RDT Standard

INSTRUMENT TREE FOR SODIUM
COOLED REACTORS (FABRICATION
ONLY)

FEBRUARY 1973

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Division of Reactor Development and Technology
United States Atomic Energy Commission

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INSTRUMENT TREE FOR SODIUM COOLED REACTORS (FABRICATION ONLY)

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INSTRUMENT TREE FOR SODIUM COOLED REACTORS (FABRICATION ONLY)

1. SCOPE

This standard covers the instrument tree for sodium cooled reactors and delineates the requirements for the fabrication, quality assurance, packaging and delivery. Except for the control console, no design effort is required. A minimal amount of design effort is required on the control console as specified in the Ordering Data. The instrument tree provides 1) support for the removable instrument assemblies covered in other standards, 2) secondary holddown for the core assemblies, and 3) clearance for the control rod disconnect driveline. The instrument tree is lifted and rotated from above the core assemblies to provide access for refueling.

1.1 Components and Services to be Provided. The fabrication, quality assurance and packaging requirements contained in Sections 2 through 5 shall be provided, as specified in the Ordering Data.

1.2 Definitions

1. Instrument Tree - The complete component, including the plug, drives and in-reactor assembly that provides primary support and location of instrumentation for each driver fuel assembly and control rod channel and selected reflector assemblies and shield positions.

2. Flow Guide Tubes - Tubes which are above each driver fuel assembly.

3. Instrument Guide Tubes - Long, curved tubes that extend from the flow guide tube to the top of the column.

4. Column - A long structural tube that extends through the instrument tree plug down to the lower bearing which is supported from the core barrel.

5. Instrument Assembly - A group of devices that measure the characteristics of the flow and temperature of sodium through the flow guide tubes.

6. Useful Life - The operating time until an item no longer performs its intended function.

7. Control Rod Guide Tube - A vertical tube to house the control rod driveline and support the control rod decelerator.

8. Interfacing Hardware Items - Those components which form a common boundary with the instrument tree. Examples of such components are, core support structure, in-vessel handling machine, in-core storage, core instrumentation, and control rod driveline.

9. Operating Console - The operating station located on the operating deck over the reactor which allows operation and monitoring of instrument tree functions.

10. Delivery Point - That point at which the purchaser or purchaser's agent accepts delivery of the instrument tree and other deliverable items.

11. Designated Site - That location at which transportation of the instrument tree and associated components terminates in accordance with purchaser's instructions.

12. Deliverable Items - The instrument tree and associated components, their shipping containers and those special tools and handling devices that are required for any subsequent operations, and which by their nature or function are capable of delivery.

13. Special Handling Devices - Those devices associated with the handling of the instrument tree which may be required for subsequent handling operations and which can be delivered. Examples of such items include lifting frames, pallets, spreader bars and slings.

14. Manufacturing Drawings - Supplementary drawings prepared by the manufacturer to aid in the fabrication and assembly of the instrument tree.

15. Special Tools - Those nonstandard tools which are required to carry out repair or replacement of instrument tree components.

16. Sensitization - The intergranular precipitation of chromium carbide in austenitic stainless steels when exposed to temperatures in the approximate range of 800 to 1600 F. The depletion of chromium content in the thin envelope surrounding each grain promotes susceptibility to corrosive attack.

17. Ordering Data - The design conditions and other requirements specified in the Ordering Data package. The Ordering Data supplements this standard in defining the requirements for procurement of the instrument tree.

2. 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 date of the invitation to bid including any amendments also in effect on that date, shall apply unless otherwise specified. Where the standard appears to conflict with the requirements of a reference document, the manufacturer shall call such conflict to the attention of the purchaser for resolution. Any conflict between this standard and its Ordering Data shall be brought to the attention of the purchaser for resolution.

2.1 RDT Standards

RDT E 15-2T, Requirements for Nuclear Components (Supplement to ASME Boiler and Pressure Vessel Code, Section III)

RDT F 2-2T, Quality Assurance Program Requirements

RDT F 2-4T, Quality Verification Program Requirements

RDT F 3-6T, Nondestructive Examination

RDT F 3-37T, Special Requirements for Metal Products

RDT F 5-1T, Cleaning and Cleanliness Requirements for Nuclear Components

RDT F 6-5T, Welding Qualifications (Supplement to ASME Boiler and Pressure Vessel Code Section IX)

RDT F 6-10T, Repair of Materials by Welding

RDT F 7-2T, Preparations for Sealing, Packaging, Packing, and Marking of Components for Shipment and Storage

RDT F 7-3T, Requirements for Identification Marking of Reactor Plant Components and Piping

