type of computer equipment (e.g., mainframe, PC, networked workstations, controllers, or other digital equipment) on which the computer program resides. As defined in this Standard, computer programs include real-time (e.g., operations or process control) as well as nonreal-time (e.g., design or analysis) computer programs. The application of commercial grade dedication for computer programs included in digital equipment that are installed in physical plant safety systems should be performed as part of the dedication process for that physical plant safety component. For these systems, the requirements of Part II, Subpart 2.14 apply, and existing industry guidance to meet the commercial grade dedication requirements of this Standard includes EPRI TR 106439, Guideline on Evaluation and Acceptance of Commercial Grade Digital Equipment for Nuclear Safety Applications, October 1996; IEEE 7-4.3.2-2010, Criteria for Digital Computers in Safety Systems of Nuclear Power Generating Stations, June 17, 2010; and EPRI TR 107330, Generic Requirements Specification for Qualifying a Commercially Available PLC for Safety-Related Applications in Nuclear Power Plants, December 1996. This Subpart does not provide guidance for real-time computer programs. As described in Part II, Subpart 2.7, para. 302.1 (a), (b) and (c) describes the elements required for the computer program dedication process: (a) identification of the capabilities and limitations for intended use as critical characteristics. (b) utilization of test plans and cases as the method of acceptance to demonstrate the capabilities within the limitations. (c) instructions for use (e.g., a user’s manual) within the limits of the dedicated capabilities. The dedication process shall be documented, and
### Proposed Changes

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<td>shall be reviewed and approved. The resulting documentation and associated computer programs(s) shall establish the current baseline. These criteria can be addressed through implementing the commercial grade dedication process defined by Part II, Subpart 2.14. The identification of the capabilities and limitations for intended use should be addressed during the selection of the set of performance critical characteristics. Test plans and cases required to demonstrate those capabilities within the limitations should be exercised through special tests and surveys. Instructions for use within the limits of the capabilities should be identified through the selection of the physical or performance critical characteristic associated with a user’s manual, online help, or other methods to assist the user in the proper operation of the computer program within the limits of the dedication.</td>
<td>the performance of the actions necessary to accept the computer program shall be reviewed and approved. The resulting documentation and associated computer programs(s) shall establish the current baseline. These criteria can be addressed through implementing the commercial grade dedication process defined by Part II, Subpart 2.14. The identification of the capabilities and limitations for intended use should be addressed during the selection of the set of performance critical characteristics. Test plans and cases required to demonstrate those capabilities within the limitations should be exercised through special tests and surveys. Instructions for use within the limits of the capabilities should be identified through the selection of the physical or performance critical characteristic associated with a user’s manual, online help, or other methods to assist the user in the proper operation of the computer program within the limits of the dedication.</td>
</tr>
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<td>Part I, Requirement 3, para. 401 provides for two methods of verifying computer programs used in design or analysis of an SSC: preverification and verification of the computer program results after every use. Preverification of computer programs includes applying Part II, Subpart 2.7 in which this Subpart can provide needed guidance. When the results derived from the use of the computer program are independently verified for every use or application, the computer program is not required to be dedicated if the independent verification is performed to the requirement of this Standard. Using this latter method is not a surrogate for commercial grade dedication of the computer program. To utilize a commercial grade computer program or service, controls should be implemented to provide reasonable assurance that the computer program or service will support an SSC’s intended safety function. This Subpart can also be applied to computer programs that control the management or administrative support of safety activities. These controls should include the following: (a) determination that the computer program or service supports the performance of a safety function (b) confirmation that the computer program or service meets the applicable commercial grade definitions (c) identification and documentation of the critical characteristics, including acceptance criteria</td>
<td>Part I, Requirement 3, para. 401 provides for two methods of verifying computer programs used in design or analysis of an SSC: preverification and verification of the computer program results after every use. Preverification of computer programs includes applying Part II, Subpart 2.7 in which this Subpart can provide needed guidance. When the results derived from the use of the computer program are independently verified for every use or application, the computer program is not required to be dedicated if the independent verification is performed to the requirement of this Standard. Using this latter method is not a surrogate substitute for commercial grade dedication of the computer program. To utilize a commercial grade computer program or service, controls should be implemented to provide reasonable assurance that the computer program or service will support an SSC’s intended safety function. This Subpart can also be applied to computer programs that control the management or administrative support of safety activities. These controls should include the following: (a) determination that the computer program or service supports the performance of a safety function (b) confirmation that the computer program or service meets the applicable commercial grade definitions (c) identification and documentation of the critical characteristics, including acceptance criteria</td>
</tr>
</tbody>
</table>
**ASME Record No:** 22-1514  
Part II, Subpart 2.7, Part III Subpart 3.2-2.7.1 and Subpart 3.2-2.14

