R D T S T A N D A R D

UNITED STATES ATOMIC ENERGY COMMISSION
DIVISION OF REACTOR RESEARCH AND DEVELOPMENT

RDT F 2-2T, Amendment 8

Date June 1973

Page 1 of 2

QUALITY ASSURANCE PROGRAM REQUIREMENTS

A M E N D M E N T 8

This amendment forms a part of RDT F 2-2T
dated June 1969

1. Page 1-3: Add:

1.7 Applicable Documents. The following documents are a part of this standard to the extent specified herein. The issue of a document in effect on the effective date of the referencing specification or procurement document, including any amendments also in effect on that date, shall apply.

1.7.1 RDT Standards.

RDT F 3-2T Calibration Program Requirements

2. Page 4-3, 4.8: Change to read:

4.8 MEASURING AND TEST EQUIPMENT CALIBRATION AND CONTROL

The contractor shall establish and implement procedures for the selection, use, calibration, adjustment, maintenance and control of all measuring and test equipment used to accomplish contract requirements, during all phases of work, in accordance with RDT F 3-2.

3. Page 5-4, 5.8: Change to read (Deleting 5.8.1, 5.8.2, 5.8.3 and 5.8.4):

5.8 MEASURING AND TEST EQUIPMENT CALIBRATION AND CONTROL

The contractor shall establish and implement procedures for the selection, use, calibration, adjustment, maintenance and control of all measuring and test equipment used to accomplish contract requirements, during all phases of work, in accordance with RDT F 3-2.

4. Page 6-3, 6.7.5: Change to read:

6.7.5 Measuring and Test Equipment Calibration and Control. The contractor shall establish and implement procedures for the selection, use, calibration, adjustment, maintenance and control of all measuring and test equipment used to accomplish contract requirements, during all phases of work, in accordance with RDT F 3-2.

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5. Page 7-5, 7.9: Change to read:

7.9 MEASURING AND TEST EQUIPMENT CALIBRATION AND CONTROL

The contractor shall establish and implement procedures for the selection, use, calibration, adjustment, maintenance and control of all measuring and test equipment used to accomplish control requirements, during all phases of work, in accordance with RDT F 3-2.

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RDT Standards Transmittal

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	RDT F 2-2	Quality Assurance Program Requirements, Amendment 4 (6-11-76)	D

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R. Thiede

AMENDMENT CONTROL SHEET FOR RDT F 2-2

The changes incorporated in the August 1973 issue of RDT F 2-2 are identified by the following marginal notations:

C	Change
D	Deletion
E	Editorial
N	Addition

The number suffix following the letter code corresponds to the number of the amendment in which the change was made.

The following change pages incorporate all previous amendment actions contained in Amendment 1 (12-73) and Amendment 2 (3-74), which were published as "add-on" pages, and Amendment 3 (7-11-75). The previous "add-on" amendment pages should be discarded.

Amendment 1 (12-73) replaces pages of the August 1973 issue as follows:

<u>Old Pages</u>	<u>New Pages</u>
11 and 11A	11 and 11A
15	15 and 16*
19	19, 19A, 19B, and 20*
26	25*, 26, 26A, and 26B
30	29* and 30
32	31* and 32

Amendment 2 (3-74) replaces pages of the August 1973 issue as follows:

<u>Old Pages</u>	<u>New Pages</u>
i, ii, and iii	i, ii*, and iii
2	1*, 2, 2A, and 2B
4	3* and 4
7	7 and 8*
33	33 and 34*

Amendment 3 (7-11-75) replaces pages of the August 1973 issue as follows:

<u>Old Pages</u>	<u>New Pages</u>
Cover	Cover
1	1 and 2*
10	9* and 10
11	11, 11A, 11B, and 12*
35, 36	35, 36

*This page is not amended.

Amendment 4 (6-11-76) replaces pages of the August 1973 issue as follows:

<u>Old Pages</u>	<u>New Pages</u>
cover	cover
i and ii	i and ii
iii	iii
1 and 2	1 and 2*
11B and 12	11B and 12
13 and 14	13 and 14
17 and 18	17* and 18
23 and 24	23* and 24
27 and 28	27* and 28

*This page is not amended

RDT F 2-2

Supersedes
RDT F 2-2T, June 1969

RDT Standard

QUALITY ASSURANCE PROGRAM REQUIREMENTS

AUGUST 1973

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**U.S. ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION
* DIVISION OF REACTOR DEVELOPMENT AND DEMONSTRATION**

*Cover amended

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QUALITY ASSURANCE PROGRAM REQUIREMENTS

1. INTRODUCTION

1.1 Scope. This standard sets forth general requirements for planning, managing, conducting, and evaluating quality assurance programs for reactor development and test facility projects and associated processes, structures, components, and systems. These quality assurance requirements are based on proven practices and provide the means of control and verification whereby those responsible for project management can assure that the quality required for safe, reliable, and economical operation will be achieved. The objective of the programs covered by this standard is to assure that structures, components, systems, and facilities are designed, developed, manufactured, constructed, operated, and maintained in compliance with established engineering criteria. To achieve this objective, controls are to be established and implemented at predetermined points, and necessary action taken to prevent, detect, and correct any deficiencies.

The requirements contained in this standard are intended to cover the life of a project from concept through operation. The requirements have been arranged into the following areas, thereby enabling flexibility for selective application of those requirements that are appropriate to the project scope.

1.1.1 Management and Planning. Management and planning efforts include formulation, direction, and documentation of the entire quality assurance program; designation of organizational responsibilities for quality assurance; preparation of plans, procedures, and instructions; training and indoctrination of personnel; conduct of periodic, documented program audits, and reviews; maintenance of records; and preparation of quality status reports.

1.1.2 Design and Development. Design and development efforts in the quality assurance program include establishing, controlling, and verifying design. The development effort encompasses planning, testing, documentation, surveillance, and closed-loop review, reporting, and feedback of development information.

1.1.3 Procurement. Procurement efforts include the specification of quality assurance requirements in procurement documents, selection and surveillance of suppliers, and receipt and inspection of purchased items.

1.1.4 Manufacturing, Fabrication, and Assembly. Manufacturing, fabrication, and assembly efforts include conformance to drawings, standards, specifications, procedures, and instructions for the control of materials, components, and processes; performance of in-process and

final assembly inspections, examinations, and tests; calibration of instruments and equipment; and control of nonconforming items.

1.1.5 Construction and Installation. Construction and installation efforts include assurance that the required quality is maintained through control of field fabrication, erection, and testing activities. Quality assurance in this area is achieved through continued compliance with design drawings, specifications, codes, and standards; equipment installation procedures and work instructions; handling, storage, and cleaning practices; and requirements for performing planned inspections, examinations, and preoperational tests.

1.1.6 Operation, Maintenance, and Modification. Operation, maintenance, and modification efforts include quality assurance through systematic planning of work; application of work instructions or operating procedures for controlling operation, maintenance, and modification; preparation of records and reports of operation experience; and performance of scheduled, periodic inspection and testing.

1.2 Definitions.

1.2.1 Characteristic. Any property or attribute of an item, process, or service that is distinct, describable and measurable as conforming or nonconforming to specified requirements.

1.2.2 Contractor. The individual or company entering into a contract, subcontract, or purchase order issued by the purchaser.

1.2.3 Failure. The inability of an item to perform within specified limits.

1.2.4 Unusual Occurrence. An unusual or unplanned event having programmatic significance such that it adversely affects or potentially affects the performance, reliability, security, or safety of a reactor or test facility, or causes injury or potential hazard to personnel which may require special evaluation, correction, or preventive action to be taken.

C2

1.2.5 Item. Any level of unit assembly, including system, subsystem, subassembly, component, part, or material.

1.2.6 Nonconformance. A deficiency in characteristic, documentation, or procedure which renders the quality of an item or service unacceptable or indeterminate.

1.2.7 Objective Quality Evidence. Any recorded fact or facts pertaining to the quality of an item, process, or service based on observation, measurement, or test, that can be verified.

each drawing, the list shall include specific identification of the applicable revision; level of approval required, i.e., which organizations must take approval action; and current status, e.g., in preparation, issued for approval, released for use.

3.5 Design Reviews. The contractor shall conduct planned and documented design reviews in accordance with procedures to verify that the design meets requirements. Design reviews are intended to provide assurance that studies, calculations, and analyses involving nuclear effects, electrical, mechanical, thermal, hydraulic, safety, reliability, maintainability, and other pertinent considerations are complete and correct; that research and development programs and tests associated with the design provide optimal benefits to the design; that materials and design interface are compatible; that maximum use is made of qualified, standardized, or approved parts, materials, components, and processes; that accessibility for in-service inspection, maintenance, or repair is adequate; and that acceptance criteria for inspections and tests are delineated. Design reviews shall be held to discuss and resolve technical problems concerning design adequacy among the design contractor, the purchaser, and other project participants.

The contractor shall identify those components and systems for which independent formal design reviews are to be scheduled and conducted by the responsible design organization. Design reviews shall be independent in the sense that the reviewers have no direct responsibility for the design, but are technically competent and may be from the same organization that prepared the design. Participation in design reviews should be interdisciplinary, involving key technical personnel in the areas of design, manufacturing, testing, quality assurance, operation, and maintenance, as well as project management and consultants, as appropriate. Joint design reviews with other participating contractors shall be held by the responsible design organization when design interfaces are under consideration.

