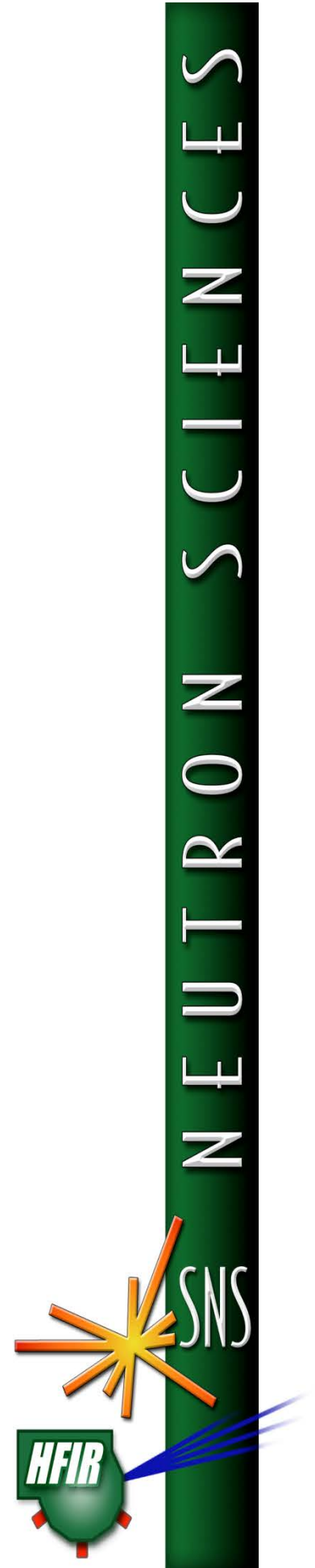


104110000-SW0008-R00

SPALLATION NEUTRON SOURCE

STATEMENT OF WORK PPU CRYOMODULE

July 12, 2016



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1.0 Introduction

The Proton Power Upgrade (PPU) requires that 7 High Beta Cryomodules are to be installed in the LINAC.

Within this document, references and engineering drawings with labels of “SNS” or the Company – UT-Battelle / Oak Ridge National Laboratory. “The Seller” shall refer to the manufacturer / vendor doing the work. This document shall be referred to as “the Agreement.”

2.0 Scope

This statement of work (SOW) describes procurement, manufacturing, and assembly requirements for the PPU Cryomodules. Most fabrication and assembly requirements are provided in the reference drawings for the Cryomodules. Additional requirements and responsibilities are imposed on the Seller as outlined in this document. These requirements fall into the categories listed below:

- Quality assurance documentation
- Material certification, tracking, documentation and labeling of subcomponents
- Labeling finished components
- Fabrication travelers and documentation
- Certified welder program
 - Welder certification, documentation and training records
 - Weld material labeling and proper storage
 - Weld inspection and analysis
- Component cleaning before welding documentation
- Vacuum leak testing of components and completed assemblies
- Pressure testing of Vacuum Vessel and End-cans

2.1 Deliverables to the Company

The Seller shall offer for acceptance 7 fully fabricated Cryomodules that conform to this statement of work, associated drawings, and quality control specifications in this document.

2.2 Seller Furnished Materials, Equipment, and Services

- 2.2.1 The Seller shall provide all materials necessary to fabricate complete deliverables except what is defined in Section 3.0.
- 2.2.2 The Seller shall provide manufacturing engineering services required to generate internal shop drawings and all documentation needed to manage and support their suppliers. This will include all technical and commercial supervision required in order for the Company to receive an assembly that meets all requirements and specifications.
- 2.2.3 The Seller shall provide all labor to assemble, test and supervise the manufacture of all components regardless of where these are made: within the Seller's plant or in a second facility or sub-contractor.
- 2.2.4 The Seller shall provide the blank flanges and miscellaneous hardware required to perform the pressure and leak testing. These flanges will also be furnished to the Company for shipping and storage of the Cryomodule.

3.0 Company Furnished Materials, Equipment, and Services

- 3.1.1 The Company shall procure the Cavity Material and Cavities, RF Couplers, He Vessels, and He Vessel Instrumentation
- 3.1.2 The Responsibility Matrix for the Company and Seller is defined in Section 9.0
- 3.1.3 The Company shall provide reference procedure manual. Variation from this will require Company approval.