RDT F 8-1T, Preloading Threaded Fasteners and Closures

RDT F 8-6T, Hoisting and Rigging of Critical Components and Related Equipment

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- RDT M 1-1T, Stainless Steel Covered Welding Electrodes
(ASME SFA-5.4 with Additional Requirements)
- RDT M 1-2T, Stainless Steel Welding Rods and Bare Electrodes
(ASME SFA-5.9 with Additional Requirements)
- RDT M 1-6T, Mild Steel Electrodes and Welding Rods (ASME
SFA-5.18 with Additional Requirements)
- RDT M 1-19T, Nickel-Chromium-Molybdenum-Columbium Bare
Welding Rods and Electrodes (ASME SFA-5.14
with Additional Requirements)
- RDT M 2-2T, Stainless and Low Alloy Steel Forgings (ASME
SA-182 with Additional Requirements)
- RDT M 2-7T, Carbon and Alloy Steel Forgings, Vacuum Treated
(ASME SA-508 with Additional Requirements)
- RDT M 2-15T, Nickel-Chromium Alloy Bars, Forgings, and Forging
Stock (ASTM A637 with Additional Requirements)
- RDT M 3-2T, Stainless and Alloy Steel Seamless Tubes
(ASME SA-213 with Additional Requirements)
- RDT M 3-6T, Austenitic Stainless Steel Pipe (ASME SA-312
with Additional Requirements)
- RDT M 5-1T, Stainless Steel Plate, Sheet and Strip (ASME
SA-240 with Additional Requirements)
- RDT M 5-2T, Carbon Steel Plates (ASME SA-516 with Additional
Requirements)
- RDT M 5-4T, Nickel-Chromium-Iron Alloy Plate, Sheet, and
Strip (ASME SB-168 with Additional Requirements)
- RDT M 5-21T, Nickel-Chromium-Molybdenum-Columbium Alloy
Plate, Sheet, and Strip (AMS 5596 with Additional
Requirements)
- RDT M 6-1T, Alloy Steel Bolting Material for Low Temperature
Service (ASME SA-320, with Additional Requirements)
- RDT M 6-2T, Mechanical Locking Devices
- RDT M 6-3T, Alloy Steel Bolting Material for High Temperature
Service (ASME SA-193 with Additional Requirements)

RDT M 7-3T, Stainless Steel Bars and Shapes (ASME SA-479 with Additional Requirements)

RDT M 11-1T, Non-Metallic Seal Materials

2.2 American National Standards Institute (ANSI)

ANSI B46.1, Surface Texture

ANSI Y14, Drafting Manual

ANSI B1.1, Unified Screw Threads

2.3 ASME Boiler and Pressure Vessel Code

Section III Nuclear Power Plant Components

Section IX Welding Qualifications

2.4 American Society for Testing and Materials (ASTM)

ASTM E29, Recommended Practices for Indicating Which Places of Figures are to be Considered Significant in Specified Limiting Values.

2.5 Drawings

Drawings as specified in the Ordering Data.

3. TECHNICAL REQUIREMENTS

3.1 Materials. Materials and standards for the instrument tree pressure boundary and surfaces wetted by sodium or sodium vapor are listed in Table 1. The remaining components of the instrument tree have the material requirements specified on the applicable drawings. The pressure boundary is shown on Figure 1. The components comprising the pressure boundary are listed in Table 2. Materials wetted by sodium or sodium vapor are contained within or are below the pressure boundary.

3.2 Fabrication. The instrument tree components which form the pressure vessel boundary shall be fabricated to the Class 1 requirements (including an "NPT" stamp) of the ASME Code Section III (hereafter referred to as the Code) as supplement by RDT E 15-2. Components wetted by sodium or cover gas shall be fabricated to the intent of the Code. All of the pressure boundary or sodium wetted components shall meet the requirements of the documents referenced in Section 2 and as specified in the Ordering Data.

3.2.1 Fabrication Release. The release to fabricate component parts and assemblies, including deliverable items, and special handling devices requires prior purchaser approval. Prior to fabrication release by the purchaser, the manufacturer must submit to the purchaser and received approval for the following documents:

1. Quality Assurance Program Plan.
2. Inspection and Test Plan.
3. Fabrication Plan.
4. Cleaning and Cleanliness Control Procedures.

TABLE 1. MATERIAL REQUIREMENTS CHART*

Material Product Form	Material Type or Grade	RDT Standard or Other Description of Material	Required Options in RDT Standards
Weld Electrode	E-308-15	RDT M 1-1	
Weld Electrode	E-308-16	RDT M 1-1	
Weld Electrode	--	RDT M 1-6	--
Weld Wire	ER-308	RDT M 1-2	--
Weld Wire	NiCrMoCo	RDT M 1-19	--
Forgings	F-304	RDT M 2-2	
Tubes	TP-304	RDT M 3-2	2
Pipe	304	RDT M 3-6	1
Plate, Sheet, Strip	304	RDT M 5-1	3
Plate	410	RDT M 5-1	3
Bolting Material	B7	RDT M 6-3	2
Bolting Material	--	RDT M 6-1	--
Bars and Shapes	304	RDT M 7-3	
Mechanical Locking Devices	--	RDT M 6-2	--
Sheet, Strip, Plate	NiCrMoCo	RDT M 5-21	--
Plate	NiCrFe	RDT M 5-4	
Bars, Forgings	NiCr	RDT M 2-15	
Forgings	SA-508	RDT M 2-7	A, 2
Plates	Carbon Steel	RDT M 5-2	
Seals	--	RDT M 11-1	--

*Sodium and sodium vapor wetted components, pressure boundary and holddown system components.