Hold points shall be established in the project beyond which further design work or initiation of fabrication shall not proceed pending an independent design review. Each design review shall be documented by the contractor in a report that shall include a synopsis of significant problems, decisions, and assigned action items. Design review reports shall be reviewed, approved, and issued by the responsible design organization and submitted to the purchaser as required by the contract.

3.6 Design Verification Testing. Measures shall be established and documented to assure that design verification testing activities are identified, performed, and controlled. Design verification testing includes the testing of materials, components, features, subassemblies, systems or processes to verify design or process adequacy, or to obtain quantitative data for use in the establishment of designs or process parameters.

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3.6.1 Test Requirements. Design verification test requirements shall be defined and documented in test criteria, requests for approval-in-principle, test specifications, test requests, product specifications, design descriptions, or other engineering documents. Test requirements shall include the following provisions as appropriate:

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1. Test objectives.
2. Technical requirements and restraints.
3. Identification of items or processes to be tested.
4. Test facilities to be used and any modifications.
5. Evaluation of measuring and test equipment.
6. Tests to be performed.
7. Data acquisition and reduction requirements.
8. Pre- and post-test examinations.
9. Readiness reviews.
10. Acceptance limits.
11. Archive samples.
12. Disposition of test items.
13. Documentation and reporting requirements.

Test requirements and acceptance criteria and changes thereto shall be specified or approved by the responsible design organization, unless otherwise designated. Approval requirements and authorizations for planning, procedures, and changes to these shall be defined.

3.6.2 Planning. Design verification testing activities shall be planned in accordance with the test requirements and coordinated with other design activities. Planning shall include the definition of organizational responsibilities, the procedures to be used, and the sequence of activities and milestones. Statistical test design may be used when economically warranted. Planning shall also include provision for personnel and equipment protection and other actions to be taken in the event of failure or malfunction.

3.6.3 Procedures. Design verification testing activities shall be performed in accordance with written procedures and changes thereto which incorporate test requirements, acceptance criteria, and test methods. Test procedures shall identify test prerequisites including calibrated instrumentation, trained personnel, readiness of test facilities, equipment, supplies and test items, suitable environments, and verification of data acquisition capability, as appropriate.

3.6.4 Test Items. Measures shall be implemented for the identification, characterization, control, and ultimate disposition of test items. Such measures shall verify that test items have been properly fabricated, calibrated, analyzed, cleaned, handled, stored, shipped, inspected, and protected against loss or damage. Essential features of the test item shall be characterized and documented, prior to and upon completion of testing. Test items which will be used in a facility as operating units shall meet all requirements specified for such units before incorporation into the facility.

3.6.5 Test Equipment and Fluids. Measures shall be implemented to verify that the range, accuracy, and precision of test equipment are commensurate with the test requirements. Measures shall also be implemented to verify that test fluids are characterized and controlled in accordance with the test requirements.

C4

3.6.6 Data Acquisition Equipment and Method. Data acquisition instrumentation, analytical standards and methods, and data collection and reduction methods shall be evaluated prior to use to verify accuracy, stability, and repeatability. The evaluation results shall be documented.

a. Commercially available instrumentation or standard methods for which sufficient information exists need not be evaluated if used in accordance with established practice.

b. When possible, specially designed instrumentation and methods shall be checked out under conditions which will be encountered in testing to verify suitability for use.

Data acquisition equipment shall be calibrated, adjusted, or maintained prior to use or at prescribed intervals according to equipment stability, and the results documented.

3.6.7 Readiness Reviews. Measures shall be implemented for the performance of documented test readiness reviews to verify that all prerequisites have been satisfied.

3.6.8 Failure Analysis. Measures shall be implemented for the documented analysis of significant failures during testing. Significant failures include any unplanned, premature or incipient failure of test items and test equipment. Such measures shall provide for the determination of cause and mode of failure, an evaluation of effect on safety or operability, the corrective action to preclude recurrence, and reporting to appropriate organizations.

3.6.9 Test Results. Measures shall be implemented for the recording, analysis, and reporting of design verification test results.

3.6.10 Test Review. Measures shall be implemented for the documented review of design verification test results by the responsible design organization to determine whether the test requirements have been satisfied. Such reviews may be performed separately or as a part of the design review process of 3.5.

3.6.11 Test Records. Measures shall be implemented for the retention of test data and results, failure analyses, test reviews, reports, and other pertinent documents.

3.7 Item Qualification. Items, whose adequacy for service cannot be fully verified through studies or calculations, shall be qualified through design verification testing, similarity to a previously qualified item, or use experience. Design verification testing shall be performed on prototypic items under conditions which are equal to or more severe than those specified for in-service use. Similarity to the previously qualified item shall be demonstrated and documented in all pertinent aspects, such as design, manufacturing methods, and intended service application. Successful in-service experience shall cover the full, maximum range of design conditions.

C4

3.8 Quality Records. The contractor shall compile and maintain records and data generated during design and development. Typical records include codes, standards, practices, design description, specifications and drawings, design data and studies, design review reports, development plans, procedures and test reports, and failure reports. Copies of records shall be distributed within the contractor's organization to other participating organizations as appropriate and provided to the purchaser as required.

3.9 Quality Audits. The contractor shall regularly audit quality assurance activities related to the design and development phase in accordance with the requirements of Section 8.

(End of Amendment Page)

receiving and identification of raw material; the fabrication, processing, or testing activities; and the preparation of items for shipment. Special effort shall be made to inspect items at the earliest practical time so that deficiencies may be detected and corrected before assembly or subsequent work precludes inspection. Source surveillance and inspection may not be required when the quality of an item can be verified to conform to specifications or drawings by review of certified test reports, inspection upon receipt, or other means.

4.9 Receiving Inspection.

4.9.1 Planning and Inspection. The contractor shall establish and implement procedures for receipt, inspection, test, and distribution of items delivered by suppliers. Receiving inspection shall be coordinated with source surveillance and inspection activities.

The contractor shall inspect or test purchased items upon receipt for cleanness and dimensional, chemical, physical or other characteristics as appropriate to verify conformance to specified requirements. The contractor shall routinely or periodically validate supplier-furnished material certifications by means of independent analyses or overchecks. The contractor's receipt inspection planning shall define the necessary inspections and tests and shall provide for inspection density adjustment depending upon source, quality performance history, lot size and other factors.

Inspection instructions and test procedures shall provide for verification of characteristics in accordance with acceptance criteria in contract drawings and specifications. Emphasis shall be placed on assuring that items have not been damaged in shipment and that interface characteristics that influence subsequent fabrication, construction, or end use are verified. Special examinations or tests required at the point of receipt shall be identified and conducted in accordance with contract requirements.

Sampling inspection methods may be used when: (1) tests are destructive or (2) inherent characteristics, inspection records, or noncritical applications of the material or product indicate that a reduction of inspection will not jeopardize the quality, reliability, or design intent of the material or product. The use of sampling inspection methods other than those stated in the contract shall be subject to approval for use by the purchaser.

4.9.2 Documentation. The contractor shall review and provide appropriate approval of supplier-generated documents, such as drawings, manuals, certifications, test results, and inspection data for completeness, acceptability, and conformance to contract requirements before accepting completed items.

4.9.3 Disposition of Received Items. Materials or products found to be damaged upon receipt shall be identified and withheld from inspection or end use until disposition is decided. Acceptable materials and products shall be identified as to inspection status and processed to storage or end-use

areas. Nonconforming materials and products shall be identified, segregated, and disposed of in accordance with 4.11.

4.10 Control of Nonconforming Items. The contractor shall develop and implement procedures to control purchased items that do not conform to contract requirements. The procedures shall provide for prompt identification, documentation, segregation, technical review, and disposition of nonconforming purchased items. Significant nonconformances that cannot be reworked to conform to requirements shall receive a technical review, and resultant decisions to accept, repair, or return a nonconforming item to its source for correction shall be supported by records of all cases submitted for action. When deficiencies are detected during contract performance, the contractor shall promptly feed back all information necessary for correction to the supplier or source. The contractor shall maintain active coordination with suppliers to assure rapid resolution of quality problems.

Items rejected by the contractor and later resubmitted by the supplier shall be identified as resubmittals. In each case, the supplier shall refer to the contractor's rejection document and shall furnish evidence to show that the cause for rejection has been corrected.

4.11 Control of Received Items. The contractor shall establish and implement procedures for identifying, controlling, handling, and storing received materials and equipment. These procedures shall provide for maintaining records of marking and identification to assure that the items and pertinent data can be traced to their origin in accordance with contract requirements. Controls shall be implemented to protect items that deteriorate from environmental exposure or which may be damaged during handling operations. Material or equipment that deteriorates with age shall be identified, and controls implemented to assure utilization during its useful life.

4.12 Quality Audits. The contractor shall regularly audit quality assurance functions related to procurement, in accordance with Section 8.

4.13 Alloy Verification. Items identified by the purchaser shall be checked by appropriate nondestructive tests to verify that they conform to the specified alloy types. The checks shall be performed at the time permanent identification is applied to a part, at the time of assembly, or just prior to shipment, except that parts, subassemblies or assemblies with permanent identification applied may be checked at the contractor's receipt inspection. The contractor shall demonstrate or justify, to the satisfaction of purchaser, that the test devices or methods will reliably detect incorrect materials.

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5.12 Handling, Preservation, Packaging, Storage, and Shipping.