4.0 Requirements

4.1 Dimensional Conformance

The Company's drawings and all drawings referenced shall be used by the Seller for configuration control and dimensional conformance. Dimensional variances and overall envelope configuration shall be maintained within specified tolerances.

4.2 Leak Checking of Components

The Seller shall leak check and submit documentation for the following: Beamline, He Vessel, Explosion Bonded Joints, Coupler Bellows, and Primary & Secondary He Circuits.

4.3 Leak Checking of Vacuum Vessel and End-Cans

The Seller shall fabricate or procure any non-standard blanks. The Seller shall procure the blank flanges for the standard flanges and associated hardware. The Seller shall provide a minimum of two weeks' notice prior to leak checking to allow for travel arrangements to the Seller's site for inspection prior to leak checking.

Helium leak testing of the vacuum vessel & end-cans including but not limited to weld joints, penetrations, nozzles, seals, etc., shall show no detectable leak greater than $1.0E-9$ Torr*Liters/Second using a Mass Spectrometer Leak Detector. Metal seals shall be utilized in testing where used in normal operation. Rubber seals are only allowed to be used for leak testing when the normal operation of the vessel calls for rubber seals. The Seller shall attach a calibrated leak to the vacuum vessel that leaks at a rate equal to or less than the accepted leak rate for the vacuum vessel for the duration of the witnessed leak check. The Seller shall use a Mass Spectrometer Leak Detector calibrated to a nationally recognized standard for this testing and shall provide recorded evidence that clearly state the date, time, equipment (with unique identifiers), and conditions of these tests.

A final Helium leak test shall be completed after pressure testing of both the vacuum vessel and end-cans. The Seller shall provide a minimum of two weeks' notice prior to leak checking to allow for travel arrangements to the contractors site for inspection prior to the final leak checking. A leak test report shall be provided to the Company and approved before final delivery.

4.4 Out-Gassing of Vacuum Vessel and End-Cans

An out-gassing report shall be provided to the Company and approved before final delivery.

4.5 Pressure Vessel Requirements

The vacuum vessel and end-can design is part of the pressure boundary for the PPU Cryomodule design. The design pressure for the vacuum vessel is 3 ATM absolute. This design will require the Seller and any subcontractors to follow the ASME Boiler and Pressure Vessel Code requirements including pressure testing of the completed end-can assembly. The Company is requiring the Seller to "U" stamp this vessel. The Company has completed a structural analysis to show that the vacuum vessel design is compliant with the ASME Boiler and Pressure Vessel Code requirements and can be reviewed upon request.

The vacuum vessel is to be hydrostatic tested. After hydrostatic testing the vessel it must be dried and cleaned according to the Company's cleaning and handling specification prior to final leak checking and delivery and meet the Out-Gassing requirements in Section 3.3.

The end-cans are to be pressure tested pneumatically. The Seller must use clean dry air or Nitrogen for the pressure test.

4.6 Welding

4.6.1 Vacuum Vessel & End-Can

- 4.6.1.1 The vacuum vessel and end-can fabrication welding shall be performed using the Gas-Tungsten-Arc Welding (GTAW) method. Seller shall ensure that no entrapped gases, fluxes, pits, cracks, or like imperfections are left in the heat affected zones. All edges shall be rounded and burrs removed from all seams, joints and weld areas.
- 4.6.1.2 All category A & B weld joints shall be fully radiographed according to ASME B&PV Code, Section VIII, UW-51.
- 4.6.1.3 All welders shall be qualified in accordance with the ASME B&PV Code, Division 1, Section IX.
- 4.6.1.4 Post cleaning of welds is required to leave the surface in a bright condition with no trace of solvents or residue. The Seller shall identify the cleaning process used to remove the residue as part of the bid package. See General Requirements for cleaning and handling of components for use in the SNS Cryomodule 104110000-TS0001 Rev0.

4.6.2 Piping

- 4.6.2.1 Piping shall be welded in accordance with ASME B31.3.
- 4.6.2.2 Welds exposed to cryogenic temperatures must meet or exceed ORNL welding specification GT88-1(PP) REV 12.

