CHAPTER IV

QA Plan, Fabrication Plan and Inspection Plan

IV-1 MICE Solenoid QA Plan

Project QA plan is presented in appendix D

IV-2 Superconductor Fabrication and Inspection Plan

Superconductor is purchased by LBL and fabricated by OK superconductor. Mechanical and electrical characteristics were tested by OK. We shall repeat short sample test for each spool, examine conductor filament, and twisting pitch for each terminal of coil.

IV-3 6061T6 Bobbin Fabrication and Inspection Plan

For good assurance of vacuum leak tightness, the bobbin will be forged 6061T6 aluminum cylinder in one piece length (100.16" long). We require manufacturer's verification of chemical composition before forging and after forging. After forging, we need to examine maximum void size by 100% x-ray. It will be roughly machined as shown in Drwg MICE-001A, then final machined to dimensional tolerance per drawing MICE C001.

It must be deburr, degrease, and finally, leak check to a sensitivity of 1×10^{-10} torr-liter/ sec.

IV-4 Coil ground plan insulation installation and Inspection plan

After inspect bobbin, cleaniness and leak tight. The coil mandrel will be insulated first. Then, the side wall is insulated. We, then, perform megger 5kV test to verify leakage current less than 200 nA.

IV-5 Coil winding plan and inspection plan

We shall setup dust free and metal chip free winding facility. We have written winding instruction as shown in appendix II-9-1. Turn-to-turn short and layer-to-layer short will be measured at the end of each coil layer. The coil will be wet-layer-up, so mixing epoxy must be carefully controlled. Inspection of left over epoxy in the mixing up will provide another proof that epoxy is mixed and cured well.

IV-6 Coil banding, Banding insulation, and Inspection plan

On the last layer of coil surface in each coil, we install ground plan insulation before we install 6 mm thick aluminum banding. After banding, the coil is meggered for 5 kV again with respect to ground and to banding.

IV-7 Installation of Reinforce Aluminum Ring

To assure that the axial force does not open up the coil former and cause epoxy crack and conductor motion, each coil after banding, is welded to reinforce the aluminum ring and assure that the winding pack is tight and well supported after cooldown and after energization. This reinforce ring must be welded without heating the conductor pack.

IV-8 Magnet protection subassembly and Inspection Plan

To make sure protection diode will work at low temperature, diode subassembly will be tested in liquid nitrogen temperature or liquid helium temperature before installed on top of the reinforce ring of coil C.

IV-9 Superconducting Feedthrough fabrication and Inspection Plan

Each MICE tracker solenoid will need six superconducting feedthroughs (A, B, C, D and F, per Fig II-14-1), each rated at 500A, and two trim lead feedthrough, each rated at 100A. We shall purchase two units of UHV feedthrough with four hollow conductors each. Then, we shall perform vacuum soldering for superconducting feedthrough. These feedthroughs will be tested in liquid helium environment for leak tightness. Thermal cycle five times will be performed to verify the vacuum tightness before it is installed.

IV-10 Final Coil Assembly Coil and Inspection

Per Fig II-14-1, coil terminals will be soldered together with coil protection subassembly and superconducting feedthrough. Liquid helium sensor, cernox sensors, pt sensors and voltage taps will be bundled and routed to quench vent line and feedthrough.

Leading superconducting cable wiring between coils will be at the bottom of coil and will have copper to superconductor ration of at least 30 to 1 and at least five times superconducting margin. It will be insulated from each other and from precool line which is also at the bottom of the coil.

IV-11 Helium Shell Installation Plan weld prep, welding procedure and leek check procedure

He shell shall be made of 1/2'' thick 6061 T6 rolled half cylinder as shown in Drwg MICE-C002 and –C002A.

The seam weld will be nearly 100% penetration. The weld preparation is 0.394''x 45°. There is a backup strip 1/8'' thick x 1/2'' wide tacked to inside of the cylinder to prevent torch penetration into the coil during seam weld.