<table>
<thead>
<tr>
<th>Dedication Documentation</th>
<th>Dedication Documentation</th>
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</thead>
<tbody>
<tr>
<td><strong>802</strong> Dedication Documentation</td>
<td><strong>802</strong> Dedication Documentation</td>
</tr>
</tbody>
</table>
| Documentation of the commercial grade computer program or service dedication process shall be traceable to the computer program or services and should contain the following types of documents, depending on the applicable dedication method:  
- (a) dedication plans or procedures, including the essential elements of the dedication process  
- (1) the scope and objectives for the dedication process  
- (2) the requirements document for computer program or service dedication  
- (3) plans for a configuration management process for computer program or service dedication, including planned regression test requirements and expected results  
- (4) computer program V&V methodology  
- (b) commercial grade item or service procurement documents  
- (c) technical evaluations  
- (1) computer program requirements, summary, and review  
- (2) documentation referenced during the technical evaluation  
- (d) critical characteristic identification and acceptance criteria  
- (e) test plan(s), test specifications, test report(s) or results, inspection reports, and analysis reports  
- (1) review of test coverage  
- (2) evaluation of test results — validation  
- (f) commercial grade survey reports  
- (g) source verification reports  
- (h) historical performance information [e.g., availability and use of user experience(s)] | Documentation of the commercial grade computer program or service dedication process shall be traceable to the computer program or services and should contain the following types of documents, depending on the applicable dedication method:  
- (a) dedication plans or procedures, including the essential elements of the dedication process  
- (1) the scope and objectives for the dedication process  
- (2) the requirements document for computer program or service dedication  
- (3) plans for a configuration management process for computer program or service dedication, including planned regression test requirements and expected results  
- (4) computer program V&V methodology  
- (b) commercial grade item or service procurement documents  
- (c) technical evaluations  
- (1) computer program requirements, summary, and review  
- (2) documentation referenced during the technical evaluation  
- (d) critical characteristic identification and acceptance criteria  
- (e) test plan(s), test specifications, test report(s) or results, inspection reports, and analysis reports  
- (1) review of test coverage  
- (2) evaluation of test results — validation  
- (f) commercial grade survey reports  
- (g) source verification reports  
- (h) historical performance information [e.g., availability and use of user experience(s)] |
<p>| <em>(i)</em> dedication report containing sufficient data to accept the item or service | <em>(i)</em> dedication report containing sufficient data to accept the item or service |</p>
<table>
<thead>
<tr>
<th>Published 2022 Edition</th>
<th>Proposed Changes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Part III, Subpart 3.1-3.1</strong></td>
<td><strong>Part III, Subpart 3.1-3.1</strong></td>
</tr>
<tr>
<td><strong>300 DESIGN PROCESS</strong></td>
<td><strong>300 DESIGN PROCESS</strong></td>
</tr>
<tr>
<td>The design activities may be prescribed in job specifications, work instructions, planning sheets, procedure manuals, test procedures, or any other typed or written form that provides adequate control and permits reviewing, checking, or verifying the results of the activity.</td>
<td>The design activities may be prescribed in job specifications, work instructions, planning sheets, procedure manuals, test procedures, or any other <strong>typed or written</strong> form that provides adequate control and permits reviewing, checking, or verifying the results of the activity.</td>
</tr>
<tr>
<td><strong>401.2 Case (2): Verification of Computer Program Results for Each Application</strong></td>
<td><strong>401.2 Case (2): Verification of Computer Program Results for Each Application</strong></td>
</tr>
<tr>
<td>(Second Paragraph) It is not sufficient to compare the results with those of another computer program that has not undergone acceptance testing (i.e., is unproven) or is not properly maintained under configuration management. The reference against which the results are verified is justified by good engineering practice, such as hand calculations, measurements taken on a physical system similar to that being modeled, or another computer program that has been properly accepted for such use and controlled (i.e., a computer program that meets all of the requirements listed for Case (1)).</td>
<td>(Second Paragraph) It is not sufficient to compare the results with those of another computer program that has not undergone acceptance testing (i.e., is unproven uncontrolled) or is not properly maintained under configuration management. The reference against which the results are verified is justified by good engineering practice, such as hand calculations, measurements taken on a physical system similar to that being modeled, or another computer program that has been properly accepted for such use and controlled (i.e., a computer program that meets all of the requirements listed for Case (1)).</td>
</tr>
<tr>
<td><strong>401.3 Changes to Computer Code or Defined Limits</strong></td>
<td><strong>401.3 Changes to Computer Code Program or Defined Limits</strong></td>
</tr>
<tr>
<td>Where changes to a previously accepted computer program are performed, the new version requires verification in accordance with Part I, Requirement 3, para. 401. Any use of an accepted and controlled computer program beyond the limits previously verified must be justified, either by performing additional acceptance testing, as in Case (1), for the newly defined limits or by independently verifying, as in Case (2), all results that could be affected by such usage. Justification should be provided for judging any results to be unaffected by the out-of-scope usage.</td>
<td>Where changes to a previously accepted computer program are performed, the new version requires verification in accordance with Part I, Requirement 3, para. 401. Any use of an accepted and controlled computer program beyond the limits previously verified must be justified, either by performing additional acceptance testing, as in Case (1), for the newly defined limits or by independently verifying, as in Case (2), all results that could be affected by such usage. Justification should be provided for judging any results to be unaffected by the out-of-scope usage.</td>
</tr>
<tr>
<td><strong>301 Design, Construction, and Testing Phases</strong></td>
<td><strong>301 Design, Construction, and Testing Phases</strong></td>
</tr>
<tr>
<td>The following are examples of the items and services provided during design, construction, and testing phases: (c) long-lead items such as the nuclear steam supply, process equipment, including major equipment fabrication and test, and high-level waste storage tanks</td>
<td>The following are examples of the items and services <strong>provided procured</strong> during design, construction, and testing phases: (c) long-lead items such as the <strong>nuclear steam supply, nuclear steam supply system</strong>, process equipment, including major equipment fabrication and test, and high-level waste storage tanks</td>
</tr>
</tbody>
</table>
(h) software, such as development of facility operating procedures, technical manuals, and computer codes