4.7 Manufacturing Engineering

- 4.7.1 The Seller shall fabricate jigs and simple fixtures to ensure run pipes, pipe fittings, brackets and other important components are maintained to specified tolerances.
- 4.7.2 The Company's component parts are detailed to the nominal and assembled material conditions. It is the responsibility of the Seller to allow for fitting and welding tolerances by adjusting said drawings to their manufacturing techniques.
- 4.7.3 The Seller is required to generate shop travelers and sequencing documentation to document fabrication of the Cryomodule.

4.8 Material

- 4.8.1 The material used in the fabrication of the vacuum vessel and end-can assemblies shall conform to the specifications in associated drawings. It is required to use 304L or dual certified 304/304L stainless steel for all welded components and may be used in other applications. It is the responsibility of the Seller to ensure that all material used is identified and traceable to the stated specification.
- 4.8.2 Material traceability documents shall be provided to the Company as part of the delivered finished Cryomodule. These documents must provide enough information to back track material labels to the original material test reports.

4.9 Documentation

4.9.1 The Seller shall submit a Quality Assurance Program with the proposal for the Company approval. The program shall be in sufficient detail and scope that the Company can evaluate the adequacy of quality controls to be expected from the Seller. The QA/QC program shall contain as a minimum the following elements; training and qualification, improvement program, documents and records program, process control (including a mature calibration program), design control, procurement control, inspection and test, and assessment program.

A project specific Quality Assurance Plan (QAP) must be provided within 4 weeks of contract award. In addition, said plan shall be maintained during the term of the contract.

4.9.2 Certified mill test reports (CMTR) of all raw materials used to fabricate deliverables shall be provided to the Company with each delivery.

4.9.3 These material certifications shall include all processes and tests with grade and composition being clearly identifiable.

4.9.4 Copies of all travelers shall be provided to the Company with each delivery.

4.9.5 Copies of all inspection and test reports shall be provided to the Company with each delivery.

4.9.6 Copies of Weld Procedure Specifications (WPS), the Procedure Qualification Records (PQR) being used, and the Welder Performance Qualification for the WPS's being used shall be provided to the Company upon bid acceptance.

4.9.7 Copies of certified qualifications in accordance with ASNT SNT-TC-1A or equivalent for personnel performing visual examination, leak checking, and NDE of welds shall be provided to the Company upon bid acceptance.

4.9.8 A production timeline that meets the Company's delivery schedule for fabrication, starting from time of award running through F.O.B. shall be provided as part of the bid package. Following the Company approval of timeline and contract award, it is the responsibility of the Seller to comply with and meet dates specified in approved timeline.

4.9.9 Seller may propose deviations from the specifications, drawings, or other technical requirements of this procurement. Where time is a consideration, the Seller may communicate the proposed deviation directly to the engineer or technical lead, with a copy to the Company buyer. The engineer or technical lead will evaluate the technical aspects and recommend to the buyer, who will communicate acceptance or disapproval to the Seller. The request should identify the affected items, drawing/specification number & revision number, a description of the proposed deviation, and the justification for it.

4.9.10 The Company expects to receive equipment items, components, materials, software, and documentation that conform to all codes, standards, specifications, and procedures in the Agreement. The Seller may use its own nonconformance program to identify, report, and recommend disposition of all non-conformances, but dispositions that would leave any remaining nonconformity must be submitted to the Company for approval. The request should identify the affected item(s) by name and serial number, citing the drawing/specification number & revision number containing the specific requirement that has not been met. It should state the number of nonconforming items being reported. The request should include a description of the cause, and a corrective actions plan and schedule if pertinent. The issuance and acceptance of such a request in no way limits or affects the warranty provision of the Agreement. Such a request shall not establish a precedent or obligation to accept existing or future items not conforming to all provisions of the Agreement.

4.10 Marking and Traceability Requirements

4.10.1 The Seller shall inscribe all parts with clear markings (0.25" high characters) such that a visual inspection will provide traceability and fast identification. Identification applies to the smallest mechanically disassembled component. At a minimum, the markings shall include the drawing part or identifying number. The markings may also include identification of the component's source (i.e. contractor / subcontractor), material specification, and any other information that will allow for immediate recognition of said components and their source. Purchased parts are excluded from this requirement.