All weldment must be trimmed properly to have good fit and then tack weld before rootpass. Die penetrant inspection must be made and approved before second pass of tig weld.

The weldment at each end flange will be 1/2'' x 1/2'' x 90° weld. It must be tack welded before seam weld.

IV-12 Cold Mass Support Fabrication, installation and Inspection Plan

Cold mass support are fabricated with unidirectional fiberglass per Wang nmr proprietary fabrication process. During fabrication of each support, a small cross sectional element was cut and tested to ultimate strength. Each cold mass support system will be tested to 110% full load for 24 hours.

Each support is then sealed to avoid moisture attack. A safety factor of 4 is designed because it is a plastic structure.

IV-13 Cryocooler Recondenser Fabrication and Cold head installation

4.2K recondenser will be made of OFHC Copper. EDM wire cut will be used to make the heat exchange surface. It will be vacuum braized to a 304L SS enclosure as shown in Drwg MICE-CON-000. It will be chemically cleaned, dry and sealed and leak check.

The contact surface between 4.2 K recondenser and 4.2 K cold head (2^{nd} stage) will be indium (0.002'' to 0.005'') or indium solder or low temperature soft soldered. It will be bolted together with lock washer.

The contact surface between 60K thermal shield and 50-60K first stage cold head will be softsoldered and bolted with lock worker. Bimetal (AL-Cu) and OFHC copper strips will be used to enhance thermal bond between 6061T6 aluminum shield and first stage copper ring.

IV-14 HiTc lead installation and inspection

Because HiTc lead is too brittle to take thermal or mechanical stress. As shown in Drwg MICE-E000, each HiTc lead must be soldered to a flexible heat-conduction element and superconducting cable.

The HiTc lead must be positioned and oriented such that no significant field is per pendicalor to its broadface.

The top end must be at least doubly thermal intercepts to reduce $\triangle T$ or it will receive large heat flow from I^2R lead. The top end will be mechanically supported while lower end is free to move.

Both the top end and the bottom end will be softsoldered with Eutectic soft solder.

IV-15 60K Thermal Shield installation and inspection plan

60K thermal shield will have a flux break against azimuthal eddy current. The outer cylinder shield will be assembled with a flux break. The top cylinder half have cutout to allow installation for vent tube and to allow installation of cryocooler cold heads (stage1 and stage2) and HiTc lead thermal intercept. The 60K shield outer cylinder half will be suspended to vacuum vessel. Superinsulation could be installed as blanket.

After installation of 4.2K system, then inner shield (whole cylinder) and end shield will be installed after installation of all 4.2K system and its cold mass suspensions. Spacing between 60K to 4.2 K will be inspected and recorded before and after 60K system assembly weldment.

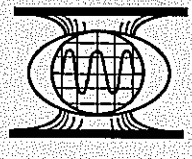
IV-16 300K Vacuum Vessel and Magnet Support System Installation and Inspection plan

300K outer vacuum vessel is installed in full cylinder. The vacuum cylinder is installed to support 60K shield and 4.2K system. We then adjust all cold mass suspension and inspect the vacuum gap between 4.2K and 60K, and between 60K and 300K the data of vacuum gap will be recorded.

Final assembly will be the weldment of 300K end cap and the 300K penetration ports (pump out, vacuum relief, vacuum feedthroughs, instrumentation feedthrough, cryogens transfer and vent, relief valve and rupture discs, etc). The major inspection will be pump down and leak check all 4.2K system and 300K system.

APPENDIX D

QA PLAN



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Appendix D MICE Solenoid QA plan

D. Wang NMR QA Manual for Project#032706

QUALITY ASSURANCE PLANNING -GENERAL REQUIREMENT

1.0 SCOPE

This plan is applicable to tasks associated with design, engineering, procurement, manufacturing, inspection, and development tasks for superconducting magnet/cryostat.

2.0 QUALITY ASSURANCE PLANNING

This program requirements reviews began during the proposal phase for assessment of equipment, processes, methods, and skills needs. Coordinated development of production and quality assurance methods will continue throughout the engineering design phase and culminate with detailed definition and implementation of the requirements to support magnet fabrication. This process identifies needs for new and unique methods, equipment, and technology which are pursued to resolution.