TABLE 2

<u>Drawing No.</u>		<u>Identification of Components Forming Pressure Boundary</u>
H-4-23113	Item 3	Bonnet Cover
H-4-23113	Item 6	Nut
H-4-23113	Item 4	Bolt
H-4-23113	Item 1	Lower Bonnet Assembly
H-4-23113	Item 9	Cap
H-4-23113	Item 11	Socket Head Capscrew
H-4-23113	Item 10	"O" Ring Seal
H-4-23112	Item 1	Platform Assembly
H-4-23112	Item 5	Seal Housing
H-4-23112	Items 50 & 55	Bolt
H-4-23112	Item 18	Shear Plate Retainer
H-4-23112	Item 17	Shear Plate
H-4-23112	Item 83	Pin
H-4-23112	Item 99	Turnbuckle Assembly
H-4-23112	Item 107	"O" Ring Seal
H-4-23125	Items 3 & 4	Bolt
H-4-23122	Item 16	Clevis
H-4-23122	Items 14 & 15	Bolt
H-4-23122	Item 6	Clevis Pin
H-4-23122	Item 4	Seal Cap
H-4-23122	Item 3	Guide
H-4-23122	Item 11	Platform Retainer
H-4-23122	Item 10	Bolt Ring
H-4-23112	Items 60, 63 & 81	"O" Ring Seals
H-4-23112	Item 62	Bolt
H-4-23133	Item 2	Upper Bonnet Assembly

3.2.2 Threaded Element & Bolts. Threaded connections shall conform to the following requirements:

1. All screw threads shall be in accordance with ANSI B1.1.
2. Threads shall conform to the Unified-Thread Form, unless otherwise specified.
3. Thread fits shall be Unified 2A and 2B or National Class 2, unless otherwise specified.
4. Lubricants applied to threaded parts exposed to sodium shall be approved by the purchaser.
5. Torquing and thermal straining shall be in accordance with RDT F 8-1.
6. All threaded fasteners shall have locking devices in accordance with RDT M 6-2 (unless otherwise specified on the drawings).

3.2.3 Welding and Thermal Cutting. All welding, hardsurfacing and thermal cutting operations shall comply with the ASME Code as supplemented by RDT E 15-2. Purchaser approval is required to make weld repaired to remove weld defects that recur:

1. After the first cycle of weld repair of cracks or fissures at the fusion zone or adjacent base metal.
2. After the second cycle of repair in welds that are heat treated after each repair cycle.
3. After the third cycle of weld repair for all other welds.

The supplier shall prepare and maintain current a schematic record of each weld joint in the instrument tree for the purpose of monitoring weld process control, quality and history. This record will include all repairable defects, and shall include type of defect, number, size and location of repair and repair process and parameters used. This record and all associated NDT information, including radiographs which shall be available for inspection by the purchaser until the components are shipped, shall be come a part of the permanent record of the contract, and shall be accessible for review by the operating contractor thereafter.

3.2.4 Weld Qualification. Procedural, equipment, and operator performance qualification shall be in accordance with Section IX of the Code as supplemented by RDT F 6-5.

3.2.5 Heat Treatment. The heat treatments which are to be applied to the structure after welding or machining and straightening operations shall be in accordance with the provisions as specified in the Ordering Data. Heat treatment and corrosion protection plans shall be submitted to the purchaser for approval prior to performing the operation.

3.2.6 Bending and Forming. Bending and forming procedures for shaping tubes, plates, bars, etc., shall be in accordance with the Code or with procedures prepared by the manufacturer. All procedures must be approved by the purchaser. The design dimensions and ovalities after bending and forming operations shall be within the design limits as specified in the Ordering Data. The manufacturer shall evaluate the need for heat treatment for stress relief or material structure improvement following bending or forming operations and submit a recommendation for purchaser approval.

3.2.7 Surface Finish. The manufacturer shall select fabrication processes to give the following surface finishes unless otherwise specified in the Ordering Data:

1. Surfaces in contact with sodium-not greater than 125 microinches.
2. Mating surfaces-not greater than 63 microinches.
3. Weld reinforcement-not greater than 125 microinches.
4. All machined surfaces shall be not greater than 125 microinches.

Where plate surfaces will not be subsequently machined or otherwise finished during fabrication, the material shall be ordered hot rolled, solution annealed, surface cleaned and ground, or pickled in accordance with RDT M 5-1.

Surface finish shall be measured in accordance with ANSI B46.1.

3.2.8 Special Processes. The following processes are limited in application to the extent specified on the drawings.

1. Plating.
2. Weld Peening.
3. Hardfacing.
4. Use of Lubricants.

Any other application requires prior purchaser approval.

3.2.9 Cleanliness. The fabrication of a part, combination of parts, subassembly, or complete instrument tree shall meet the cleanliness requirements of RDT F 5-1 and any additional requirements as specified in the Ordering Data.

The manufacturer, furnishing components that meet the requirements of RDT F 5-1, shall be responsible for ensuring that all parts and subassemblies furnished by his subcontractors conform to the cleanliness requirements.

3.2.10 Lubricants. Lubricants selected for shaft seals and bearings shall be non-halogenated. Materials in contact with lubricants, except anti-friction bearings, shall be selected for corrosion resistance without the use of paint or other protective coatings. Purchaser approval is required for all lubricants used.

3.2.11 Assembling. Component parts shall be assembled in accordance with a detailed assembly procedure prepared by the manufacturer and submitted as specified in the Ordering Data. The procedure shall contain as a minimum:

1. Assembly sequence.
2. Cleaning procedures, sequence, and precautionary rules.
3. Any special machining or fitting-at-assembly instructions.
4. Intermediate and final inspection criteria and hold points.
5. Handling methods, equipment and precautions.
6. Procedures for the securing of locking devices.
7. Drawings or photographs as required to illustrate assembly or techniques.
8. Special data, measurements, or observations to be recorded in quality control records.
9. Welding procedures.
10. Bolt torques.
11. Lubrication instructions.
12. Ring and plug gage checks.