<table>
<thead>
<tr>
<th>Published 2022 Edition Subpart 3.1-4.1</th>
</tr>
</thead>
</table>

400 CATEGORIZATION OF PROCUREMENT ACTIONS

The types of procurements listed in para. 302 of this Subpart may also be categorized in terms of what is supplied by the Supplier, i.e., hardware, services, installation, and total system supply or combinations thereof.

100 GENERAL

This Subpart provides nonmandatory guidance on the control of procurement activities as specified in Part I, Requirement 7, except for commercial grade items.
<table>
<thead>
<tr>
<th>Current Revision</th>
<th>Proposed Text Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part III Subpart 3.1-2.2 “Quality Assurance Programs, Lead Auditor Qualification”</td>
<td>Part III Subpart 3.1-2.2 “Quality Assurance Programs, Lead Auditor Qualification”</td>
</tr>
<tr>
<td><strong>100 GENERAL</strong></td>
<td><strong>100 GENERAL</strong></td>
</tr>
<tr>
<td>This Subpart provides nonmandatory guidance on the education and experience that may be used for the qualification of Lead Auditors. This Subpart may be used in conjunction with Part I.</td>
<td>This Subpart provides nonmandatory guidance on the education and experience that may be used for the qualification of Lead Auditors. This Subpart may be used in conjunction with Part I, Requirement 2, Section 303.</td>
</tr>
<tr>
<td><strong>200 EDUCATION AND EXPERIENCE</strong></td>
<td>No Changes</td>
</tr>
<tr>
<td>The prospective Lead Auditor should have verifiable evidence that a minimum of 10 credits under the following score system have been accumulated.</td>
<td></td>
</tr>
<tr>
<td><strong>201 Education (4 Credits Maximum)</strong></td>
<td>No Changes</td>
</tr>
<tr>
<td>(a) an associate degree from an accredited institution</td>
<td></td>
</tr>
<tr>
<td>(1) score 1 credit</td>
<td></td>
</tr>
<tr>
<td>(2) score 2 credits, if the degree is in engineering, physical sciences, mathematics, or quality assurance</td>
<td></td>
</tr>
<tr>
<td>(b) a bachelor’s degree from an accredited institution</td>
<td></td>
</tr>
<tr>
<td>(1) score 2 credits</td>
<td></td>
</tr>
<tr>
<td>(2) score 3 credits, if the degree is in engineering, physical sciences, mathematics, or quality assurance</td>
<td></td>
</tr>
<tr>
<td>(3) score 1 additional credit for a master’s degree in engineering, physical sciences, business management, or quality assurance from an accredited institution</td>
<td></td>
</tr>
<tr>
<td><strong>202 Experience (9 Credits Maximum)</strong></td>
<td>No Changes</td>
</tr>
<tr>
<td>(a) Technical experience in engineering, manufacturing, construction, operation, or maintenance: score 1 credit for each full year with a maximum of 5 credits for technical experience.</td>
<td></td>
</tr>
<tr>
<td>(b) Specialized technical experience scores 1 to 4 additional credits as follows:</td>
<td></td>
</tr>
<tr>
<td>(1) score 1 additional credit if 2 yr of this experience have been in the nuclear field</td>
<td></td>
</tr>
<tr>
<td>(2) score 2 additional credits if 2 yr of this experience have been in quality assurance</td>
<td></td>
</tr>
</tbody>
</table>
(3) score 3 additional credits if 2 yr of this experience have been in auditing
(4) score 3 additional credits if 2 yr of this experience have been in nuclear quality assurance
(5) score 4 additional credits if 2 yr of this experience have been in nuclear quality assurance auditing