Project's statement of Work was reviewed for Quality Asssurance requirements. Table D-1 provides a summary of critical requirements to be implemented. The Quality Assurance requirements are typically implemented by testing, measuring, or visual inspection of hardware elementes. Due to the required facilities, the conductor Jc screening will be performed.

To provide a Quality Assurance program which is tailored to the use and importance of the hardware, the criticality of major components will be identified and reported.

D-1. ASSURANCE PLAN ELEMENTS FOR MAGNET TEST

The quality assurance requirements were studied by Wang NMR Inc. to establish Quality Assurance Requirements. Table D-1 provides a summary of critical requirements to be implemented. The Quality Assurance requirements are typically implemented by testing, measuring, or visual inspection of hardware elements.

TABLE D-1:
MAGNET PRODUCTION
QUALITY ASSURANCE PLAN ELEMENTS

CRITICAL TASK	CUSTOMER'S REQUIREMENT	SPECIFICATION
LBL Procure Conductor	Quality Assurance Plan Short Sample Tests Critical Current at 4.2K & Field Level	Per LBL's conductor specification
Cable Specification Cable Test Methods		N/A
Wire Springback Test		
Wire Tensile Test		
Welding & Cleanliness		Per Spec. LBL-10150
	Welder Qualification	ASME CODE SEC.IX
	Procedure Qualification	ASME CODE SEC. IX
	Dimensional Measurements	& Per drawings by
	Reports/Records	Wang NMR Inc.
Vacuum Leak Check Procedure		Per Spec. LBL-10151
Multilayer Superinsulation		Per Spec. LBL-10152
Fabrication, Assembly Test and Shipping		Per Spec. LBL-10154

(TABLE D-1 CONTINUED)

CRITICAL TASK	CUSTOMER'S REQUIREMENT	SPECIFICATION
Coil Winding	Cleanliness Inspection Checklists Electrical Test (Hi-Pot, Ground, etc.) Dimensional Measurement Instrumentation Lead Inspection Records/Reports	Per Winding Instructions of Wang NMR Inc.
Conductor Persistent joint	Visual Inspection Splicing Insulation Inspection Dimensional Measurements Inspection Check List Records/ Photographs	Specification & Procedure to be written by Wang NMR Inc. for each joint
Coil Testing	Cooldown, Charging up, field measurement, High Pot test, Quench Monitoring, field persistent measurement, etc.	Per Coil Testing Instructions of Wang NMR Inc.
Epoxy	Age/shelf life and storage control.	Per Instruction To be Written by Wang NMR
Packaging, Handling, Transportability and Preservation	NAS855	To be Written by Wang NMR
Magnet Shipping	Shipping container to absorb shock and vibration. Wrap in double walled evacuated hot sealed Polyethylene Plastic Bag and Wooden Crate.	Instruction To Be Written by Wang NMR
Name Plates and Product Markings	Per LBL Purchase order	
Final Written Report on Individual Magnet	Parts List Assembly Procedure Material Sources Certification Coil Resistance, Inductance, Continuity, High Pot Test Field Strength, Quench Data	To be Written by Wang NMR

D-2 WANG NMR QUALITY ASSURANCE MANUAL & ORGANIZATION

1.0 OBJECTIVE

This manual establishes the responsibilities for the implementation of the Quality Assurance Program.

2.0 GENERAL

2.1 It is the policy of WANG NMR to assure that the quality, Performance and Reliability of our products meets or exceeds all specification requirements.

2.2 The quality Assurance Program is designed to provide conformance with the ASME Boiler & Pressure Vessel Code VIII Section, "Unfired Pressure Vessels"

2.3 The Quality Assurance group is a key function of the corporate administration group and provides direction and service to each of the corporate divisions as required by contract or operational needs. Our QA group reports directly to the project manager. The Quality Assurance procedure chart is shown in Table D-1.