5.12.1 Handling. The contractor shall develop and implement handling practices, procedures, and instructions as required by applicable codes, standards, and specifications. Special carts, boxes, containers, hoists, manipulators, and transport vehicles shall be used during fabrication and assembly operations when damage due to handling might otherwise result.

Where special precautions are required during handling or lifting of items to prevent damage because of weight, size, susceptibility to shock damage, high nil-ductility transition temperature, or other considerations, detailed instructions or procedures shall be prepared and implemented. Items not specifically covered by special instructions or procedures shall be handled in accordance with sound handling practices. The responsible organization shall ensure that operators of handling and lifting equipment are competent, experienced and properly supervised.

5.12.2 Preservation, Packaging, and Storage. Contractor quality assurance programs shall provide procedures and instructions for the preservation, packaging, and storage of items. The contractor shall assure that items subject to deterioration or damage through exposure to air, moisture, or other environments during fabrication, processing, assembly, and interim storage periods are cleaned and have preservative applied at such points and by such methods as required to preclude damage. Items being packaged for shipment shall be preserved in accordance with contract requirements. Items subject to damage shall be packaged in such a manner, and with such materials, as required to prevent damage. Packaging requirements shall allow for conditions that could affect the item at the contractor's plant, in transit to the destination, and at the destination. Items to be stored shall be adequately protected against deterioration and damage. Periodic inspections shall be performed to detect deterioration or damage, and corrective action shall be taken as required.

5.12.3 Shipping. The contractor shall provide for inspection and control of all items shipped from his plant to assure that:

1. Items to be shipped have received and satisfactorily passed the required inspections and tests.
2. Items have been preserved and packaged in accordance with applicable specifications and procedures.
3. Items and packaging have been properly identified.
4. Devices to record conditions during shipping have been provided.

5.13 Quality Records. In accordance with the requirements of 2.4, inspection, test, and other data related to the quality status of parts, components, assemblies, and systems shall be collected, processed, analyzed, and distributed to pertinent areas within the contractor organization, to sources of supply when appropriate, and to the purchaser when required by the contract.

Examples of records include acceptance test data, inspection and test reports, material certifications, welder qualifications, quality audit reports, summaries of nonconformances, and corrective actions.

5.14 Quality Audits. The contractor shall regularly audit quality assurance functions related to fabrication and assembly operations in accordance with the requirements of Section 8.

5.15 Alloy Verification. Items specified by the purchaser shall be checked in accordance with 4.13, except for permanently identified items with previous, documented checks showing acceptability. The checks shall be performed at the time of assembly or when permanent identification is applied to a part.

N4

(End of Amendment Page)

6.7.5 Control of Nonconforming Items. The contractor shall implement a system that assures control of nonconforming material resulting from construction operations. This system shall include provisions for corrective action and feedback and shall comply with the requirements of 5.10.

6.7.6 Statistical Quality Control and Analysis. The contractor may utilize statistical sampling plans and analysis methods in accordance with the requirements of 5.9.

6.7.7 Indication of Status of Components and Systems. The contractor shall establish and implement methods to indicate, by tagging or other appropriate means, the status of components and systems to prevent their inadvertent operation where such operation would be detrimental to the quality of components or systems.

6.8 Inspection. The contractor shall establish and maintain an inspection system that assures control of the construction work effort. This system shall include the following quality control elements.

6.8.1 Source Inspection. The contractor shall establish and implement plans and procedures for source surveillance and inspection in accordance with 4.9.

6.8.2 Receiving Inspection. The contractor shall prepare and implement procedures for inspecting materials and equipment on arrival at the construction site in accordance with 4.10. These procedures shall define the extent to which items are uncrated and re-crated and the points of critical interest that are to be inspected. The procedures shall require that an inspection report be prepared that indicates the quality status of the item being received.

6.8.3 Site Inspection. The contractor shall provide a system for performing inspection at the construction site, with adequate personnel and clearly defined instructions to assure that the quality of materials, work in process, and completed construction conforms to contract requirements. Inspection instructions shall include acceptance criteria.

6.8.4 Installation Inspection. The contractor shall plan and perform inspections and tests to be performed after installing assemblies, subsystems, and systems. Inspection instructions and test procedures shall be prepared in accordance with the requirements of 6.4. Inspections and tests shall be conducted to the extent necessary to verify that installation operations have been accomplished in accordance with design drawings, specifications, and codes stipulated in the contract. The contractor shall provide objective evidence to verify that the as-built configuration of installed assemblies, subsystems, systems, and facilities conforms to applicable codes, specifications, drawings, and other contractual requirements, including authorized changes.

6.9 Testing, Operation, and Maintenance.

6.9.1 Start-up of Equipment and Systems. The contractor shall establish check points and procedures to assure that, as a minimum, the following items are evaluated prior to start-up operations:

1. Completeness of construction activities leading up to the point of start-up as outlined by construction work planning.
2. Cleanness of items.
3. Availability of start-up procedures.

6.9.2 Preoperation Testing. Preoperation testing plans and procedures shall be prepared and reviewed by the contractor to assure compliance with safety standards, prevention of damage to the item being tested, and conformance to testing requirements of the contract.

6.9.3 Operation and Maintenance. Procedures shall be established and implemented by the contractor for operating and maintaining equipment and systems that are used for construction purposes and which will eventually become an integral part of the finished project, as well as for assuring the integrity and quality of such items.

6.10 Quality Assurance Records. The contractor shall systematically compile and maintain records and data generated during the construction phase. Typical records include material certifications and identification data for traceability; special process and personnel certification and test reports; inspection and test reports; design drawings, specifications, procedures; and reports of nonconformance. These records shall correctly identify the as-built project and furnish objective evidence of quality. The records shall be indexed, filed, and maintained to allow access for retrieval and review of information; and all records shall be protected against deterioration and damage. The record file shall be maintained by the contractor and transmitted to the purchaser of his designee.

6.11 Quality Audits. The contractor shall regularly audit the quality assurance activities related to construction and installation in accordance with the requirements of Section 8.

6.12 Alloy Verification. Items specified by the purchaser shall be checked in accordance with 4.13, except for permanently identified items with previous documented checks showing acceptability. The checks shall be performed at the time of installation or assembly.

N4

R D T S T A N D A R D

UNITED STATES ATOMIC ENERGY COMMISSION
DIVISION OF REACTOR RESEARCH AND DEVELOPMENT

RDT F 2-2, Amendment 1

DATE December 1973

PAGE 1 OF 2

QUALITY ASSURANCE PROGRAM REQUIREMENTS

A M E N D M E N T 1

This amendment forms a part of RDT F 2-2
dated August 1973

1. Page 11, 3.4.1: Change to read:

3.4.1 Engineering Document Review and Approval. The contractor shall establish and implement procedures that provide for the review and approval of specifications, drawings, analyses and other significant engineering documents, including changes thereto, before issuance. Reviews and evaluations shall be conducted systematically to verify completeness, correctness, and adequacy with respect to project or contract requirements, engineering standards, design practices, and intended application. Approval authority shall be evident through sign off by personnel designated as responsible for establishing the technical requirements. Other personnel shall participate in review and approval activities as required by the contractor's procedures. Changes to approved engineering documents shall be reviewed and approved by the same organizations that performed the original review and approval unless the contractor, with purchaser approval, designates another responsible organization.

2. Page 11, 3.4.2: Change to read:

3.4.2 Document Control. The contractor shall establish and implement procedures that assure the control of engineering documents authorized for release and use. Such controls shall assure that engineering documents and changes thereto are properly prepared, coordinated, and released by authorized personnel; distributed to prescribed organizations and locations; and that obsolete, incorrect, and inappropriate documents are removed from points of issue or use.

3. Page 15, 4.4: Change to read:

4.4 Procurement Document Review. The contractor shall establish and implement procedures whereby designated personnel shall review procurement documents and changes thereto to assure that requirements are complete and appropriate.

4. Page 19, 5.3: Change second paragraph to read:

The contractor's inspection and test plan shall establish those inspections and test points from raw materials through fabrication, processing, and assembly at which conformance of parts, components, and systems to design requirements will be verified. For pressure-retaining components, the inspection and test plan shall provide for direct wall thickness measurements of the pressure boundary. The inspection and test plan shall specify for purchaser approval the type, frequency, and location of wall thickness measurements as well as the measurement techniques to be used.

5. Page 25, 6.5: Add a third paragraph:

Provisions shall be made for the evaluation and approval of field or supplier-generated documents by designated personnel.

6. Page 30, 7.4.5: Change to read:

7.4.5 Document Control. The contractor shall establish and implement procedures that assure control of preparation, review, approval, release, change, distribution, and use of documents required for operation, maintenance, and modification activities. Documents, including procedures, specifications, operational analyses and objectives, and inspection and test results, shall be reviewed and approved by designated personnel prior to issuance for use.

7. Page 32, 7.5.5: Delete.

8. Page 35, 8.4: Add a second paragraph:

The contractor shall audit engineering, procurement, and other significant documents, including changes thereto, to verify accuracy, completeness, and currentness and to cause the correction of deficiencies by responsible management.