| 203 Other Credentials of Professional Competence (2 Credits Maximum) |  
|---|---|
| For certification of competency in engineering science, or quality assurance specialties issued and approved by a state agency or national professional or technical society: score 2 credits. | No Changes |

| 204 Rights of Management (2 Credits Maximum) |  
|---|---|
| The Lead Auditor's employer may grant up to 2 credits for other performance factors applicable to auditing, which may not be explicitly called out in this Subpart. Examples of these factors are leadership, sound judgment, maturity, analytical ability, tenacity, past performance, and quality assurance training courses completed or presented. | No Changes |

| 300 RECORDS |  
|---|---|
| The sample form shown in Figure 300 of this Subpart is provided for utilization as a record of Lead Auditor qualification. | No Changes |
**Figure 300**
Sample Form for Record of Lead Auditor Qualification

## RECORD OF LEAD AUDITOR QUALIFICATION

<table>
<thead>
<tr>
<th>QUALIFICATION POINT REQUIREMENTS</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EDUCATION</strong></td>
<td>4 Credits Max.</td>
</tr>
<tr>
<td>Accredited Institution/Degree:</td>
<td>Degree Date:</td>
</tr>
<tr>
<td><strong>EXPERIENCE</strong></td>
<td>9 Credits Max.</td>
</tr>
<tr>
<td>Technical experience (1 credit for each full year of experience up to 5 maximum):</td>
<td></td>
</tr>
<tr>
<td>Additional credits for technical experience in any one of (1) through (5):</td>
<td></td>
</tr>
<tr>
<td>(1) 2 yr nuclear field (1 credit)</td>
<td></td>
</tr>
<tr>
<td>(2) 2 yr quality assurance (3 credits)</td>
<td></td>
</tr>
<tr>
<td>(3) 2 yr auditing (3 credits)</td>
<td></td>
</tr>
<tr>
<td>(4) 2 yr nuclear quality assurance (3 credits)</td>
<td></td>
</tr>
<tr>
<td>(5) 2 yr nuclear quality assurance auditing (4 credits)</td>
<td></td>
</tr>
<tr>
<td>Dates:</td>
<td></td>
</tr>
</tbody>
</table>

| OTHER CREDENTIALS OF PROFESSIONAL COMPETENCE | 2 Credits Max. |
| Certificate Date: |
| 1. Government State Agency | |
| 2. National Professional or Technical Society | |
| Rights of Management | 2 Credits Max. |
| Justification: | |

| EVALUATED BY (NAME AND TITLE): | Date: |
| **TOTAL CREDITS** | |

### AUDIT COMMUNICATION SKILLS

| EVALUATED BY (NAME AND TITLE): | Date: |
| **AUDIT TRAINING COURSES** | |
| Course Title or Topic: | Date: |

### AUDIT or ASSESSMENT PARTICIPATION

<table>
<thead>
<tr>
<th>Audit or Assessment Type</th>
<th>Description/Audit or Assessment Number</th>
<th>Nuclear (Yes/No)</th>
<th>Date(s) Start and Completion</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### EXAMINATION:

- [ ] Written
- [ ] Oral
- [ ] Practical
- Passed (Y/N): Date: |

The individual listed above is certified as a Lead Auditor to organize and direct audits, report audit findings, and evaluate corrective actions.

| QUALIFICATION CERTIFIED BY: (Signature and Title) | Date Certified: |
## Current Revision:

### Part III Subpart: 3.1-2.3, “Quality Assurance Programs, Inspection and Test Personnel Qualification”

### Proposed Text Change

### 100 GENERAL

This Subpart provides nonmandatory guidance on the qualifications and use of inspection and test personnel. This Subpart may be used in conjunction with Part I, Requirement 2. This does not address guidance for qualification for software testers of Part II, Subpart 2.7.