3.0 RESPONSIBILITY

3.1 The WANG NMR Quality Assurance group has overall responsiblity for the formulation and maintenance of the "Quality Program".

3.2 The implementaion of each of the procedures is the responsibility of the organizations as defined in the Manual. The methods of implementation are defined in operating procedures, work instructions, route cards or other documents appropriate to the circumstances. The documents:

3.2.1 Shall provide the criteria for the performance of the function.

3.2.2 Shall be prepared, issued and maintained by the organization responsible for the performance of the work.

4.0 PROCEDURE

4.1 Quality Assurance plans are developed for each manufacturing operation or contract as applicable.

4.2 The elements of the "Quality Program" are defined by the Quality Assurance Procedures.

4.3 Quality Assurance procedure are implemented by one of the following:

4.3.1 Process Control Chart.
4.3.2 Manufacturing Instruction.
4.3.3 Receiving Inspection Data Sheet.
4.3.4 Dimensional Inspection Data Sheet.
4.3.5 Test Procedure.

5.0 ADMINISTRATION OF THE QA PLAN

The principal investigator (PI) for Wang NMR Inc. is Dr. Bert Wang. The PI will be responsible for the administration and the technical direction of the project within his organization.

Either Mr. Bob Wahrer or Dr. Henry Chen will be responsible for the independent assessment of all project elements for compliance to this plan and for providing guidance for correcting observed deficencies. He will maintain those technical records to ensure that procedures, traceability of data or calibration are properly maintained, including those at conductor subcontractor's facility.

6.0 WANG NMR PURCHASING PROCEDURE

This Procedure defines the actions taken by WANG NMR Purchasing and Quality Assurance for procurement of materials and services to meet the requirments of applicable contract.

6.1 RESPONSIBILITY

(1). The Buyer (Purchasing) is responsible for procurement of items and services in accordance with the approved requisitions, purchase order, specifications, and vendor list.

(2). "Approved" requisitions and purchase orders require concurrence of Quality Assurance. Such concurrence is indicated by signature of Quality Assurance.