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RDT Standards Transmittal

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	NUMBER	DESCRIPTION	ACTION
	RDT F 2-2, Quality Assurance Program Requirements, Amendment 2 dated March 1974 This amendment changes the definition of and the requirements for incident report- ing, consistent with RDT F 1-3T as directed by RRD:LC:301 dated June 11, 1974	D	
SIGNATURE		<i>S. J. Rogers</i>	

RDT STANDARD

UNITED STATES ATOMIC ENERGY COMMISSION
DIVISION OF REACTOR RESEARCH AND DEVELOPMENT

RDT F 2-2, Amendment 2
DATE March 1974
PAGE 1 OF 1

QUALITY ASSURANCE PROGRAM REQUIREMENTS

AMENDMENT 2

This amendment forms a part of RDT F 2-2
dated August 1973

1. Page 2, 1.2.4: Change to read:

1.2.4 Unusual Occurrence. An unusual or unplanned event having programmatic significance such that it adversely affects or potentially affects the performance, reliability, security, or safety of a reactor or test facility, or causes injury or potential hazard to personnel which may require special evaluation, correction, or preventive action to be taken.

2. Page 4, 1.7.1: Add:

RDT F 1-3T Preparation of Unusual Occurrence Reports

3. Page 7, 2.6: Change to read:

2.6 Corrective Action. The contractor shall establish and implement procedures to assure that conditions adverse to quality, including unusual occurrences, unsatisfactory practices, deficiencies, failures, malfunctions, deviations, nonconformances, and defective material, are documented and corrected by responsible management and technical personnel. The cause of the adverse condition shall be determined and action taken to minimize or prevent recurrence. Quality trends shall be analyzed for improvement in work practices. Corrective action shall be extended to the work of subcontractors and suppliers, as appropriate.

4. Page 7, 2.8: Add:

2.8 Unusual Occurrence Reporting. The contractor shall establish and implement procedures for the detection, reporting, analysis, and correction of unusual occurrences during all phases of work in accordance with the requirements of RDT F 1-3.

5. Page 33, 7.10: Delete.

Supersedes
RDT F 2-2T, June 1969

RDT Standard

QUALITY ASSURANCE PROGRAM REQUIREMENTS

AUGUST 1973

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AMENDMENT CONTROL SHEET FOR RDT F 2-2

The changes incorporated in the August 1973 issue of RDT F 2-2 are identified by the following marginal notations:

C	Change
D	Deletion
E	Editorial
N	Addition

The number suffix following the letter code corresponds to the number of the amendment in which the change was made.

The following change pages incorporate all previous amendment actions contained in Amendment 1 (12-73) and Amendment 2 (3-74), which were published as "add-on" pages, and Amendment 3 (7-11-75). The previous "add-on" amendment pages should be discarded.

Amendment 1 (12-73) replaces pages of the August 1973 issue as follows:

<u>Old Pages</u>	<u>New Pages</u>
11 and 11A	11 and 11A
15	15 and 16*
19	19, 19A, 19B, and 20*
26	25*, 26, 26A, and 26B
30	29* and 30
32	31* and 32

Amendment 2 (3-74) replaces pages of the August 1973 issue as follows:

<u>Old Pages</u>	<u>New Pages</u>
i, ii, and iii	i, ii*, and iii
2	1*, 2, 2A, and 2B
4	3* and 4
7	7 and 8*
33	33 and 34*

Amendment 3 (7-11-75) replaces pages of the August 1973 issue as follows:

<u>Old Pages</u>	<u>New Pages</u>
Cover	Cover
1	1 and 2*
10	9* and 10
11	11, 11A, 11B, and 12*
35, 36	35, 36

*This page is not amended.

RDT STANDARD

RDT F 2-2 Amendment 2 (3-74)

U.S. ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION
DIVISION OF REACTOR RESEARCH AND DEVELOPMENT

DATE August 1973

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QUALITY ASSURANCE PROGRAM REQUIREMENTS

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RDT STANDARD

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RDT F 2-2 Amendment 3 (7-11-75)

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QUALITY ASSURANCE PROGRAM REQUIREMENTS

1. INTRODUCTION

1.1 Scope. This standard sets forth general requirements for planning, managing, conducting, and evaluating quality assurance programs for reactor development and test facility projects and associated processes, structures, components, and systems. These quality assurance requirements are based on proven practices and provide the means of control and verification whereby those responsible for project management can assure that the quality required for safe, reliable, and economical operation will be achieved. The objective of the programs covered by this standard is to assure that structures, components, systems, and facilities are designed, developed, manufactured, constructed, operated, and maintained in compliance with established engineering criteria. To achieve this objective, controls are to be established and implemented at predetermined points, and necessary action taken to prevent, detect, and correct any deficiencies.

The requirements contained in this standard are intended to cover the life of a project from concept through operation. The requirements have been arranged into the following areas, thereby enabling flexibility for selective application of those requirements that are appropriate to the project scope.

1.1.1 Management and Planning. Management and planning efforts include formulation, direction, and documentation of the entire quality assurance program; designation of organizational responsibilities for quality assurance; preparation of plans, procedures, and instructions; training and indoctrination of personnel; conduct of periodic, documented program audits, and reviews; maintenance of records; and preparation of quality status reports.

1.1.2 Design and Development. Design and development efforts in the quality assurance program include establishing, controlling, and verifying design. The development effort encompasses planning, testing, documentation, surveillance, and closed-loop review, reporting, and feedback of development information.

1.1.3 Procurement. Procurement efforts include the specification of quality assurance requirements in procurement documents, selection and surveillance of suppliers, and receipt and inspection of purchased items.

1.1.4 Manufacturing, Fabrication, and Assembly. Manufacturing, fabrication, and assembly efforts include conformance to drawings, standards, specifications, procedures, and instructions for the control of materials, components, and processes; performance of in-process and

final assembly inspections, examinations, and tests; calibration of instruments and equipment; and control of nonconforming items.

1.1.5 Construction and Installation. Construction and installation efforts include assurance that the required quality is maintained through control of field fabrication, erection, and testing activities. Quality assurance in this area is achieved through continued compliance with design drawings, specifications, codes, and standards; equipment installation procedures and work instructions; handling, storage, and cleaning practices; and requirements for performing planned inspections, examinations, and preoperational tests.

1.1.6 Operation, Maintenance, and Modification. Operation, maintenance, and modification efforts include quality assurance through systematic planning of work; application of work instructions or operating procedures for controlling operation, maintenance, and modification; preparation of records and reports of operation experience; and performance of scheduled, periodic inspection and testing.

1.2 Definitions.

1.2.1 Characteristic. Any property or attribute of an item, process, or service that is distinct, describable and measurable as conforming or nonconforming to specified requirements.

1.2.2 Contractor. The individual or company entering into a contract, subcontract, or purchase order issued by the purchaser.

1.2.3 Failure. The inability of an item to perform within specified limits.

1.2.4 Unusual Occurrence. An unusual or unplanned event having programmatic significance such that it adversely affects or potentially affects the performance, reliability, security, or safety of a reactor or test facility, or causes injury or potential hazard to personnel which may require special evaluation, correction, or preventive action to be taken.

C2

1.2.5 Item. Any level of unit assembly, including system, subsystem, subassembly, component, part, or material.

1.2.6 Nonconformance. A deficiency in characteristic, documentation, or procedure which renders the quality of an item or service unacceptable or indeterminate.

1.2.7 Objective Quality Evidence. Any recorded fact or facts pertaining to the quality of an item, process, or service based on observation, measurement, or test, that can be verified.

1.2.8 Purchaser. The agency responsible for issuance and administration of a contract, subcontract, or purchase order imposing this standard or portions thereof.

1.2.9 Quality Assurance. The planned and systematic actions necessary to provide adequate confidence that a material, component, system, or facility will perform satisfactorily in service.

(End of Amendment Page)

1.2.10 Quality Control. The quality assurance actions that control the attributes of the material, process, component, system, or facility in accordance with predetermined quality requirements.

1.2.11 Repair. The process of restoring a nonconforming item to an acceptable condition, although it does not conform to a specified requirement.

1.2.12 Rework. The process by which a nonconforming item is made to conform to specified requirements.

1.3 Applicability. The requirements of this standard shall apply to all activities from design and development through fabrication, construction, test, operation and maintenance that affect the performance and quality of any essential portion of a reactor, test facility, or development program, including engineered components associated with such facilities and programs.

For projects or programs of significant scope, complexity, and duration, this standard or entire sections thereof, shall be invoked. For those projects or programs whose scope, complexity, and duration do not warrant total application of this standard or entire sections thereof, the specific requirements of this or other standards that are essential to the assurance of quality shall be invoked in the specification. If any part of this standard is to be invoked, Section 1 shall be included.

Requirements of this standard and of other regulations, codes, standards and specifications applicable to the contract shall be invoked for systems, components, materials, processes, services, or other elements of work under the contract based upon their function, relative importance, and contribution toward the objectives of the program or project. The implementation of these specific requirements for given elements of work shall be defined in such documents as specifications, drawings, quality assurance program indexes, procedures, instructions, and the like.

1.4 Responsibility. The contractor shall establish and implement an effective program for the assurance of quality of items, processes or services which meets the applicable requirements of this standard and other pertinent regulations, codes and standards. The level of quality assurance activity established by the contractor shall be appropriate to the product and effective in causing deficiencies to be identified and promptly corrected by responsible line management. The contractor shall perform all those activities that are essential to the assurance of adequate quality of items, processes or services included in the program, or may delegate quality assurance activities to other organizations, such as subcontractors, suppliers or consultants, but shall retain prime responsibility for the adequacy of those activities.

The contractor shall identify specific quality assurance requirements to be invoked for individual systems, components, materials, processes, and services as appropriate for control of essential elements of work, and shall inform the purchaser of such requirements.