### 200 FUNCTIONAL QUALIFICATIONS

Three levels of qualification may be utilized depending on the complexity of the functions involved. The recommendations for each level focus on functional inspection or test activities, not on organizational position or professional status.

### 201 Level I Personnel Capabilities

- A Level I inspector or tester should be capable of performing and documenting the results of inspections or tests that are required to be performed in accordance with documented procedures, acceptance standards, and/or industry practices as defined in the organization's written procedures.

### 202 Level II Personnel Capabilities

- A Level II inspector or tester should have all of the capabilities of a Level I inspector or tester for the designated inspection or test activity.
- In addition, a Level II inspector or tester should have additional demonstrated capabilities in:
  1. planning inspections and tests
  2. setting up tests, including preparation and setup of related equipment, as appropriate
  3. supervising or maintaining surveillance over the inspections and tests
  4. supervising and certifying lower level personnel
  5. evaluating the validity and acceptability of inspection and test results

### 203 Level III Personnel Capabilities

- A Level III inspector or tester should have all of the capabilities of a Level II inspector or tester for the designated inspection or test activity.
- In addition, a Level III inspector or tester should be capable of evaluating the adequacy of specific programs used to train and certify inspection and test personnel whose qualifications are covered by this Subpart.

### 300 EDUCATION AND EXPERIENCE QUALIFICATIONS

- Education and experience should be considered, including such factors as inspection/test scope, complexity, or the special nature of the activity to...
establish reasonable assurance that a person can competently perform a particular task.

(b) Other factors that may demonstrate capability in a given inspection or test function include previous performance or satisfactory completion of capability testing. These factors and the basis for their equivalency should be documented.

<table>
<thead>
<tr>
<th>301 Level I</th>
<th>No changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Two years of experience related to equivalent inspection or testing activities; or</td>
<td></td>
</tr>
<tr>
<td>(b) High school (or equivalent) diploma plus 6 months of experience in equivalent inspection or testing activities; or</td>
<td></td>
</tr>
<tr>
<td>(c) Completion of college/university level work leading to an associate degree from an accredited institution (or equivalent) in a technical discipline plus 3 months of experience in equivalent inspection or testing activities.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>302 Level II</th>
<th>No changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) One year of satisfactory performance as a Level I in the corresponding inspection or test activity; or</td>
<td></td>
</tr>
<tr>
<td>(b) High school (or equivalent) diploma plus 3 years of experience related to equivalent inspection or testing activities; or</td>
<td></td>
</tr>
<tr>
<td>(c) Completion of college/university level work leading to an associate degree from an accredited institution (or equivalent) in a technical discipline plus 1 year of experience in equivalent inspection or testing activities; or</td>
<td></td>
</tr>
<tr>
<td>(d) Completion of a 4-yr college degree from an accredited institution (or equivalent) in a technical discipline plus 6 months of experience in equivalent inspection or testing activities.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>303 Level III</th>
<th>No changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Six years of satisfactory performance as a Level II in the corresponding inspection or test activity; or</td>
<td></td>
</tr>
<tr>
<td>(b) High school (or equivalent) diploma plus 10 years of experience in equivalent inspection or testing activities; or</td>
<td></td>
</tr>
<tr>
<td>(c) High school (or equivalent) diploma plus 8 years of experience in equivalent inspection or testing activities with at least 2 yr as a Level II and with at least 2 yr associated with nuclear facilities — or, without nuclear facilities experience, at least sufficient training to be acquainted with the relevant quality assurance aspects of a nuclear facility; or</td>
<td></td>
</tr>
</tbody>
</table>
| (d) Completion of college/university level work leading to an associate degree from an accredited institution (or equivalent) in a technical discipline and 7 yr of experience in equivalent inspection or testing activities with at least 2 yr of this experience associated
with nuclear facilities — or, without nuclear facilities experience, at least sufficient training to be acquainted with the relevant quality assurance aspects of a nuclear facility;

(e) Completion of a 4-yr college degree from an accredited institution (or equivalent) in a technical discipline plus 5 yr of experience in equivalent inspection or testing activities with at least 2 yr of this experience associated with nuclear facilities — or, without nuclear facilities experience, at least sufficient training to be acquainted with the relevant quality assurance aspects of a nuclear facility.

<table>
<thead>
<tr>
<th>400 USE OF INSPECTION AND TEST PERSONNEL</th>
</tr>
</thead>
</table>

(a) Prior to assigning personnel to perform inspection and test activities, supervision should determine that the individuals have the experience or training commensurate with the scope, complexity, or special nature of the activities.