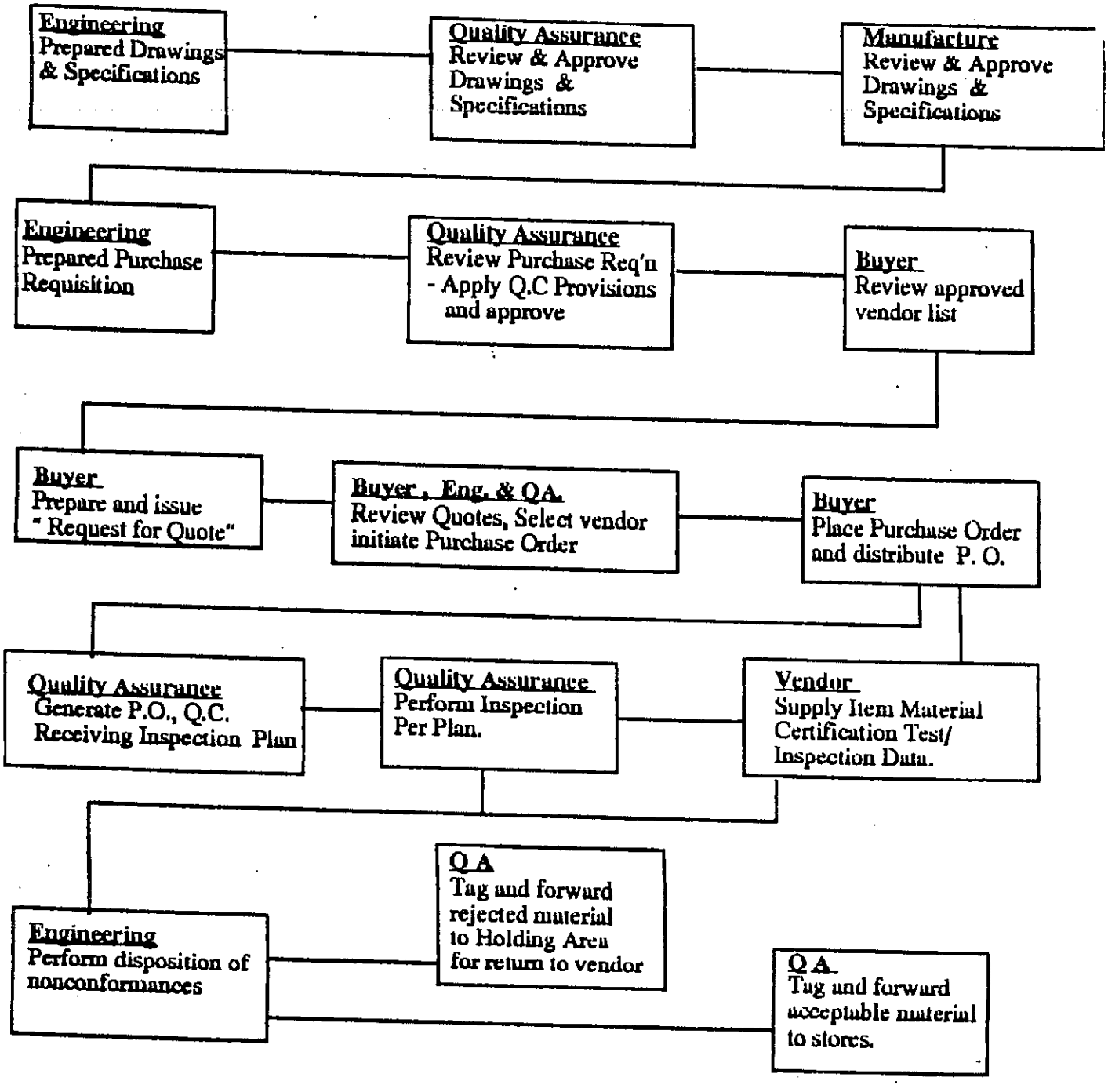
(3). Quality Assurance is responsible for maintaining and distributing to purchasing the list of approved vendors. Changes and alterations to the list are kept current by distribution of the Vendor Quality Survey Checklist (VQSC).

QUALITY PROCEDURE

See Quality Assurance Flow Chart TABLE D-2.

TABLE D-2

PROCUREMENT QUALITY ASSURANCE FLOW CHART



D-3 QUALITY CONTROL PROGRAM

1.0 Design Control

The QA Manager is an integral part of the design process. Through this approach, he will maintain his first hand technical knowledge of the program and will be aware of the critical elements. He will review all drawings and specifications for design completeness, producibility, and inspectability. He will ensure that critical inspections are defined and identified on the drawing. During the design phase, these reviews will be basically on-the-drawing-board reviews involving the designer, manufacturing, engineering, and quality assurance.

Design adequacy shall be verified by QA manager, signature approval by the QA Manager of drawings and specifications denotes that they are in accordance with applicable specifications, codes, and standards. QA will participate in all formal design reviews with the customer's personnel. Design changes shall be governed by control changes.

Critical measurements tolerances and test criteria shall be specified in the design documents.

2.0 Procurement Control

Our Procurement Quality Assurance provides the systems and disciplines to ensure that procured material and services will meet the customer's technical and quality requirements. These controls include requirement definition and monitoring of processes, and terminate with the acceptance of hardware on the dock. Control is exercised through (1) establishing program plan requirements, (2) review of purchase orders for contract and engineering requirements, (3) preparing instructions for source inspection, and (4) defining receiving inspection requirements for in-house inspection.

3.0 Material Certifications and Control

Our procurement documents require that suppliers identify all material and components before shipment. Identification such as chemical analysis, supplier heat or batch number, and other identifiers are verified and then documented in historical records retained in Receiving Inspection. Traceability of material and components is maintained and documented.