1.5 Relation to Other Requirements. The applicable requirements of this standard shall be satisfied in addition to the quality assurance requirements of other applicable regulations, codes, standards and specifications. The requirements of this standard shall not be interpreted in a manner that would result in a duplication or derogation of work effort.

1.6 Purchaser Actions. The quality assurance program of the contractor and of his subcontractors and suppliers will be subject to surveillance, inspection, evaluation, and audit by the purchaser or by his designated representative at any time during the course of the program. Such actions by or on behalf of the purchaser shall not relieve the contractor of his responsibility for compliance with contract requirements.

Upon request, the contractor shall furnish, or provide access to, contract-related quality assurance information, documents, records, material samples, and other items required by the purchaser or his designated representative. Representatives of the purchaser shall have access to the contractor's plant, facilities, and equipment for the purpose of inspection of work and materials.

1.7 Applicable Documents. The following documents are a part of this standard to the extent specified herein. The issue of a document in effect on the effective date of the referencing specification or procurement document, including any amendments also in effect on that date, shall apply.

1.7.1 RDT Standards.

RDT F 1-3T Preparation of Unusual Occurrence Reports

|N2

RDT F 3-2T Calibration Program Requirements

incident and failure reports, corrective actions, and other records required by applicable sections of this standard.

2.4.3 Quality Status Reports. The contractor shall submit periodic quality assurance program status reports to the purchaser as required by the contract. The reports shall contain brief, narrative descriptions of quality assurance program progress and accomplishments; summaries of current problems, nonconformances, and failures, with their analysis and corrective action status; quality trend data; and results of program audits and management reviews.

2.5 Audits and Reviews.

2.5.1 Quality Audits. The contractor shall audit the quality assurance program both periodically and at major project milestones, as prescribed in Section 8.

2.5.2 Management Reviews. Quality assurance review meetings shall be held periodically by the contractor, with attendees including the contractor's project-management personnel. The reviews shall provide a means for assessing project quality accomplishments, discussing program audits, and resolving management problems.

2.6 Corrective Action. The contractor shall establish and implement procedures to assure that conditions adverse to quality, including unusual occurrences, unsatisfactory practices, deficiencies, failures, malfunctions, deviations, nonconformances, and defective material, are documented and corrected by responsible management and technical personnel. The cause of the adverse condition shall be determined and action taken to minimize or prevent recurrence. Quality trends shall be analyzed for improvement in work practices. Corrective action shall be extended to the work of subcontractors and suppliers, as appropriate.

C2

2.7 Engineering Holds. The contractor shall establish and implement procedures for the identification, reporting and management of engineering holds imposed during design, procurement, fabrication, construction and installation, and operations activities. Engineering holds, which may result from design uncertainties or changes, discrepancy or nonconformance reports, waivers, insufficient documentation, or other circumstances, shall be identified in drawings, drawing lists, or other documents, and shall define the limits beyond which work shall not proceed. The contractor shall prepare periodic hold reports to describe each outstanding hold, the action required to remove the hold, the organization or individual responsible for resolution, and the need date for resolution.

2.8 Unusual Occurrence Reporting. The contractor shall establish and implement procedures for the detection, reporting, analysis, and correction of unusual occurrences during all phases of work in accordance with the requirements of RDT F 1-3.

N2

3. DESIGN AND DEVELOPMENT

3.1 Scope. This section describes the quality assurance program requirements to be implemented by the contractor to control design and development activities. The requirements include planning, definition and control, development and qualification testing, documentation, and auditing.

3.2 Design Planning. The contractor's planning of design activities shall include outlining the approach and measures to be used in achieving project objectives. Planning for these activities shall be outlined and documented in appropriate form, such as procedures, practices, tables, charts, and diagrams. Milestones at which design criteria, standards, specifications, drawings, procedures, and other engineering documents will be prepared, reviewed, approved, released, and integrated into the design effort shall be delineated. Designs, materials, components, and processes requiring development shall be defined, as well as the level of effort to be applied in verifying quality. Interrelationships among those responsible for preparation of designs, coordination of interfaces, and the lines of communication shall be defined. The planning and outlining of design activities shall be kept current and shall indicate the status and progress of design effort.

3.3 Design Definition and Control. The contractor shall establish and implement methods for controlling design activities to assure that applicable design criteria, codes, standards, practices, and requirements for those materials, structures, components, systems, facilities, and processes to which this standard applies are defined and correctly translated into specifications, drawings, procedures, and instructions. The contractor shall establish and implement methods for coordinating and interfacing with other participating organizations to assure compliance with these requirements during the design and development phase and throughout succeeding phases of fabrication, testing, construction, and operation.

3.3.1 Design Criteria. The contractor shall define and document criteria stating the requirements to be satisfied by the design. These criteria shall include the project performance objectives, operating conditions, and requirements for safety and availability, as well as the requirements for materials, fabrication, construction, testing, operation, maintenance, and quality assurance.

3.3.2 Codes, Standards, and Practices. The contractor shall establish and enforce procedures to assure that appropriate codes, standards, and practices for design, materials, fabrication, construction, testing, inspection, and operation of components, structures, systems, facilities, and processes are defined, documented, and employed. The contractor shall employ, where applicable, AEC, ANSI, ASME, ASTM, and other recognized codes, standards, and practices, including those of the contractor.

Where such recognized engineering codes, standards, and practices are nonexistent or inadequate to meet the needs of the project, the contractor shall develop new or supplemental codes, standards, and practices. Any proposed development of new or supplemental codes, standards, and practices for

project use shall be subject to authorization by the purchaser prior to initiation of efforts. In developing such codes, standards, and practices, the contractor shall coordinate with other appropriate organizations and shall furnish copies of proposed codes, standards, and practices as directed by the purchaser.

Codes, standards, and practices which the contractor proposes to employ shall be thoroughly identified and referenced in design criteria, analyses, descriptions, plans, specifications, drawings, and other engineering documents.

3.3.3 Engineering Studies. The contractor shall conduct and document engineering studies sufficient to establish that the design meets the design criteria, that it is based on proven practices, and that it is adequate for the intended service. Engineering studies should focus on those aspects involved in the intended service, such as operation, maintenance, in-service inspection and safety, and be based on analysis of reactor physics, structural stress, thermal, hydraulic, environmental, and other effects. Engineering studies should include analysis of "trade offs" and alternatives, identify weaknesses, and provide for incorporation of appropriate preventative design features, operating and maintenance practices, and safety precautions.

3.3.4 Parts, Materials, and Processes. The contractor shall establish methods for the selection, standardization, identification, and application review of essential parts, materials, and processes to be used in the project.

The contractor shall select parts, materials, and processes on the basis of proven experience or qualification for the intended service. Where applicable parts, materials, and processes have been developed and qualified by ERDA or other appropriate programs or are reflected in applicable recognized standards, they shall be used; where necessary parts, materials, and processes have not been so qualified, the contractor shall recommend to the purchaser appropriate action. If development or qualification testing efforts are necessary, the conduct of such efforts will require coordination by the contractor with other on-going ERDA programs. The contractor shall make every effort to reduce the variety of parts, materials, and processes through standardization. | E3

3.3.5 Design Descriptions. The contractor shall prepare design description documents for essential components, systems, and facilities as required by the purchaser and in accordance with the latest ERDA instructions. Design descriptions are intended to provide a means to define and integrate the various technical, operational, and safety considerations involved; maximize application of past experience; relate research, development, test, and backup design efforts; identify interfaces; and serve as a common technical basis for other project activities. Design descriptions provide a technical reference for detailed component specifications, operational test procedures, and safety analysis reports. | E3

3.3.6 Specifications, Drawings, and Instructions. The contractor shall prepare specifications, drawings, instructions, and other engineering documents necessary to define specific design requirements. These documents shall include as applicable, requirements for detail design, materials, fabrication, construction, installation, testing, inspection, maintenance, cleaning, packaging, shipping, storage, operation, and quality assurance.

3.3.7 Identification. The contractor shall establish procedures for identifying materials, parts, components, and processes on drawings, specifications, and other engineering documents. The identification system shall allow for traceability, through the use of lot numbers, heat numbers, part numbers, serial numbers, or other appropriate means, between engineering documents and products. Those materials, parts, and components requiring specific traceability to original certification data shall be so designated.

3.3.8 Acceptance Criteria. The contractor shall identify within appropriate design documents those criteria to be used for acceptance. The documents shall specify the check points during the work process at which compliance with the criteria will be accomplished and verified.

3.3.9 Interface Control. The contractor shall establish methods for definition and control of design interfaces among other project participants and design organizations. To the extent practicable, a common identification system shall be used by all design organizations on the items and documents for a given design interface. The contractor shall establish procedures for the exchange of required design data and for prompt analysis and resolution of design interface problems.

3.4 Document Review and Control.

3.4.1 Engineering Document Review and Approval. The contractor shall establish and implement procedures that provide for the review and approval of specifications, drawings, analyses and other significant engineering documents, including changes thereto, before issuance. Reviews and evaluations shall be conducted systematically to verify completeness, correctness, and adequacy with respect to project or contract requirements, engineering standards, design practices, and intended application. Approval authority shall be evident through sign off by personnel designated as responsible for establishing the technical requirements. Other personnel shall participate in review and approval activities as required by the contractor's procedures. Changes to approved engineering documents shall be reviewed and approved by the same organizations that performed the original review and approval unless the contractor, with purchaser approval, designates another responsible organization.