4.11 Cleanliness Requirements

4.11.1 Surfaces shall be cleaned and protected at all stages of fabrication such that dust, oils and other contaminants are removed prior to final assembly and preparation for delivery to the Company. See General Requirements for cleaning and handling of components for use in the SNS Cryomodule 104110000-TS0001 Rev 0.

4.11.2 The vacuum vessel and end-can assemblies shall be cleaned to a bright metal condition by using grit-less abrasive pads or the Company's approved equivalent. No solvents, waxes, oils, or protective coatings shall be placed (or left) on this interior surface. The end-can assemblies will be used in a moderate to high vacuum service.

4.12 Instrumentation

4.12.1 The PPU Cryomodule shall have Cernox temperature sensors.

4.12.2 The Seller must track serial numbers and provide that information to the company for configuration of the temperature signal conditioners.

4.13 Alignment

- 4.13.1 The Seller shall submit an Alignment plan to the Company for review.
- 4.13.2 The overall straightness of the cavity string horizontally and vertically shall be within 0.004”.
- 4.13.3 The Seller shall provide coordinate data for fiducial points on the exterior of the vacuum vessel, related to the as-left geometry of the aligned cavity string.
- 4.13.4 The Seller shall submit a report of all survey data.

5.0 Acceptance

- 5.1 Both leak test and out-gassing reports shall be approved by the Company prior to shipping.
- 5.2 Instrumentation testing and verification at the Seller’s site.
- 5.3 After inspection, the Cryomodule shall be prepared for crating and shipment to the Company.
- 5.4 The assemblies will be inspected and tested at the Company prior to final acceptance.
- 5.5 The Company reserves the right to have its technical or procurement representatives witness any or all manufacturing steps, tests, and inspections established under the Sellers’ quality assurance program to demonstrate compliance with this specification. Any information of a proprietary nature must be identified in the bid response.
- 5.6 The Company representatives shall have unannounced visitation access to the Seller’s plant and personnel during normal operation hours in order to conduct Quality Assurance Audits.
- 5.7 Final Acceptance shall occur after successful cold RF testing of the Cryomodule by the Company.

6.0 Preparation for Shipment

- 6.1 The Seller shall ship the specified equipment properly packed, to ensure that damage is not incurred during shipment, in accordance with transportation industry standards.
- 6.2 All deliverables including documentation shall be catalogued and offered for acceptance to the Company at the time of Cryomodule delivery. Documentation

must accompany the products such that the Company receiving personnel clearly understand the contents and can match delivery to a purchase order.

- 6.3 Any internal component that may be subject to dynamic (road) damage shall be blocked, internally braced or temporarily supported. These shall be easily removed by simple hand tools.
- 6.4 A packing list of loose items shall be included in any kits required.
- 6.5 Assembly packaging shall be such that no damage is incurred during transit. This shall include weather protection and the closure of all open pipes with test plugs or removable caps. Sizing shall be such that handling is facilitated and weight limitations imposed by the transportation industry can readily be met. All flanges and openings shall be blanked off and the cryomodule is to be shipped under vacuum.
- 6.6 The Seller shall submit a shipping plan to the Company for review prior to shipment. The Cryomodule shall not be shipped until the Company has reviewed and accepted the shipping Plan. The shipping plan shall include provisions for sealing, loading, securing, and shipping the equipment, handling and rigging details and a drawing of the shipping/storage frames or crating.
- 6.7 The outside of the shipping container shall be clearly and legibly marked as stated below:
SNS PPU Cryomodule #X
P.O. Number
Attention: Stephen Stewart / Matt Howell

7.0 Seller Deliverables

- 7.1 Leak checking reports, prior to delivery of Cryomodule
- 7.2 Project Specific Quality Assurance Plan, within 4 weeks of contract award
- 7.3 Certified Mill Test Reports, with each delivery of Cryomodule
- 7.4 Fabrication Traveler, with each delivery of Cryomodule
Inspection / test reports, with each delivery of Cryomodule
- 7.5 Alignment report, with each delivery of Cryomodule
- 7.6 Welds NDE personnel qualification records
- 7.7 WPS, PQR, and welder qualification evidences
- 7.8 Production Schedule, as part of the bid package
- 7.9 A copy of the final signed U-1 form