Material and components accepted by Receiving Inspection are tagged or inspection-stamped, as appropriate, and released to stores. Material and components are not accepted into stores or for use without evidence of acceptance by Receiving Inspection. Material flow into or out of stores is controlled by the Material Control function. Material found to be nonconforming is documented and segregated to prevent its usage pending disposition instructions. Processing of nonconformances is described in Section 9.

4.0 Training and Qualification Control

Training and certification programs are conducted to ensure that personnel working with selected special processes have the necessary skill and knowledge to accomplish the processes satisfactorily and/or to verify quality.

Certification programs which ensure that employees possess the skills and knowledge to perform tasks critical to the quality and performance of the product requires approval from Dr. Henry Chen, the Quality Assurance Manager. Upon successful completion of certification, a certification card is issued to each certified employee. A separate card is used for each category of certification. Certified employees have their certification card(s) available in the work area as evidence of their certified status. Table D-3 list the skills presently requiring certification.

Table D-3
Quality Assurance Administered Certification Program

- Hand-Soldered Electrical Connections
- Welding
  TIG Welding
- Coil Winding
- Coil Assembly
- Cryostat Assembliy Alignment
- Conductor Joints
- Conductor Insulation
- Coil Insulation
- Install Superinsulation
- Cryogens Transfer
- Leak Checking
- Short Sample Ic Testing
- Coil Testing
- Conductor and Coil Heat Treatment
- Coil Epoxy Application
- Magnet Cooldown and Energization
- Shipping Packaging

5.0 Fabrication, Construction, and Installation Control

Our standard QA procedure is to approve and certify manufacturing processes and equipment to both customer and Wang NMR the codes and standards prior to production use .

Sequential control of operations and processes, by critically placed inspection steps, will be an integral feature of quality assurance at both WANG NMR and our suppliers. Personnel are trained and certified for the peformance of special processes, such as welding and soldering. Retraining to ensure that competence levels are maintained is done to an established schedule.

The scope of inspection activities range from verification of material issued for production orders through final inspection and testing of the completed magnets. Inspection responsibilities include:

1. Inspection and proofing of production tools

2. Verifying use of specified material, parts, and components.

3. Nondestructive testing.

4. Monitoring of processes per manufacturing specifications

   and process control requirements.

5. In-process inspections during fabrication, assembly, installation, and tests.

6. Inspections of completed product.

7. Quality surveillance inspection reviews of manufacturing operations, stockrooms, support areas, and laboratories to detect, preclude, and correct conditions that may adversely affect product quality.

8. Ensuring compliance with calibration requirements.

6.0 Inspection and Test Control

Inspection will ensure that testing is done in accordance with approved inspection and test procedures, and will certify recorded data. These inspection requirements are generated during the QA review of engineering design and test documents. Unique inspection techniques not presently in our QA system will require the development and verification of new procedures. All inspection and test results will be documented both at Wang NMR Inc., and suppliers.

Cleanliess to exclude metallic particles will be of paramount importance, and will require particular inspection effort during curing and splicing operations. Also, debris which could clog cooling paths will be excluded.

NDT methods will be used to examine welds of structural elements, and to detect potential leakage sites. During magnet manufacture, particular effort will be directed toward assurance of good welds (penetration, etc.), elimination of metal splatter, control of dimensions, and testing for leakage.

Engineering requirements are translated into work instructions (planning) for production/inspection use. The planning, special tools, visual aids, visual assembly aids,etc. provides specific instructions regarding material requirements, sequence of operations, setup instructions, required tools, processing instructions, inspeciton points, and inspection instructions. Quality Engineering establishes the inspection requirement and inputs the requirements to planning.

Inspection performs visual inspection and dimensional verification by measurement in accordance with requirements an other special inspections/tests required by drawing/process specifications. Inspection data stations containing current documents are established and maintained in fabrication and assembly areas to assist the inspectors in accomplishing their assigned tasks. Planning and production hardware that have been accepted by Inspection, augmented by standard inspection forms and records, provide objective evidence of task accomplishment and conformance with requirements.