3.2.12 Identification. Identification procedures shall conform with the following requirements:

1. Materials. All materials shall be identified in accordance with the requirements of the applicable material standard. When raw material is cut or sectioned, all markings shall be transferred to the unmarked portion of the material or if this is not practical, identified by a coded reference to the applicable material record. Material with lost or questionable identification shall not be used.
2. Parts. Components of the instrument tree and all deliverable items shall be identified and permanently marked in accordance with RDT F 7-3. The identification of parts shall include as a minimum material identification number, drawing number and revision, and item number. The use of metal stamping is prohibited except as specifically approved for each application by the purchaser.

3.2.13 Precautionary Measures. Restrictions on use of materials shall meet the requirements of RDT F 5-1.

3.2.14 Interchangeability. The manufacturer shall furnish information necessary to assure the purchaser of interchangeability of parts purchased to the same design. The manufacturer shall identify and mark on the component drawings the reference surfaces used during fabrication to achieve or maintain perpendicularities or concentricities.

Identifying and match marks shall be shown on the drawings and on the articles themselves.

3.2.15 Archive and Surveillance Samples. Samples of materials used in the fabrication of in-vessel components shall be accumulated, identified and preserved for use as test reference specimens. These samples shall have the same metallurgical and fabrication histories as the parent materials and shall be of sufficient size to allow retesting of the required physical, chemical, and metallurgical properties to which the parent properties are certified. Samples required shall be as specified in the Ordering Data.

Records shall be maintained on all parts of the instrument tree to provide traceability of all materials back to materials certification.

3.3 Manufacturing Data.

3.3.1 Manufacturing Drawings. The manufacturer shall prepare any drawings he requires as an aid to fabrication. All drawings that are prepared shall be in accordance with ANSI Y14 and the following:

3.3.1.1 Detail Shop Drawings. Detail drawings shall contain all information required for fabrication of the described component including the following information when needed:

1. Tolerance block, including geometric tolerances.
2. The dimensions, tolerances, and maximum roughness of each machined surface.
3. Identification of material specifications any any special requirements, including nondestructive examination, heat treatment, and hardness.
4. Fabrication instructions which shall include welding procedures numbers with their RDT symbols, hard surfacing, cleaning and inspection symbols.

3.3.2 Weights and Centers of Gravity. The manufacturer shall determine the following:

1. The dry weight and center of gravity of the instrument tree.
2. The weight and center of gravity of the drives.
3. The weights and centers of gravity of the components into which the instrument tree shall be divided for shipping purposes.

3.3.3 Drawing and Specification Lists. The manufacturer shall maintain a current list of all drawings and specifications in accordance with the requirements of RDT F 2-2 for the instrument tree. All current drawings shall include the current revision letter and each specification number shall include the applicable revision date.

3.3.4 Parts List. The manufacturer shall provide a complete parts list which shall be organized by assemblies. Each drawing number shall include the current revision number. The manufacturer shall provide a copy of the parts list which shall serve as a basis for monitoring changes.

3.3.5 Interface Identification. The manufacturer shall provide a complete list of connectors and mating portions (electrical and mechanical) for each component which is connected to an external service (e.g., motor power, control logic, instrumentation, cooling or heating lines, and gas lines).

3.4 Electrical Equipment and Instrumentation. The specific requirements for the design, manufacture and testing of electrical equipment and instrumentation are as specified in the Ordering Data.

3.5 Operation and Maintenance Manual. The manufacturer shall submit all manuals covering subcontractor supplied equipment.

4. QUALITY ASSURANCE REQUIREMENTS

4.1 Quality Assurance Program. The manufacturer shall establish, implement and maintain a documented Quality Assurance Program in accordance with Sections 1, 2, 4, 5, and 8 of RDT F 2-2.

4.2 Quality Assurance and Other Documents. The manufacturer shall prepare the following documents based on the requirements of RDT F 2-2.

4.2.1 Quality Assurance Documents. The manufacturer shall prepare the following documents based on the requirements of RDT F 2-2.

4.2.1.1 Quality Assurance Program Plan. The manufacturer shall prepare an inspection and test plan in accordance with RDT F 2-2, Section 2.

4.2.1.2 Inspection and Test Plan. The manufacturer shall prepare an inspection and test plan in accordance with RDT F 2-2, Section 5.

4.2.1.3 Special Process Control and Nondestructive Examination Procedures. The manufacturer shall submit and qualify procedures and equipment for special processes and nondestructive examinations in accordance with RDT F 2-2, Section 5.

4.2.1.4 Inspection, Test and Sample Plan Procedures

The manufacturer shall submit inspection and test procedures in accordance with RDT F 2-2, Section 5. These procedures shall include the details of all sampling plans proposed by the manufacturer and the basis for selection of the proposed sampling plan in accordance with RDT F 2-2, Section 5.

4.2.1.5 Nonconforming Item Documentation. The manufacturer shall establish, implement and maintain procedures, and document all nonconformances including corrective action and proposed rework/repair/retest procedures in accordance with RDT F 2-2, Section 5.

4.2.1.6 Quality Verification Plans. The manufacturer shall require the supplier of materials, components, and services to submit for approval prior to use the following documents which shall meet the requirements of RDT F 2-4.

1. Quality verification plan.
2. Sampling plan, if proposed by the supplier.
3. Special process controls.
4. Inspection and test procedures (including NDT procedures).
5. Cleaning and packaging procedures.

4.2.1.7 Handling, Preservation, Packaging, and Storage Procedures. The manufacturer shall prepare handling, preservation, packaging and storage procedures in accordance with Section 5 of this document and RDT F 2-2, Section 5. These procedures shall include instructions for removing all items from packaging.