(b) When a single inspection or test requires implementation by a team or a group, personnel not yet meeting the requirements of Part I, Requirement 2, section 300, may be used in data-taking assignments or in plant or equipment operation, provided they are supervised or overseen by a qualified individual.

(c) Appropriate training, which may include on-the-job training, should be conducted as needed to qualify personnel to perform inspections and tests. The use of personnel performing inspections and tests during on-the-job training qualification should be under the observation and supervision of a qualified person, since the verification of conformance is the responsibility of a qualified person.

<table>
<thead>
<tr>
<th>400 USE OF INSPECTION AND TEST PERSONNEL</th>
</tr>
</thead>
</table>

(a) Prior to assigning personnel to perform inspection and test activities, supervision should determine that the individuals have the experience, and training commensurate with the scope, complexity, or special nature of the activities.

(b) When a single inspection or test requires implementation by a team or a group, personnel not yet meeting the requirements of Part I, Requirement 2, section 300, may be used in data-taking assignments or in plant or equipment operation, provided they are supervised or overseen by a qualified individual.

(c) Appropriate training, which may include on-the-job training, should be conducted as needed to qualify personnel to perform inspections and tests. The use of personnel performing inspections and tests during on-the-job training qualification should be under the observation and supervision of a qualified person, since the verification of conformance is the responsibility of a qualified person.
### Existing Text of NQA-1-2022

**Alternative Treatment Requirements** – Those requirements that meet section (d)(2) of 10 CFR 50.69.

- **LSS** – Low Safety Significant
- **HSS** – High Safety Significant

These definitions are applicable to implementers of a risk-informed approach and provide a more specific methodology than the “graded approach” definition found in Part I.

### Proposed Revision

**Alternative Treatment Requirements** – Those requirements that meet section (d)(2) of 10 CFR 50.69.

- **LSS** – refers to Low Safety Significant
- **HSS** – refers to High Safety Significant

These definitions are applicable to implementers of a risk-informed approach and provide a more specific methodology than the “graded approach” definition found in Part I.

### 403.2 Quality Assurance Program

The application of risk-informed approach to QA program requirements is the basis for implementing alternative treatment requirements. Performing a review of the safety significance of SSCs using a probabilistic risk assessment to determine initial SSC categorization, confirming categorization with an Integrated Decision-making Panel, and getting regulatory approval is the foundation for implementing alternative treatment requirements to SSCs. Section 200 describes a suggested approach for this.

After the SSCs have been categorized, development of alternative treatments for alternative treatment categorized items can begin. Although the QA rigor for alternative treatment categorized SSCs may be reduced in comparison to a special treatment approach, the facility operator must ensure that alternative treatment categorized SSCs remain capable of performing their safety-related functions with reasonable confidence under design basis conditions. Adjustment of QA program controls for training and qualification of personnel working on alternative treatment categorized SSCs, should be adjusted to ensure adequate staff is qualified to work on special...
treatment categorized SSCs is maintained. This training should include the qualification and use of probabilistic risk assessments and qualifications of members of the Integrated Decision-making Panel.

Because nuclear facility operators often use several quality levels for QA activities, it is recommended that quality level nomenclature not use terms such as “safety-related” or “non-safety-related” following classification in the risk categories described previously.

The qualification of facility regulator staff in the use of probabilistic risk assessments, RISC categorization, and the application of Alternate Treatment Approach for SSCs should be considered by the regulator.

Because of the importance of RISC categorization and its associated decisions, and Feedback and Adjustment activities, QA records associated with these should be addressed.

602 Evaluate RISC-3 Related Inspections
The facility operator should review and evaluate data collected that is associated with alternative treatment SSC inspections to determine if there are any adverse changes in performance or reliability such that the SSC unreliability values approach or exceed the values used in prior evaluations and that calculated large early release frequency resulting from changes in treatment are small.