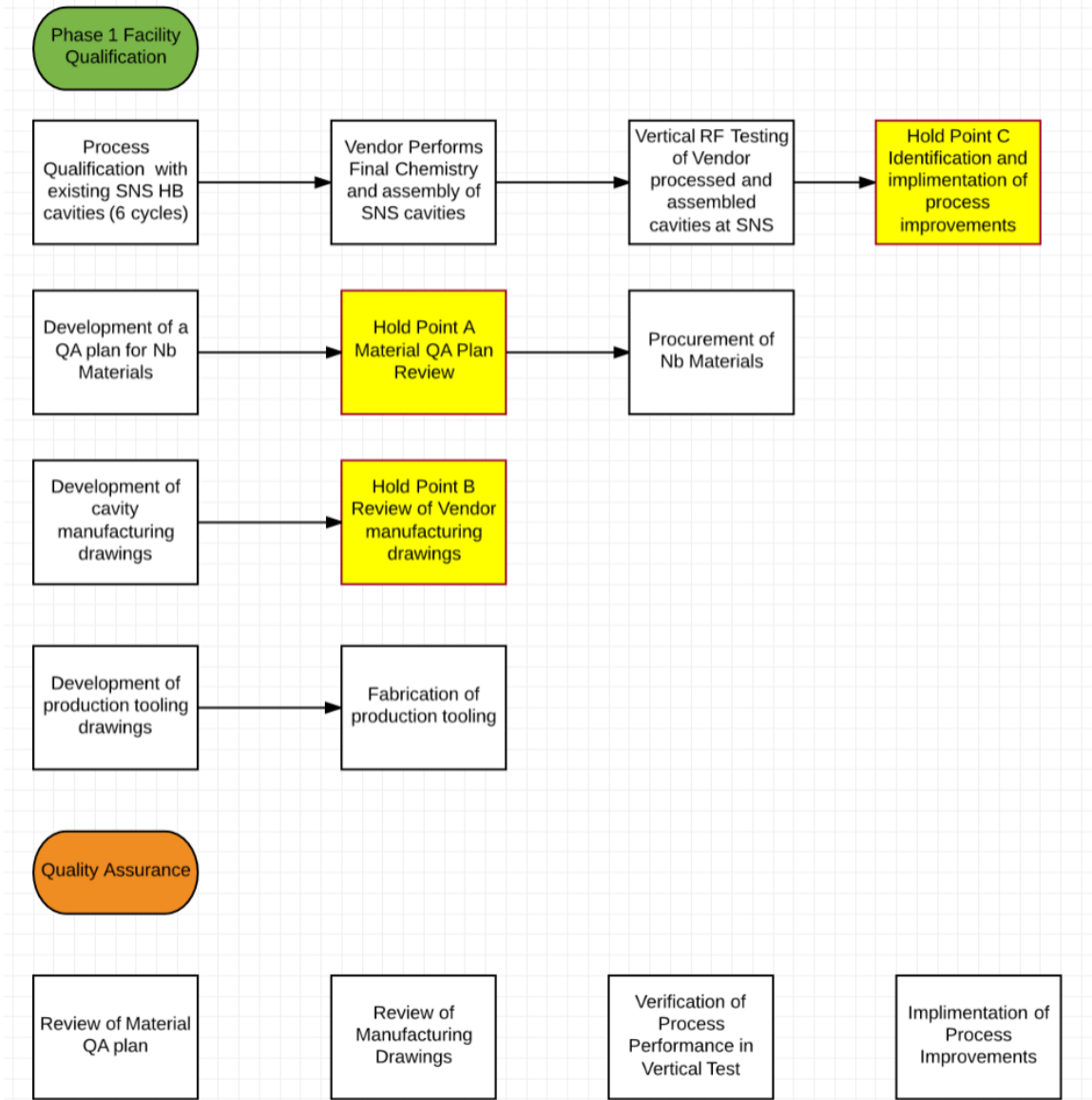
8.0 Reference Documents

- 8.1 General Requirements for cleaning and handling of components for use in the SNS Cryomodule 104110000-TS0001 Rev0
- 8.2 ORNL Welding Procedure GT88-1(PP) REV 12
- 8.3 Shipping and Alignment for the SNS Cryomodule