4.2.1.8 Quality Records. To obtain purchaser release to ship, the manufacturer shall submit, as a minimum, the following documentation pertaining to each deliverable item:

1. Parts List - List of items by part number, organized by assemblies, drawing number and revision, part name, serial number or lot, or heat number.
2. Special Processes and Nondestructive Examination Qualifications - Certifications of special processes and nondestructive examination procedures and equipment qualifications.
3. Nonconformance Records - A copy of each nonconformance and corrective action record including rework or repair and retest procedures.
4. Certification - Certification of conformance, including:

Material Certifications - Chemical and mechanical test results, non-destructive examination and corrosion test results when applicable, heat treatment data and test results of material test coupons. This data shall be traceable from the related finished components back to the mill heat numbers.

Nondestructive Examination - Results of final nondestructive examination, including radiographic films, recorder charts and photographs.

Final Inspection - A copy of final inspection data and results including a list of purchaser specified key dimensions measured.

Test Reports - Certified copy of test results, analysis of test results and test fluid temperature and metal temperatures, including temperature corrections made to test pressure.

5. As-Built Documentation - A reproducible set of drawings. Drawings shall be in accordance with ANSI Y14. In addition, the vendor shall provide data sheets of as-built dimension for fabricated components for each instrument tree.

4.2.2 Other Documents. The manufacturer shall also prepare the following documents as specified in the Ordering Data.

4.2.2.1 Fabrication Plan. The manufacturer shall submit a detailed fabrication plan including manufacturing drawings, manufacturing processes and procedures to the purchaser prior to the start of fabrication.

4.2.2.2 Periodic and Progress Reports. Reports of progress in fabrication, quality status, inspection, testing, and shipping shall be made at specified intervals. These reports shall relate the progress made since the last report with appropriate photographs with only enough repetition of previously reported events to frame the contents of the present report. These periodic reports should also include difficulties encountered and the efforts made or planned for overcoming them. Problems foreseen as possible disruptions of the schedule shall be brought to the attention of the purchaser as early as possible.

4.2.2.3 Special Tool List. The manufacturer shall prepare and keep current a list of all special tools, including gages, required for manufacturing and handling for the duration of the contract. The list will identify each tool by name, drawing number, function, operations for which it is required, and whether it is an in-process tool or a deliverable item.

4.2.2.4 Final Report. The final report shall present a description of the fabrication, testing, and shipping of the instrument tree. The final report shall include in addition to detailed accounts of the areas listed above, the following:

1. Copies of drawings with specified key as-built dimensions, (see Table 4) measured and recorded and reduced to convenient sizes for binding in the final report.

2. Photographs of major stages of fabricating, assembling, inspecting, cleaning, testing, packing and shipping.
3. A discussion of any anomalies in material behavior and of any significant problems encountered in fabrication.

4.2.2.5 Shipping Documents. The manufacturer shall submit shipping instructions and documentation as specified in 5.1.3.

4.2.2.6 Repair Parts and Replacement Parts. The purchaser shall recommend a list of spare parts to be stocked at the plant site. This list is to contain those parts and tools likely to be damaged or expended during delivery, plant operation, or both. The manufacturer shall process and deliver these spares in accordance with the requirements for deliverable items.

4.3 Nondestructive Examination Requirements

4.3.1 Calibration. All instrumentation associated with nondestructive examination shall be qualified in accordance with RDT F 3-6. The manufacturer shall specify the certification level (Level I, II, or III) required by his procedures for personnel who:

1. Perform the tests, and
2. Interpret the results relative to acceptance criteria.

4.3.3 Procedures and Acceptance Standards. Detailed procedures for all required nondestructive examinations shall be prepared by the manufacturer and submitted to the purchaser for review and approval prior to use. Calibration level and acceptance standards shall be as specified in the Code and the applicable RDT standards listed in Section 2.

4.3.4 Post Examination Cleaning. Following nondestructive examinations, areas inspected shall satisfy cleanliness requirements of RDT F 5-1 before proceeding to the next weld pass, or the next fabrication step.

4.4 Examination of Materials and Parts

4.4.1 General. In the following section, acceptance standards and calibration levels shall be as specified in the applicable RDT material or process standards. Detailed nondestructive examination procedures shall be prepared and approved prior to use by the manufacturer.

4.4.2 Visual Examination of Materials and Parts. All raw material and standard commercial purchased parts shall be examined visually by the manufacturer for surface defects and cleanliness.

4.4.3 Requirements for Nondestructive Examination. Prior to use in fabrication, all materials noted in Table 1 shall be nondestructively examined in accordance with the applicable drawings and specifications.

4.4.4 Material Repairs

4.4.4.1 Repair by Welding. Where the applicable material standard and procedure specification allows the use of welding processes for repair of defects in the material, the repair shall be accomplished in accordance with the requirements of the Code as supplemented by RDT F 6-10.

4.4.4.2 Examination of Material Repairs. The examination of material repair welds shall be in accordance with the requirements of the Code as supplemented by RDT F 6-10. The repaired area shall be re-examined by the inspection method(s) which revealed the original defect in addition to the requirements of the Code as supplemented by RDT E 15-2. The purchaser may specify that other nondestructive examination methods shall be used to assure that the quality of the item has been maintained.

4.4.5 Overcheck of Materials. Overchecks on material chemical and mechanical properties shall be made by the manufacturer in accordance with RDT F 2-2. As a minimum, overchecks shall be performed on samples of each type of material from a particular supplier by a laboratory other than that used by the material supplier.