602 Evaluate RISC-3 Related Inspections
The facility operator should review and evaluate data collected that is associated with alternative treatment SSC inspections to determine if there are any adverse changes in performance or reliability such that the SSC unreliability values approach or exceed the values used in prior evaluations and that calculated large early release frequency resulting from changes in treatment are small.
<table>
<thead>
<tr>
<th>No.</th>
<th>CC</th>
<th>Description</th>
<th>Acceptance Criteria</th>
<th>Method of Verification</th>
</tr>
</thead>
<tbody>
<tr>
<td>D-1</td>
<td>Built-in quality: adherence to coding practices</td>
<td>The degree to which the computer program complies with the approved coding standards, use of source code libraries, or automated configuration management tool. This critical characteristic can be used to provide an indicator of the errors remaining in the computer program.</td>
<td>Coding practice criteria can be a percentage (e.g., 90%) of the supplier coding standards met, and, where appropriate, 100% of possible source code library modules are used instead of recoding.</td>
<td>Verified through the review of source code inspection reports or other supplier evidence that included reviews of coding practice for the subject source code modules. The dedicating entity during a survey may also review the source code module’s compliance with the supplier’s documented coding practices (Method 2).</td>
</tr>
<tr>
<td>D-2</td>
<td>Built-in quality: source code structure (complexity, conciseness)</td>
<td>The measure to which the computer program is legible, complexity is minimized, and source code length is minimized. This critical characteristic can be used to provide an indicator as to the difficulty to verify through reviews and testing that the source code will perform as expected.</td>
<td>Source code structure criteria can be quantitative, through the use of static analysis tools, or qualitative, through reviews of the documented design or inspection of the source code. Source code structure criteria may take the form of a number of internal subroutine interfaces, a number of do-loops, numbers of exits from a module, straightforward flow of logic in source code module, and source code module depth and breadth.</td>
<td>Verified through the review of supplier-documented evidence from the use of a static analysis tool or the dedicating entity performing an inspection and manual analysis of the documented design or computer program source code (Method 2).</td>
</tr>
<tr>
<td>D-9</td>
<td>Supportability/maintainability</td>
<td>The ability for the supplier to continue supporting the computer program over the life of its use or the computer program design that provides for ease in performing modifications to the computer program. This critical characteristic may be more appropriate for computer programs whose failure could result in few or no alternatives or those alternatives that are not financially feasible.</td>
<td>Supportability/maintainability criteria can consist of the stability of the supplier based upon business longevity (e.g., 20 yr in business), size of customer base (e.g., 1,000 customers worldwide), planned future product releases (e.g., supplier R&amp;D has updates scheduled for next 3 yr), supplier history of discontinuing products (e.g., cancelled three product lines over past 2 yr), or the time required to change the computer program (mean time to change or fix).</td>
<td>Verified through one or more of the following: (a) review of the supplier history for the specific computer program, as well as the history in supporting similar computer programs or products (Method 4) (1) review of supplier metrics associated with the length of time to evaluate the change/error correction, make the source code change/correction, test the change/correction, update all computer program documentation, and release the change (Method 2)</td>
</tr>
</tbody>
</table>
### Existing Text of NQA-1-2019

<table>
<thead>
<tr>
<th>SUBPART 3.2-2.20</th>
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<td>Samples should be identified in a manner consistent with their intended use. Identification should be maintained throughout acquisition, handling, testing and analysis, preservation, shipment, transfer, storage, and disposition of samples. Samples should be identified by placing the identification directly on the samples when possible, or on their container, or on a label or tag attached to the sample or their container. Sample identification should be verified and documented prior to release for testing or analysis. Identification methods should not affect sample characteristics or interface with the intended use. Identification systems should ensure documented traceability of samples from the...</td>
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400 CONTROL OF SAMPLES

Samples should be controlled during handling, acquisition, transfer of custody, shipment, storage, and disposition to preclude damage and loss (including loss of identity or associated documentation) and minimize deterioration. Responsibilities for control of samples should be defined.

Representative archival samples should be maintained from difficult-to-repeat samples collection activities such as principal bore holes.

Consideration should be given to the type of container, time constraints on perishable materials, and other environmental or safety considerations applicable to the sample.

Where multiple organizations are involved, appropriate procedures should describe interface and custody responsibilities. The identification of samples should be verified and maintained when samples are handled, transported, or transferred from one organization’s responsibility to another’s.

Sample characteristics, integrity, and identification should be maintained or controlled during storage. The controls applied should be consistent with the planned duration and conditions of storage and should describe action to be taken where samples have a maximum life expectancy while in storage.

Storage methodology should be developed and implemented to ensure that essential sample characteristics are maintained to protect integrity. Samples should be controlled to preclude mixing of like samples. Samples on which analyses or tests have been performed

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PART IV, Subpart 4.1.3: Guidance on the Use of NQA-1-2015 for Compliance With 10 CFR 71 and/or 10 CFR 72 Requirements