9.0 Responsibility Matrix

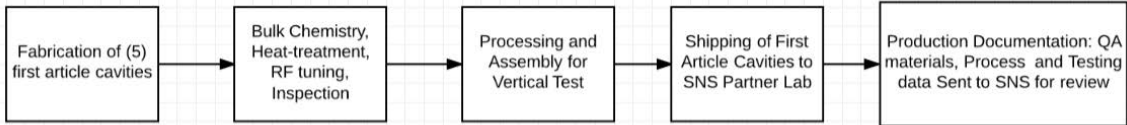
9.1 Cavity Vendor

Vendor Cavity Fabrication and Processing

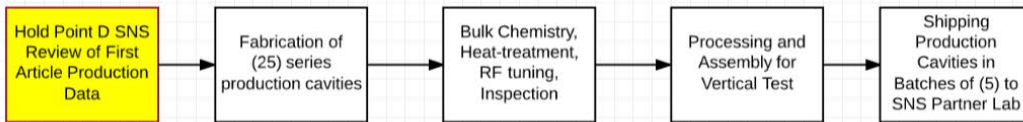


Vendor Cavity Fabrication and Processing

Phase 1a First Article Cavity Fabrication (5)



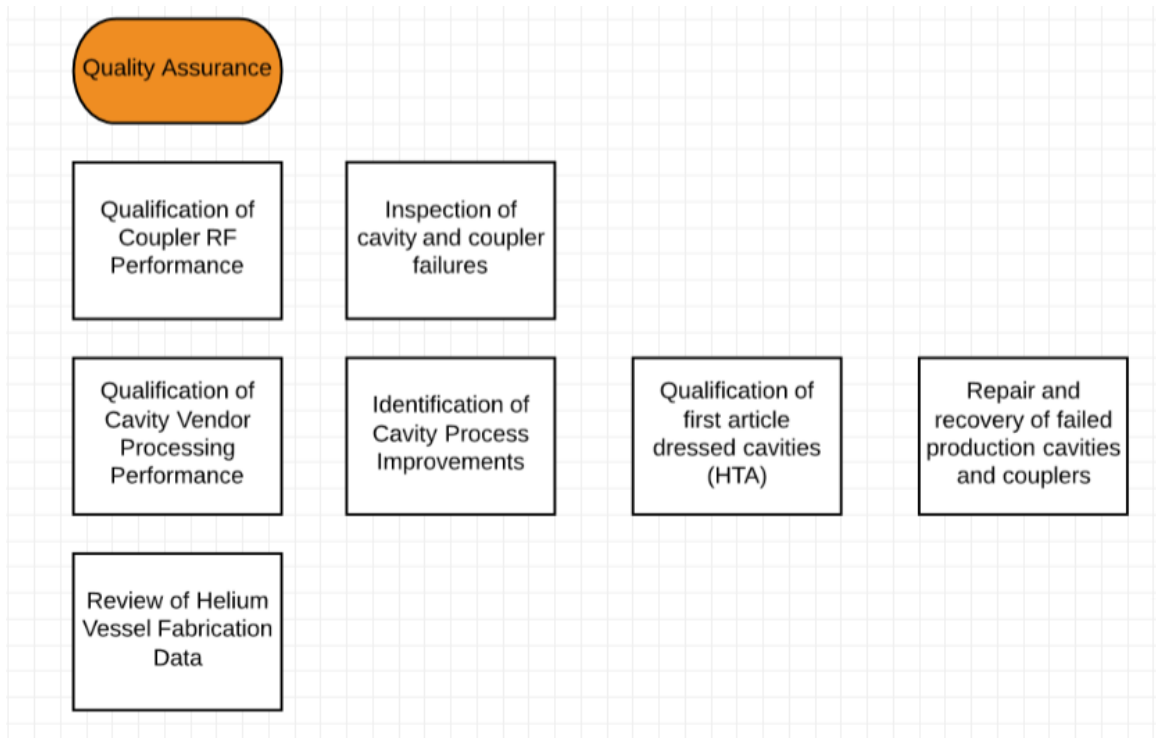
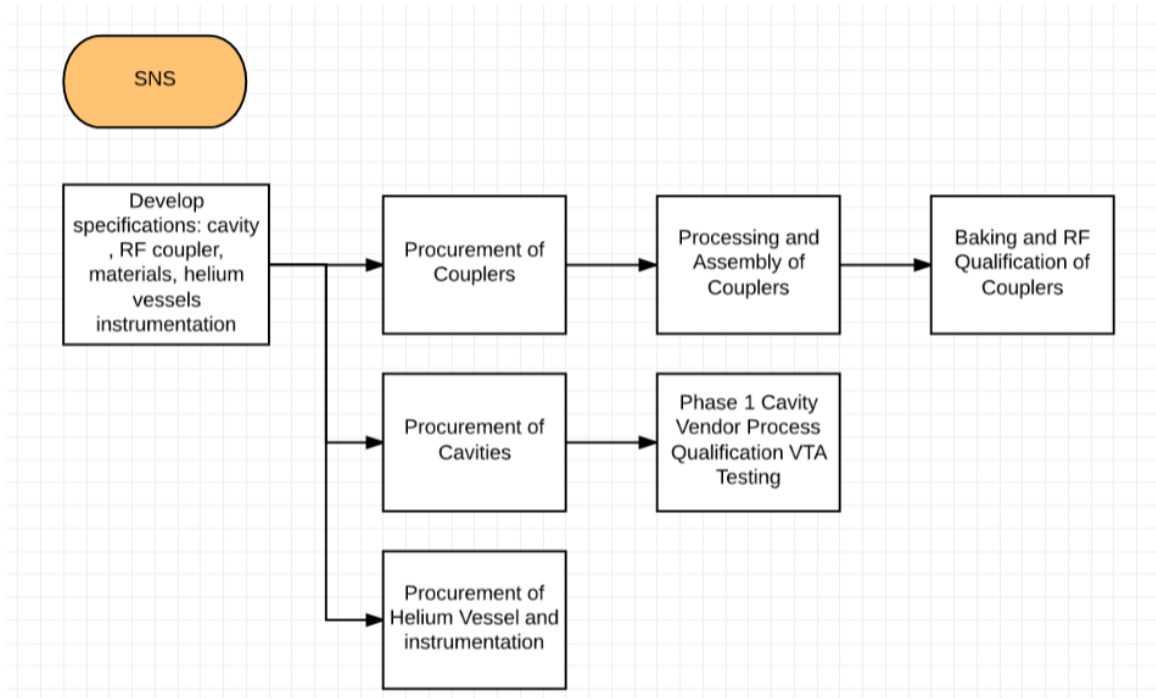
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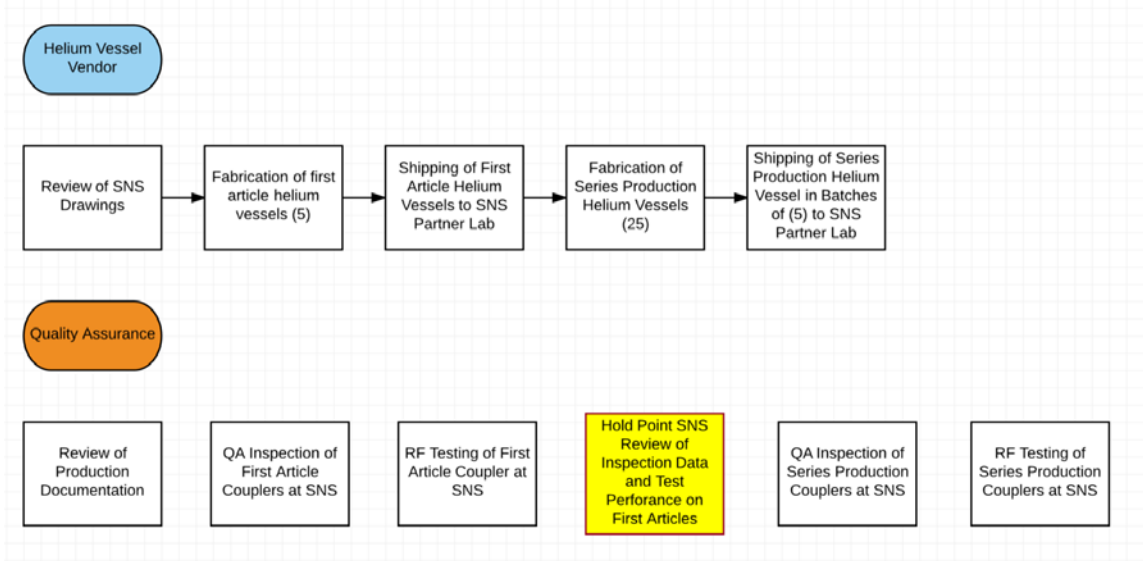
Quality Assurance