4.5 Examination During Fabrication

4.5.1 General. Examination of welds, including visual, dimensional, and nondestructive testing, shall be in accordance with the requirements of the Code and as supplemented by RDT E 15-2.

4.5.2 Visual and Dimensional Examination

4.5.2.1 General. All items shall be subjected to visual and dimensional examination to verify conformance with contract drawings. After forming operations, any formed shapes shall be 100 percent examined for conformance to prescribed shape and thickness.

4.5.2.2 Welds. All welds shall be examined in accordance with the Code as supplemented by RDT E 15-2, Section 4.

4.5.3 Radiographic Examination. All welds shall be fully radiographed in accordance with the Code as supplemented by RDT E 15-2 unless the weld configuration precludes a satisfactory examination. Purchaser approval is required for any weld configuration that cannot be radiographed.

4.5.4 Ultrasonic Examination. Welds which cannot be satisfactorily examined by radiography shall be 100 percent examined by ultrasonic methods in accordance with the Code as supplemented by RDT E 15-2, unless the weld configuration or ultrasonic properties preclude a satisfactory examination.

Welds which cannot be satisfactorily examined by either radiographic or ultrasonic methods shall be examined by a liquid penetrant method after the root pass and each successive 1/2 inch or 1/3 T (whichever is smaller) of deposited weld metal (where T is the thickness of the finished weld), as specified in the Code as supplemented by RDT E 15-2.

4.5.5 Liquid Penetrant Examination

4.5.5.1 Welds. All welds shall be examined by liquid penetrant methods to the requirements of the Code as supplemented by RDT E 15-2.

4.5.6 Examination of Weld Repairs. Weld repairs shall be examined to the requirements of the Code as supplemented by RDT E 15-2. In addition, weld repaired areas shall be reexamined by the examination method(s) which revealed the original defect.

4.5.7 Examination of Hardsurfacing. Hardsurfacing shall be examined in accordance with the requirements of the ASME Code as supplemented by RDT E 15-2.

4.5.8 Examination of Special Handling Devices. Following proof load testing of special handling devices and attachment lugs, all structural welds of these items shall be examined by the magnetic particle or liquid penetrant methods (depending on the material) in accordance with the applicable sections of RDT F 3-6 and RDT F 3-37.

4.6 Acceptance Tests. Each instrument tree shall be subjected to functional acceptance tests as specified in the Ordering Data.

4.6.1 Test Procedures. The manufacturer shall submit all procedures that are to be used during the fabrication of components for purchaser approval. These test procedures shall include at least the following:

1. Identification of the item to be tested (e.g., part number, system involved, and nomenclature).
2. Objectives of the test.
3. Measuring and test equipment to be used specifying range, accuracy, precision and type.
4. Detailed operations to be performed by the test operator including preoperational and periodic calibration checks.
5. Exact method of measuring items, including necessary manipulations controls on the item involved.
6. Operation of measuring and test equipment including pre-operation and periodic calibration checks.
7. Conditions that must be maintained during test, including ambient (environmental) conditions and precautions to be observed to prevent damage to the items or instruments involved.
8. Criteria for passing or failing the test, or for determining the acceptance or rejection of the item, including reference to applicable codes and standards.

4.6.2 Test Instruments. Instruments used to test the instrument tree shall be those normally used in test and research laboratories, with the following limitations:

1. No mercury or mercury-containing instruments shall be used.
2. Soft, metals, such as lead, copper, and aluminum shall not come in direct contact with instrument tree parts.
3. Halogens and halogenous materials shall not be used.
4. Sulphur and sulphur containing compounds shall not be used.

4.7 Inspection and Test Responsibility. Unless otherwise specified, the manufacturer shall be responsible for the performance of all tests and inspections required prior to the submission to the purchaser of any item for acceptance. The performance of such tests and inspections does not limit the right of the purchaser to conduct such other tests and inspections as the purchaser deems necessary to assure that all items are in conformance with all requirements of this standard. The manufacturer shall keep the purchaser informed of the progress of the work and shall notify him of any required tests or inspections not less than five days in advance of the test. Dimensional inspection shall be performed in accordance with Table 4.

TABLE 4 DETERMINATION OF COMPLIANCE & DATA RECORDING
FOR INSPECTION AND TEST (Page 1 of 3)

1. Tolerance Limit Interpretation - The tolerance limits specified on the purchaser's drawings and specifications shall be interpreted as "Absolute" values as defined in ASTM E29.

The practices of "rounding off" measurement within the tolerance range to determine the specified requirements shall not be used.

Example: A tolerance value specified as ± 0.001 shall be interpreted as ± 0.0010 .

2. Equipment/Technique Accuracy - Unless otherwise required or approved by the purchaser, determinations shall be made with equipment or techniques reading accurately as noted below:

- 2.1 Decimal Numbers - Use a device measuring in units no greater than 10% of the specified tolerance range.

Limits specified as "min" or "max" - Use a device measuring in units to one decimal place beyond the characteristic specified.

- 2.2 Fractional Numbers - Use a device measuring in units no greater than one-eighth of the specified tolerance range but no smaller than 1/64 inch.

- 2.3 Angles - Use a device measuring in the increments of 5 minutes when tolerance is specified in degrees. When the tolerance spread is 5 minutes or less, the measuring instrument shall indicate increments of 1 second.