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<td>This Subpart may be used by organizations intending to adopt NQA-1 as a national consensus Standard for development and implementation of a Quality Assurance Program that meets 10 CFR 71, “Packaging and Transportation of Radioactive Material, Subpart H, Quality Assurance” and/or 10 CFR 72, “Licensing Requirements for the Independent Storage of Spent Nuclear Fuel and High Level Radioactive Waste, Subpart G, Quality Assurance” requirements. This Subpart describes how NQA-1–2015 addresses the 10 CFR 71 and 10 CFR 72 Quality Assurance requirements and identifies additional information an organization intending to adopt NQA-1 for the development and implementation of a Quality Assurance Program that meets the 10 CFR 71 and/or 10 CFR 72 requirements should consider.</td>
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<td>The Nuclear Regulatory Commission (NRC) establishes “requirements for packaging, preparation for shipment, and transportation of licensed material; and procedures and standards for NRC approval of packaging and shipping procedures for fissile material and for a quantity of other licensed material in excess of a Type A quantity” in 10 CFR 71. Subpart H of 10 CFR 71 describes quality assurance requirements. The 10 CFR 72 regulation states, “establish requirements, procedures, and criteria for the issuance of licenses to receive, transfer, and possess power reactor spent fuel</td>
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and other radioactive materials associated with spent fuel storage in an independent spent fuel storage installation (ISFSI).” Subpart G of 10 CFR 72 describes quality assurance requirements.

The NRC’s approval of an applicant’s Quality Assurance Program requires acceptable standards of quality and a description of how the requirements will be met. The NQA-1 Standard is a national consensus Standard and should be considered for providing the essential implementing methods for a Quality Assurance Program including the details for effective and reliable supporting processes and procedures presented in this Subpart.

This Subpart does not usurp the sole authority of the NRC to issue guidance and interpretations for its regulations.

300 SUMMARY RESULTS

In general, the regulations in 10 CFR 71, Subpart H, and 10 CFR 72, Subpart G, are nearly identical and are included within a Quality Assurance Program complying with NQA-1. However, a few differences exist due to the wording or level of detail required by the CFRs.

Table 300 of this Subpart summarizes each of the 10 CFR 71 and 10 CFR 72 criteria and how they are addressed by NQA-1. Differences in the documents and topics that should be addressed independently of the NQA-1 criteria to meet 10 CFR 71 and/or 10 CFR 72 criteria are described. Where an NQA-1 Part 1 requirement addresses the 10 CFR 71 and/or 10 CFR 72 criterion, the associated NQA-1 Nonmandatory Guidance should also be considered to aid in addressing the NRC requirement.
Overall, the implementer of a program complying with the requirements of NQA-1-2015 may meet the requirements of 10 CFR 71 (1-1-15 Edition) and/or 10 CFR 72 (1-1-15 Edition) with minimal program revisions. The differences cited are of administrative actions and prescriptive details in Parts 71 and 72. Refer to Table 300 for details.
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<td>The following guidance should be considered for the control of samples:</td>
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<td>(a) Controls should include identification of sample orientation relative to the location</td>
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<td>that was sampled, as appropriate.</td>
<td>location that was sampled, as appropriate.</td>
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<tr>
<td>(b) Sample identification methods should ensure that traceability is established and</td>
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<td>maintained from the samples to applicable procedures or other specifying documents.</td>
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<td>(c) Sample chain of custody should be tracked and documented from the time of collection</td>
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<td>(d) Physical markings, when used, should</td>
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<td>(1) be applied using materials and methods that provide a clear and legible identification</td>
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<td>(2) not detrimentally affect the sample content or form</td>
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<td>(3) be transferred to each identified sample part when the sample is subdivided</td>
<td>identification</td>
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<td>(4) not be obliterated or hidden by surface treatments or sample preparations unless</td>
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<td>other means of identification are substituted</td>
<td>(3) be transferred to each identified sample part when the sample is subdivided</td>
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<td>(e) Sample control methods should address the following guidance:</td>
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<td>(1) If samples have limited use or storage life, methods should be established that</td>
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<td>preclude using the sample beyond its intended use or storage life. Use of samples beyond</td>
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affected by exceeding the storage life. Justification for use of samples beyond their storage life should be documented.

(2) If sample storage is required, methods should be established for the control of sample identification that are commensurate with the planned duration and conditions of storage. These methods should provide for

   (-a) maintenance or replacement of markings and identification tags damaged during handling or aging

   (-b) protection of identification markings subject to excessive deterioration resulting from environmental exposure

   (-c) updating related documentation to reflect future intended use

(f) Archiving Samples. Implementing documents should specify the representative samples to be archived.

(g) Handling, Storage, and Shipping. Part I, Requirement 13 should be applied to handling, storage, and shipping of samples.

(h) Disposition of Nonconforming Samples. For samples that do not meet requirements specified in work controlling documents or if the results of sample analysis do not meet desired objectives, it should be identified, documented, evaluated, and the sample should be segregated. The disposition for nonconforming samples should be identified and documented and should be limited to “use-as-is,” “limited use,” or “discard.”