3.4.2 Document Control. The contractor shall establish and implement procedures that assure the control of engineering documents authorized for release and use. Such controls shall assure that

C1

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engineering documents and changes thereto are properly prepared, coordinated, and released by authorized personnel and distributed to prescribed organizations and locations. | C1
| C3

3.4.3 Engineering Drawing Lists. The contractor shall prepare and maintain complete and current lists of engineering drawings, including subcontractor and vendor drawings, which are applicable to the work. For

(End of Amendment Page)

each drawing, the list shall include: specific identification of the applicable revision; level of approval required, i.e., which organizations must take approval action; and current status, e.g., in preparation, issued for approval, released for use.

3.5 Design Reviews. The contractor shall conduct planned and documented design reviews in accordance with procedures to verify that the design meets requirements. Design reviews are intended to provide assurance that studies, calculations, and analyses involving nuclear effects, electrical, mechanical, thermal, hydraulic, safety, reliability, maintainability, and other pertinent considerations are complete and correct; that research and development programs and tests associated with the design provide optimal benefits to the design; that materials and design interface are compatible; that maximum use is made of qualified, standardized, or approved parts, materials, components, and processes; that accessibility for in-service inspection, maintenance, or repair is adequate; and that acceptance criteria for inspections and tests are delineated. Design reviews shall be held to discuss and resolve technical problems concerning design adequacy among the design contractor, the purchaser, and other project participants.

The contractor shall identify those components and systems for which independent formal design reviews are to be scheduled and conducted by the responsible design organization. Design reviews shall be independent in the sense that the reviewers have no direct responsibility for the design, but are technically competent and may be from the same organization that prepared the design. Participation in design reviews should be interdisciplinary, involving key technical personnel in the areas of design, manufacturing, testing, quality assurance, operation, and maintenance, as well as project management and consultants, as appropriate. Joint design reviews with other participating contractors shall be held by the responsible design organization when design interfaces are under consideration.

Hold points shall be established in the project beyond which further design work or initiation of fabrication shall not proceed pending an independent design review. Each design review shall be documented by the contractor in a report that shall include a synopsis of significant problems, decisions, and assigned action items. Design review reports shall be reviewed, approved, and issued by the responsible design organization and submitted to the purchaser as required by the contract.

3.6 Development. The contractor shall establish and implement methods for assuring quality in the development of materials, processes, equipment, components, or design concepts defined in project design as required to demonstrate, evaluate, or substantiate the fulfillment of the design objectives.

3.6.1 Development Planning. The contractor's development efforts shall be planned and documented in coordination with project design efforts. Planning shall include the delineation of objectives of the development effort; the materials, components, systems, or processes to be developed; and the quality assurance standards, practices, and procedures to be employed. Planning shall also define the test criteria, the applicable

4. PROCUREMENT

4.1 Scope. This section includes quality assurance program requirements to be satisfied by a contractor during the procurement phase of a project. The requirements include procurement planning, selection and evaluation of procurement sources, preparation and review of procurement documents, control of configuration, source and receiving inspection activities, control of finished items, and recording and auditing of procurement activities. The contractor shall employ those controls necessary to assure that procurement functions are accomplished in accordance with the contract and any contract-specified codes, standards, drawings, and specifications.

4.2 Procurement Planning. The contractor, in planning his procurement activities, shall document in outline form, such as tables, charts, or other appropriate means, the methods to be used to accomplish the procurement and related quality assurance activities. The planning shall identify milestones during the project when procurement documents will be prepared, reviewed, approved, and released for bid. The planning shall provide for evaluation and selection of potential suppliers and shall identify source and receiving inspection activities and controls to be used for acceptance and disposition of purchased items. Contractor procurement planning and outlining of the work effort shall be kept current to reflect the progress and status of the activities.

4.3 Procurement Requirements. Contracts, purchase orders, work authorizations, and changes thereto, shall include or reference specific, selected requirements of this standard and other applicable regulations, codes and standards for the assurance of quality of each purchased item or service. Procurement documents shall identify the quality assurance documentation to be prepared and submitted, such as quality assurance indexes, inspection and test plans, process control, nondestructive examination and cleaning procedures, reports and records, as appropriate, and shall specify submittal dates and approval requirements. Requirements for access to subcontractor or supplier records and facilities for the performance or witnessing of inspections, examinations or tests by the purchaser shall be defined. Applicable quality assurance requirements shall be extended to the work of lower tier subcontractors and suppliers.

4.4 Procurement Document Review. The contractor shall establish and implement procedures whereby designated personnel shall review procurement documents and changes thereto to assure that requirements are complete and appropriate.

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4.5 Evaluation and Selection of Procurement Sources.

4.5.1 General Requirements. The contractor shall select procurement sources primarily on the basis of demonstrated capability to provide a similar product, or service in accordance with the requirements of the

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request for proposal (RFP). When records are not available to indicate quality capabilities, the facilities, organizations, and quality assurance functions of the potential sources shall be evaluated to determine their adequacy.

4.5.2 Acceptable-Source List. The contractor shall establish and maintain lists of suppliers who have demonstrated their capability to provide acceptable specific products or services and shall use the lists in selecting sources for similar products or services.

4.5.3 Pre-Award Evaluation. Sources for procurement of complex or high-cost products or services shall be evaluated by qualified contractor personnel prior to contract award to determine capability of the source to perform in accordance with the requirements of the RFP. A procurement source's history of quality performance shall be considered as an element of this evaluation.

4.5.4 Interchange of Source-Capability Information. The contractor shall obtain and make use of available information on supplier capabilities with respect to products, processes, services and quality performance.

4.6 Control of Configuration.

4.6.1 Contract Change Control. The contractor shall establish and implement procedures to assure control of approved changes in contracts, design drawings, specifications, test procedures, inspection instruction, and other procurement documents. As part of these procedures, affected organizations, including designers, material suppliers, and manufacturers, shall be notified of changes; and the contractor shall receive verification of timely incorporation of changes. Materials, products, processes, drawings, specifications, and other items affected by the change shall be re-identified when required by the design.

4.6.2 As-Built Verification. The contractor shall establish and implement procedures to verify that the asbuilt configuration of purchased items conforms to applicable codes, specifications, drawings, and other contractual requirements, including authorized changes.

4.7 Measuring and Test Equipment Calibration and Control. The contractor shall establish and implement procedures for the selection, use, calibration, adjustment, maintenance and control of all measuring and test equipment used to accomplish contract requirements, during all phases of work, in accordance with RDT F 3-2.

4.8 Source Surveillance and Inspection. The contractor shall establish and implement procedures for maintaining surveillance at the source of materials and services. Source surveillance procedures shall be established in accordance with the relative importance, complexity, and quality of items being procured and shall provide a means for determining the effectiveness of the quality assurance program. When required, the contractor shall assign personnel to the supplier's facility to check, inspect, or witness the

5. MANUFACTURING, FABRICATION, AND ASSEMBLY

5.1 Scope. This section includes quality assurance requirements to be satisfied by the contractor during manufacturing. The requirements include manufacturing planning; control of materials and processes; inspection or testing of in-process or completed items; control of nonconforming items; preparation for shipping; recording and auditing of activities. The requirements are intended to assure that the quality of items manufactured by the contractor will conform to contract requirements.

5.2 Planning. The contractor shall establish and implement those procedures and instructions required to assure that fabrication, processing, and assembly activities of manufacturing are planned and conducted in accordance with requirements of the contract and its specified documents. Contractor planning activities shall include identification and sequencing of fabrication, processing, and assembly functions and their associated inspection and testing activities.

5.3 Inspection And Test Plan. The contractor's quality assurance program shall provide for the necessary detailed planning of inspection and test activities related to fabrication, processing, and assembly operations. An inspection and test plan shall be prepared, either as separate documents identified with the parts, components, or assemblies, or as an integral part of the contractor's work instructions. The inspection and test plan shall consist of a flow chart, diagram, or narrative description of the sequence of activities for fabrication, processing, assembly, inspection, and test and shall indicate the type of characteristics to be measured, the methods of examination, and the applicable acceptance criteria.

The contractor's inspection and test plan shall establish those inspections and test points from raw materials through fabrication, processing, and assembly at which conformance of parts, components, and systems to design requirements will be verified. For pressure-retaining components, the inspection and test plan shall provide for direct wall thickness measurements of the pressure boundary. The inspection and test plan shall specify for purchaser approval the type, frequency and location of wall thickness measurements as well as the measurement techniques to be used.

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The plan shall be submitted to the purchaser for approval prior to implementation. When mandatory hold points, which require inspection of selected characteristics of an item or process or witnessing of testing by the purchaser, and beyond which work is not to proceed without the written consent of the purchaser, are established by the purchaser, such hold points shall be identified in the contractor's inspection and test plan.

5.4 Material Identification and Control. Materials and items subjected to fabrication, processing, or assembly operations shall be identified and controlled throughout manufacturing in accordance with requirements established in specifications, drawings, or other technical documents. Identification shall be indicated either on the fabricated item or assembly or in related records. Controls shall be exercised at all points necessary to assure that only accepted materials and items are used. Materials and items that deteriorate with age shall be marked to indicate the date when useful life began or the date when useful life will expire. The contractor shall provide for proper control, preservation, and storage of materials or items furnished by the purchaser.

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5.5 Control Of Processes.