TABLE 4. DETERMINATION OF COMPLIANCE & DATA RECORDING
FOR INSPECTION AND TEST (Page 2 of 3)

REQUIREMENTS FOR MEASUREMENTS & FOR THE RECORDING
OF CHARACTERISTICS HAVING SPECIFIED TOLERANCE LIMITS

Examples of Specified Tolerance Limits	Inspection or Test Instrument To Have Units of Measurement Minimum Increments Of	Characteristics Shall Be Recorded As Follows Unless Otherwise Req'd Or Approved By the Purchaser
<u>Decimals</u>		
$\pm .X$	.0X0 Times 2	OK if in tol. Actual value recorded if not
$\pm .0X$	.00X Times 2	OK if in tol. Actual value recorded if not
$\pm .00X$	.000X Times 2	Actual value
$\pm .00X$ -- .000	.000X	Actual value
X.X Min.	.0X	OK if in tol. Actual value recorded if not
X.XX Max.	.00X	OK if in tol. Actual value recorded if not
X.XXX Min.	.000X	Actual value
<u>Fractions</u>		
$\pm 1/4$	1/16	OK if in tol. Actual value recorded if not
$\pm 1/4 - 0$	1/32	OK if in tol. Actual value recorded if not
$\pm 1/32$	1/64	OK if in tol. Actual value recorded if not
$\pm 1/32 - 0$	1/64	OK if in tol. Actual value recorded if not
<u>Min. or Max.</u>		
Less than 36 in.	1/64	OK if in tol. Actual value recorded if not
36 in. through 71 in.	1/32	OK if in tol. Actual value recorded if not
72 in. through 143 in.	1/16	OK if in tol. Actual value recorded if not
Over 144 inches	1/8	OK if in tol. Actual value recorded if not

TABLE 4 DETERMINATION OF COMPLIANCE & DATA RECORDING
FOR INSPECTION AND TEST (Page 3 of 3)

REQUIREMENTS FOR MEASUREMENTS & FOR THE RECORDING
OF CHARACTERISTICS HAVING SPECIFIED TOLERANCE LIMITS

Examples of Specified Tolerance Limits	Inspection or Test Instrument to Have Units of Measurement Minimum Increments of	Characteristics Shall Be Recorded As Follows Unless Otherwise Req'd Or Approved By the Purchaser
<u>Angles</u>		
$\pm 1^\circ$	5'	OK if in tol. Actual value recorded if not
$\pm 0^\circ 30'$	5'	OK if in tol. Actual value recorded if not
$+ 0^\circ 30' - 0^\circ 0'$	5'	OK if in tol. Actual value recorded if not
$\pm 0^\circ 5'$	1"	Actual value
$+ 0^\circ 5' - 0^\circ 0'$	1"	Actual value
$\pm 0^\circ 0' 30''$	1"	Actual value
Surface Finish		OK if in tol. Actual value recorded if not
Gaged (Go-No-Go)		and record gage number used

5. PREPARATION FOR DELIVERY

5.1 Delivery Requirements. The manufacturer shall deliver all items to the designated site.

5.1.1 Preparation. Upon completion of all shop testing and inspection, the manufacturer shall prepare all deliverable items for delivery to the designated site. This shall include, but is not limited to, all disassembly (as required), recleaning (if necessary), surface preparation, examination, etc. Following preparation, all deliverable items shall be packaged in accordance with the requirements of 5.1.2.

5.1.2 Packaging and Packing. Items subject to deterioration, corrosion or damage shall be packaged in a manner to preserve them. All sealing, packaging, packing and identification marking shall be in accordance with RDT F 7-2 and as specified in the Ordering Data. Packaging shall be adequate to protect the time while at the manufacturer's facilities, during transportation to the designated site, and at the designated site. The center of gravity and weight of the loaded shipping container shall be marked on the external surface of the container.

The manufacturer shall prepare handling, preservation, packaging and storage procedures in accordance with RDT F 2-2, Section 5. These procedures shall include instructions for removing all items from packaging.

5.1.3 Shipping. The manufacturer shall be responsible for the delivery of all items covered by this standard to the designated site. A shipping plan shall be prepared and submitted for purchaser approval at a time as specified in the Ordering Data. This plan shall conform to the following requirements:

5.1.3.1 Routing. The manufacturer shall submit routing for all material, components or both for which he is responsible. When approved by the purchaser, the manufacturer shall make all arrangements necessary to ship those materials, components or both in accordance with the terms of the contract and requirements of this standard.

5.1.3.2 Shipping Instructions. The manufacturer shall prepare and submit suitable instructions to the carrier for handling, shipping, in-transit storage, unloading, and storing of all items for which the manufacturer has delivery responsibility.

5.1.3.3 Loading. Required shipping position, supports and crating shall be determined by the manufacturer. The manufacturer shall provide supervision for loading the components onto the transporting vehicle. All handling equipment shall be designed to prevent any damage to components during handling and shipping operations in accordance with the requirements of 5.1.3 and 5.1.4.

5.1.3.4 Documentation. The manufacturer shall identify all technical documentation, e.g., instructions, drawings, reports and manuals which are to be shipped with the deliverable items.

5.1.4 Handling. Lifting and handling equipment used for lifting all components, assemblies and raw material for an instrument tree shall comply with the requirements of RDT F 8-6.

6. NOTES AND ORDERING DATA CHECKLIST

6.1 Ordering Data Checklist. The detailed supplementary requirements and conditions necessary to fabricate, examine, test, and deliver an instrument tree in accordance with this standard are included in the Ordering Data. The following list includes those paragraphs in which the standard makes specific reference to the Ordering Data.