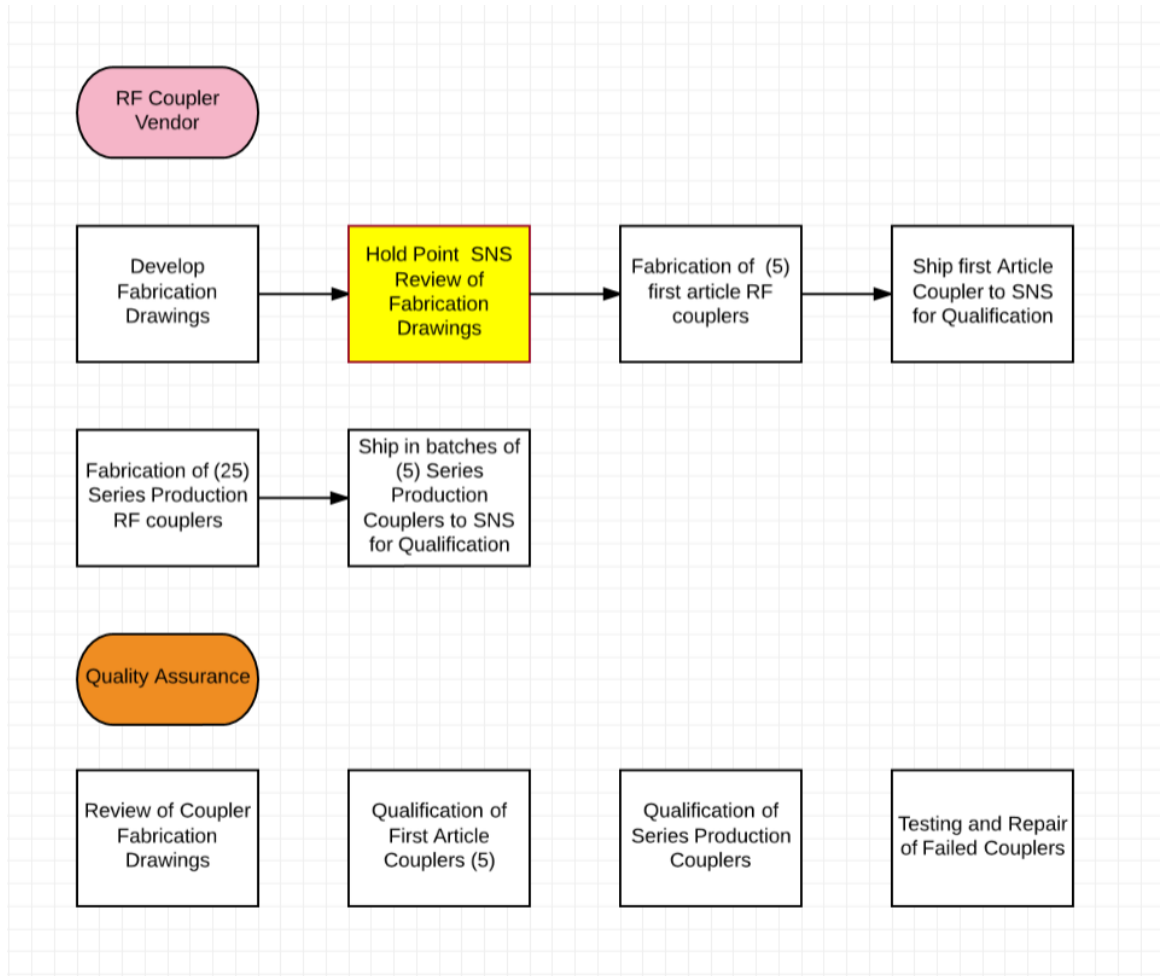
9.2 The Company



9.3 Helium Vessel Vendor



9.4 RF Coupler Vendor



9.5 The Seller