5.5.1 Fabrication and Assembly Processes. To assure that the required quality is achieved, the contractor shall establish and implement procedures and instructions for the control of fabrication and assembly processes, including metallurgical, chemical, bonding, welding, coating, and plating. Emphasis shall be placed on prevention, elimination, and correction of nonconformances at the earliest possible stage.

Process controls shall include: shop orders, process sheets, travelers, inspection instructions, and other shop documents prepared as supplements to specifications, codes, and standards; verification of adequacy of shop documents; assurance of compliance; and maintenance of records.

When a fabrication or assembly process must be conducted in a special environment, such as in a vacuum or an inert atmosphere, the process controls shall assure that the required environment is maintained.

Tooling, jigs, fixtures, and other equipment used for process control and precision inspection of dimensions, contours, and locations shall be identified in planning documents. Such items of equipment shall be closely controlled and inspected prior to use and at prescribed intervals to assure that their required accuracy is maintained.

5.5.2 Process Qualification. The contractor shall qualify procedures for performance of designated processes before fabrication is started and to the extent required by the contract. Upon request of the purchaser, the contractor shall furnish qualification documents for approval, including procedures and drawings and the results of tests and inspections.

5.5.3 Nondestructive Examination. Nondestructive examination procedures for processes such as radiography, ultrasonic examination, liquid penetrant examination, and magnetic particle examination shall be qualified and controlled to assure that results provide accurate, uniform, and reproducible indications of actual quality. Nondestructive examinations shall be performed in accordance with qualified procedures and specified acceptance criteria.

5.5.4 Cleaning. The contractor shall prepare and implement procedures to assure that lubricants, chemicals, materials, precision parts, components, assemblies, and systems are cleaned under controlled conditions as specified in the contract, and that required cleanness is maintained.

5.6 Inspections and Tests.

5.6.1 General Requirements. Throughout the manufacturing cycle, the contractor shall perform or have performed inspections and tests in accordance with established plans, instructions, and procedures. The contractor shall verify that inspection and test prerequisites are met, that appropriate instruments and devices are used, and that inspections and tests are performed in the proper sequence under suitable environmental conditions.

6. CONSTRUCTION AND INSTALLATION

6.1 Scope. This section covers the basic quality assurance requirements to be satisfied by the contractor during the construction phase of nuclear reactor and test facilities projects. These quality assurance program requirements are intended to assure that structures, components, and systems essential to safety, operability, and reliability are installed, constructed, and tested at the plant or facility site in conformance with contract requirements and applicable codes, standards, specifications, and drawings.

6.2 Organization. Contractor personnel performing quality assurance functions shall be independent of direct control by site construction organizations. The authority and responsibility of personnel performing quality functions shall be defined by the contractor and shall give these personnel the freedom to examine materials and workmanship; identify and evaluate the problems; and initiate, recommend, or provide their solutions.

6.3 Contract Review. The contractor shall review the contract, design drawings, specifications, and interface requirements prior to start of work. Participants in the review shall include representatives of the purchaser and the construction contractor, particularly the cognizant design, construction, and quality assurance personnel. The significant or important requirements of the contract, design drawings, and specifications shall be reviewed to assure that the construction organization is aware of requirements.

The need for special controls, processes, equipment, and personnel training shall be reviewed. In projects with multiple contractors or subtier contractors, the review participants shall include representatives of the organizations responsible for quality assurance functions and work activities.

6.4 Construction Planning. The contractor shall delineate the construction and installation work and the quality assurance requirements for this phase. The planned activities shall be outlined to define the systematic, sequential progression of work and shall be documented by appropriate means such as charts and diagrams. The items to be procured, fabricated in the shop or field, constructed, and installed shall be defined; and the qualified personnel, organizations, or contractors supplying the items or services shall be identified. The procedures and work instructions necessary to comply with contract requirements such as those for special processes, surveillance, inspection, test, repairs and rework, cleaning, identification, and operation of the equipment, systems or facilities shall be identified, and provisions shall be made for their preparation, approval, release, and control. Methods to be used for the collection, handling, and disposition of records, data, and reports shall be designated. This outline of planned activity shall be kept current and shall depict the progress and status of work activity and quality verification.

6.5 Control of Configuration. The contractor shall establish and implement a system for the control and verification of configuration, including

control of design changes, identification for traceability, and as-built configuration, in accordance with the requirements of 3.3.

The contractor shall prepare and implement procedures that assure control of documents required for construction and installation and for timely incorporation of authorized changes. These documents include the drawings and specifications, work instructions, quality control procedures, inspection instructions, and testing procedures. The system shall provide for the documents to be distributed to or removed from the proper points in time to assure that work and quality functions are accomplished in accordance with the latest applicable documents.

Provisions shall be made for the evaluation and approval of field or supplier-generated documents by designated personnel. | N1

6.6 Construction Procurement. In accordance with the appropriate provisions of Section 4, the contractor shall establish and implement procedures for controlling and verifying that purchased material, equipment, and services, whether purchased directly by the contractor or through other contractors, conform to quality requirements. The procedures shall provide for reviewing purchase orders and contracts for appropriate quality assurance requirements; evaluating and selecting procurement sources; surveillance, inspection, and testing of items at the source when required to ascertain product quality; furnishing of objective evidence of quality by the source; examination of products on receipt; and prompt correction of nonconforming items.

6.7 Construction and Installation Control.

6.7.1 Material, Handling, and Cleaning Control. Procedures to assure control of material; proper handling, lifting and storage practices; and cleaning and contamination control shall be prepared and implemented by the contractor. Such procedures shall be in accordance with the requirements of 5.4.

6.7.2 Special Process Control. For special construction and examination processes, including placement of concrete, welding, heat treating, cleaning, and nondestructive examination, the contractor's quality assurance program shall assure that process control standards, specification, and instructions are available and used at the work site and are enforced to assure that processing equipment and the required environments are properly maintained.

6.7.3 Interface Control. The contractor shall provide for the definition and control of construction and installation interfaces. This control shall provide assurance of a coordinated effort among the various project participants.

6.7.4 Measuring and Test Equipment Calibration and Control. The contractor shall establish and implement procedures for the selection, use, calibration, adjustment, maintenance and control of all

measuring and test equipment used to accomplish contract requirements,
during all phases of work, in accordance with RDT F 3-2.

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7. OPERATION, MAINTENANCE, AND MODIFICATION

7.1 Scope. This section covers the quality assurance program requirements to be satisfied by the contractor during the operation and maintenance phase of a project. The requirements include: planning for operating and maintaining plant, equipment, and facilities; control of operating modes or conditions and maintenance of systems and components; training and certification of personnel; control of modifications; preparation of records; and the auditing of methods and activities. These requirements are intended to assure that controls are established and maintained and that plants and equipment are operated, maintained, and modified in accordance with the contract and its applicable codes, standards, drawings, specifications, operating permits, and predetermined safety restrictions.

7.2 Operation, Maintenance, and Modification Planning. The contractor's planning of his operation, maintenance, and modification activities shall include preparation of documents that describe in outline form, such as by appropriate charts, diagrams, or schedules, the start-up checkouts, tests, and inspections required to place the plant into operation and the operational modes and their essential testing and in-service inspections required to sustain operation in accordance with project objectives. Maintenance and testing program planning shall be integrated to provide procedures that identify systems, components, facilities, parts, materials, and processes; administrative controls; and check points for maintenance activity review, evaluation, corrective action, and feedback. Needs shall be identified for shop and field work areas. The personnel, equipment, and services required for receiving, handling, cleaning, inspecting, repairing, storing, and dispensing activities performed in given work areas shall be identified and described. Planning shall also provide for the preparation of incident reports, quality status reports, collection and evaluation of performance data, and feedback of information to designers. Planning and outlining of the work effort shall reflect the progress and current status of activities.

7.3 Organization.

7.3.1 Responsibility and Authority. Organizational responsibilities and authorities for operation, maintenance, and modification shall be established and delineated in writing. Personnel responsible for management and control of plant or facility operation, maintenance and modification shall be identified. The mode of operations shall be defined, and organizational interfaces and lines of communication shall be indicated in procedures.

7.3.2 Training and Certification. The organization responsible for plant operation and maintenance shall assure that operating and maintenance personnel are trained and qualified in accordance with established operating procedures and specifications. The training program shall include instructions, testing, and on-job training as required to assure continued personnel proficiency and shall provide for qualified alternate or replacement personnel. Training shall provide for periodic practice of these

procedures to familiarize personnel with their use and to assess their effectiveness. The contractor shall maintain records of personnel qualifications and certifications.

7.4 Operation Control. The contractor shall establish and implement a systematic method for placing the plant, facility, or equipment into operation and meeting operating directives and requirements.

7.4.1 Operating Objectives. The objectives of operation of the project shall be clearly stated. These objectives shall identify the end results to be achieved and shall indicate the boundaries and interfaces with other projects or organizations. The statement of objectives shall include delineation of operating conditions for functional systems and their equipment and for the project.

7.4.2 Procedures. The contractor shall establish and implement certified operating procedures, run sheets, work instructions, and checklists. Pre-start-up checkout and evaluation procedures shall be prepared for checking each system and its interaction with other systems for completeness and operational worthiness. Operating procedures and work instructions shall be prepared for predetermined conditions of normal and abnormal or upset operation. Methods and procedures to be implemented during emergency or faulted conditions shall also be prepared, and a plan formulated for periodic practice of these procedures to familiarize personnel with their use and to assess their effectiveness.