<u>Item</u>	<u>Refer to Paragraph</u>
1. Components and Services to be Provided	1.1
2. Applicable Documents	2.
3. Heat Treatment	3.2.5
4. Cleanliness	3.2.9
5. Archive and Surveillance Samples	3.2.15
6. Electrical Equipment Instrumentation	3.4
7. Quality Assurance and Other Documents	4.2
8. Periodic & Progress Reports	4.2.2.2
9. Acceptance Tests	4.6
10. Packaging & Packing	5.1.2
11. Shipping	5.1.3

INSTRUMENT TREE FOR SODIUM COOLED REACTORS (FABRICATION ONLY)

A M E N D M E N T 1

This amendment forms a part of RDT E 6-18T
dated February 1973

1. Page 2, 1.2 Definitions, 8: In the second sentence, change the first comma to a colon.
2. Page 2, 1.2 Definitions, 16: Reword second sentence as follows:

 Susceptibility to corrosive attack is increased by the depletion of chromium in a thin layer surrounding each grain.
3. Page 5, 3.1: In the third sentence, change ". . . on Figure 1" to ". . . in the Ordering Data."
4. Page 5, 3.1: In the fourth sentence, change ". . . in Table 2" to ". . . in the Ordering Data."
5. Page 5, 3.2: In the first sentence, correct the spelling of "supplemented."
6. Page 8: Delete the pressure boundary illustration.
7. Page 9: Delete Table 2.
8. Page 10, 3.2.3: Revise the second sentence to read:

 Purchaser approval shall be obtained to make weld repairs to remove weld defects that recur.
9. Page 10, 3.2.3, last paragraph: In the second sentence, change "will" to "shall".
10. Page 10, 3.2.3, last paragraph: In the last sentence, change ". . . shall be come a part of . . ." to ". . . shall become a part of . . ."
11. Page 11, 3.2.6: Reword second sentence as follows:

 Purchaser approval shall be obtained for all procedures.

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12. Page 11, 3.2.7: Replace items with the following:
 1. Surfaces in contact with sodium - not greater than 125 microinches.
 2. Mating surfaces - not greater than 63 microinches.
 3. Weld reinforcement - not greater than 125 microinches.
 4. All machined surfaces - not greater than 125 microinches.
 13. Page 11, 3.2.8: Change the period in the first sentence to a colon.
 14. Page 12, 3.2.10: Rewrite as follows:

3.2.10 Lubricants. Lubricants selected for shaft seals and bearings shall be free of halogen compounds. Materials in contact with lubricants, except antifriction bearings, shall be selected for corrosion resistance without the use of paint or other protective coatings. Purchaser approval shall be obtained for all lubricants used.
 15. Page 13, 3.2.12 Identification, 1: In the second sentence, add a comma after ". . . of the material or".
 16. Page 14, 3.3.1.1: In the first line of item 3, change the first "any" to "and".
 17. Page 15, 4.2: Change the period in the first sentence to a colon.
 18. Page 15, 4.2.1: Change the period in the first sentence to a colon.
 19. Page 16, 4.2.1.6: Change the period in the first sentence to a colon.
 20. Page 16, 4.2.1.8: Reword the beginning of the second sentence under "Material Certifications" as follows:

"These data shall be . . ."
 21. Page 17, 4.2.2: Change the period in the first sentence to a colon.
 22. Page 17, 4.2.2.1: Insert the words "a schedule for release of" between "including" and "manufacturing".
 23. Page 17, 4.2.2.2: In the third sentence, change "should" to "shall".
 24. Page 17, 4.2.2.3: In the second sentence, change "will" to "shall".
 25. Page 18, 4.2.2.6: In the second sentence, change "is to contain" to "shall contain".

26. Page 18, 4.3.1: Reword as follows:

4.3.1 Calibration. All instrumentation associated with nondestructive examination shall be qualified in accordance with RDT F 3-6. The manufacturer shall specify the certification level (Level I, II, or III) required by his procedures for personnel who perform the tests and interpret the results relative to acceptance criteria.

27. Page 20, 4.5.6: In the second sentence, hyphenate the word "re-examined".
28. Page 21, 4.6.2: Add a hyphen between "sulphur" and "containing".
29. Page 25, 5.1.2: In the third sentence, change the word "time" to "component".
30. Page 25, 5.1.3.1: Routing: In both sentences change, ". . . materials components, or both . , ." to read ". . . materials and components . . .".
31. Page 26, 6.1: Add the following item in sequence:

<u>Item</u>	<u>Refer to Paragraph</u>
Materials	3.1

R D T S T A N D A R D

UNITED STATES ATOMIC ENERGY COMMISSION
DIVISION OF REACTOR RESEARCH AND DEVELOPMENT

RDT E 6-18T, Amendment 2
DATE March 1974
PAGE 1 OF 1

INSTRUMENT TREE FOR SODIUM COOLED REACTORS (FABRICATION ONLY)

A M E N D M E N T 2

This amendment forms a part of RDT E 6-18T
dated February 1973

1. Page 3, 2.1: Add the following RDT standard in sequence:

 RDT F 3-15T Requirements for Inspection of Dimensional Characteristics
2. Page 17, 4.2.2.4, Item 1: Delete the parenthetical reference "(see Table 4)."
3. Page 19, 4.5.2.1: Revise the first sentence to read:

 All items shall be visually examined and measured to verify conformance to drawings. Inspection of dimensional characteristics shall conform to RDT F 3-15.
4. Page 22, 23, and 24: Delete Table 4.