7.4.3 As-Built Verification. The contractor shall verify the completeness of the construction process and assure that equipment has been procured, constructed, and installed as described by the drawings and specifications. The contractor shall verify that modifications or revisions subsequent to the design phase of the project are reflected in the as-built drawings and specifications. The contractor shall verify that objectives and performance defined during the design phase have not been degraded during subsequent phases of the project.

7.4.4 Technical Specifications. Specifications shall be prepared that clearly define the operating capabilities of the facility, its systems, and equipment. These specifications shall identify design features and establish operating limits and requirements for the systems and equipment to be operated. The safeguards and procedures to be established and implemented shall be delineated.

7.4.5 Document Control. The contractor shall establish and implement procedures that assure control of preparation, review, approval, release, change, distribution, and use of documents required for operation maintenance, and modification activities. Documents, including procedures, specifications, operational analyses and objectives, and inspection and test results, shall be reviewed and approved by designated personnel prior to issuance for use.

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7.4.6 Operation Reviews. The contractor shall establish and implement methods for reviewing the operating objectives, the analysis of operational readiness and safety, the results of inspections and tests, and the methods and procedures to be employed in operating the project. The reviews shall be conducted by contractor personnel responsible for design, operating, maintenance, testing, quality assurance, and project management. These reviews shall assure that operations to be performed have been planned in accordance with the established objectives and facility capabilities and are conducted in accordance with plans and procedures. The procedures shall be updated to reflect current operating practices.

7.4.7 Indication of Status of Components and Systems. The contractor shall establish and implement methods to indicate, by tagging or other appropriate means, the status of components and systems to prevent their inadvertent operation where such operation would be detrimental to the quality of components or systems.

7.5 Maintenance Control. The contractor shall establish and implement methods for assuring that the contract-specified requirements of the maintenance program are fulfilled. The contractor shall conduct his maintenance program in accordance with planned methods and under management controls that assure that equipment, systems, and facilities are maintained in accordance with project objectives. The types of maintenance activity, including preventive failure, replacement, remote, and overhaul maintenance, required to assure that components, systems, or facilities are maintained to project requirements shall be defined. These maintenance activities shall include, but not be limited to, lubrication, preplanned replacement of components, and replacement of items or equipment indicating deterioration from use.

7.5.1 Maintenance Policy. Contractor policies related to the maintenance program shall be defined and documented. These policies shall identify the objectives of the program, assign responsibilities for their implementation, and state resources to be applied and method of use.

7.5.2 Work Instructions. Maintenance work shall be identified, and work instructions shall be prepared that prescribe the activities to be performed. The work instructions shall include drawings, specifications, procedures, manuals, and data either generated by the contractor or assembled from subcontractor and supplier sources. The instructions shall emphasize special precautions indicated by contractor experience or by supplier-generated data and regulatory requirements.

7.5.3 Special Processes. The contractor shall provide for control of processes, tools, and devices required for plant or facility maintenance.

7.5.4 Parts and Materials. The contractor shall conduct procurement activities in accordance with the requirements of Section 4. The contractor shall provide for the control of spare parts and components used for replacement. The controls shall assure that, during all phases of operation, maintenance, and modification, quality conforms to that established by the design. Controls of handling and storage shall include provisions for maintenance of markings and identification records, protection of items

subject to deterioration through environmental exposure or to damage during handling operations, and use of materials or equipment subject to age deterioration. Inventory and logistic controls shall consider rate of use, importance of item or service, and project maintenance objectives.

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7.5.5 Maintenance Review. The contractor shall review the documents that define maintenance activities to assess their completeness and applicability to the work to be performed. Management shall review maintenance performance to evaluate organizational effectiveness, job performance, and compliance with procedures and work instructions. Contractor management shall assure that corrective action is taken when problems are encountered and that data, trends, and performance-history information are provided to the appropriate project organization.

7.6 Modifications. The contractor shall establish and implement a systematic method of controlling modifications of plant, equipment, services, or facilities during the operation and maintenance phase of the project. The contractor shall employ those control and assurance elements of the quality assurance program that apply within each phase of project modification activity, as described by this standard and required by the contract. The contractor shall develop and implement procedures for testing modified components, subsystem, and systems. The testing shall establish component, subsystem, or system integrity and shall provide for preoperational evaluation of performance prior to system operation.

7.7 Surveillance. The contractor shall maintain continuing surveillance, by means of overview, witnessing, or monitoring of operations, maintenance, refueling, experiment handling, modification or repair, and other related activities, to assure compliance with established regulations. Surveillance shall include the examination of maintenance data, inspection and test results, operating logs, or other pertinent records to verify technical accuracy and completeness. Surveillance methods, such as the use of instrumentation to monitor equipment and the application of statistical analysis to determine component degradation or failure trends also shall be employed, as appropriate.

7.8 Inspection and Testing. The contractor shall perform inspection and tests required to assure that items, equipment, and systems are being maintained and are performing at specified capability levels necessary to achieve project objectives. Inspection and test activities shall include those necessary to meet in-service inspection requirements of contract-specified codes and standards; evaluation of the performance capability of essential emergency and safety systems and equipment; and verification of the calibration and integrity of instruments and instrument systems. Inspection and test shall be planned and performed in accordance with approved procedures. The contractor shall establish and implement controls to assure that inspections and tests are performed as scheduled and the results are documented. Contractor controls shall

assure that detected deficiencies are corrected and the deficient items are reinspected or retested.

7.9 Measuring and Test Equipment Calibration and Control. The contractor shall establish and implement procedures for the selection, use, calibration, adjustment, maintenance and control of all measuring and test equipment used to accomplish control requirements, during all phases of work, in accordance with RDT F 3-2.

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7.11 Quality Assurance Records. The contractor shall maintain records throughout the operation, maintenance and modification phase of the project. Typical records include as-built drawings, operating logs, personnel certifications, calibration history, operational reviews, maintenance data, inspection and test results, incident reports with corrective action status, and quality audits.

7.12 Quality Audits. The contractor shall regularly audit quality assurance activities related to operation, maintenance, and modification in accordance with Section 8.

8. QUALITY ASSURANCE AUDITS

8.1 Scope. This section covers requirements for auditing and evaluating quality assurance programs established by contractors in accordance with the applicable requirements of this standard. These basic elements include: planning and performance of audits and evaluations; evaluation of contractor procedures, activities, and products; reporting of audit and evaluation results to management, including recommendations for corrective action; and follow-up to assure achievement and effectiveness of corrective actions.

The requirements of this section shall apply to the contractor in performing self-audits and may be applied by the purchaser or its designated agency in conducting independent audits of the contractor's quality assurance program.

8.2 Planning. The contractor shall provide for preparation of a written plan for audit and evaluation, scheduling and notification of proposed audits and evaluations, designation of the responsible organization, and assignment of specific areas to be audited or evaluated. The plan shall delineate the criteria, methods, procedures, and formats for each audit and evaluation. Checklists shall be prepared for each quality assurance activity or the product to be audited and shall include the quality characteristics to be evaluated.

8.3 Evaluation of Quality Assurance Methods. The contractor shall evaluate quality assurance methods, procedures, and instructions for the control and verification of activities affecting quality. Quality assurance methods shall be evaluated by experienced personnel not having direct responsibilities for the methods being audited.

8.4 Activity Audits. The contractor shall conduct audits of activities affecting quality on a regular basis. Such activities include designing, purchasing, fabricating, processing, assembling, handling, cleaning, storing, shipping, inspecting, testing, installing, operating, maintaining, repairing, and modifying. Activities shall be audited by the contractor to determine the status to compliance with requirements of the quality assurance program, established quality assurance procedures and instructions, and applicable standards and codes. Such audits should be conducted by personnel familiar with procedures, standards, and codes applicable to the areas being reviewed, but who have no specific line responsibility in such areas.

The contractor shall audit the preparation of engineering, procurement, and other significant documentation, including changes thereto, to verify adequacy, completeness, and currentness and to cause the correction of deficiencies by responsible management.

8.5 Product Audits. The contractor shall periodically audit inspection areas and re-inspect randomly selected material, product, or processing that has already been inspected, accepted, and appropriately

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identified as accepted by inspection personnel. The number of samples re-inspected must be sufficient to provide objective evidence of inspection effectiveness.

8.6 Nondestructive Examination Audits. The contractor shall periodically audit nondestructive examination and personnel certification procedures to verify that applicable specification, standards, and codes set forth in the contract have been implemented and their requirements are being met.

The contractor shall periodically audit the certification process to assure that personnel certified to perform special processes have satisfactorily passed tests indicating their competence in accordance with the requirements of applicable specifications and standards. Results of such audits and of examinations of work performed shall be used to determine if personnel need additional training and re-certification.

Nondestructive examination results, such as test data, readouts, and film, shall be periodically audited by the contractor to verify accuracy of equipment and adequacy of interpretation of examination results.

8.7 Records Audits. Results of inspections, tests, and nondestructive examinations shall be audited by the contractor to assure adequacy and availability.

8.8 Reporting and Corrective Action. Results of each audit and evaluation of quality assurance methods and activities conducted by the contractor shall be reported to and reviewed by management. Summaries of audit findings with corrective actions shall be prepared and submitted to top management and the purchaser.

Contractor quality assurance management personnel shall take necessary action to assure that any deficiency in quality assurance methods and functions is corrected. Deficient areas shall be reaudited as frequently as necessary until the required corrections have been made.