7.0 Document and Configuration Control

The Engineering checking reviews releasable engineering documentation to ensure dimensional accuracy, completeness of design, and compliance with contractual and in-house drafting practices.

Operating policies for all engineering data files are defined and standardized to ensure issuance of the latest engineering data to the users. Obsolete engineering documents are removed from all points of issue (blueprint cribs) upon receipt of superseding data. Obsolete engineering documents are removed from points of use (manufacturing and inspection areas) when the work instruction document references a later engineering change letter.

8.0 Handling, Storage, and Shipping Controls

QA will review and approve handling, shipping, packaging, and storage procedure to ensure no deterioration of the product occurs. Specific requirements are incorporated in formal work instructions and procedures to ensure that handling devices are those specified and that loading methods and transportation vehicles are suitable.

9.0 Nonconformance and Corrective Action

All nonconformances will be documented. This documentation is used to control discrepant material hardware segregation, material review and data submittal. Discrepant items and material will be identified and segregated from acceptable items and material.

The QA Manager will control:

- Disposition of submitted articles or material designated as nonconforming
- Accurate records of corrective actions
- Failure analysis investigations as required

All nonconformance items affecting system interface and product performance will be submitted to CUSTMOER QA representative for approval with our recommended disposition. It is recommended that an a customer quality assurance

representative be on call as required to expedite "repair" and "use-as-is" dispositions.

10. Control of Measuring and Test Equipment

For reportable data and inspection, calibrated measuring and test equipment will be used. Calibration of this equipment will be performed in accordance with the following requirements.

- Measuring and test equipment will be controlled, calibrated, adjusted, and maintained to ensure accuracy, at prescribed intervals or prior to use, against certified equipment with traceability to nationally recognized standards.

- Calibration will be performed by Wang NMR Inc. or by an outside equipment calibration service approved by Wang NMR Inc. engineering and QA.

- All calibrations will be performed to manufacturer's approved procedures.

- The accuracy of the standard shall be at least 4 times better than allowable tolerance of the instrument.

- Equipment will be suitably marked to indicate the calibration status by sticker or other suitable mens.

- Calibration labels will note who performed the calibration, the date of calibration and the date recalibration is due.

- Calbrated equipment shall be recalled from use on or prior to the recalibration date and not returned until the appropriate calibration is accomplished.

- Measuring and test equipment consistently found to be out calibration is to be repaired or replaced.

- If measuring and test equipment is determined to be out of calibration a record of usage will be reviewed to determining if any reportable data or acceptance of items are suspect. Wang NMR customers will be informed of any such suspect calibration.

- These requirements do not apply to tape measures, rules, levels, and other such devices.

D-4 QUALITY PROBLEM CORRECTIVE ACTION

1.0 INTRODUCTION

This Quality Assurance Manual describes ways to address corrective action in Wang NMR Inc. projects and facility operations. Its intent is to help the writer of QA plans consider all pertinent aspects of feedback and problem correction, and in a manner that requires action only where needed and the generation of records only if beneficial.

Our QA program guidelines are presented in four stages :

(1) response to a detected quality problem

(2) minimum requirements for control of corrective action

(3) a control system using the corrective action record form that is readily adaptable to most QA plans

(4) optional measures to ensure specific benefits from system application.

Examples of benefits assured by using a controlled system for corrective action are as follows :

Corrective action decisions are made by designated personnel.

An opportunity is given those responsible for the original requirements to concur, stop, or make changes in correction planning.

Changes in configuration or procedure, including the rationale are documented.

There is a "closing of the loop" when detection of the quality problem has been documented.

Problem causes are identified and corrected to prevent recurrence.

Feedback occurs where management has infrequent contact, or to alert others.

Follow up is maintained for corrective action that is complicated by interfaces or that requires an extended schedule to complete the correction.

Nonconforming material or items are not used in key assemblies or systems.

Data is gathered that is useful in evaluating trends.

2.0 PURPOSE

The goals of quality problem corrective action are :

* Regain acceptable conditions and hardware.

* Provide feedback to management and others.

* Prevent recurrence of the problem.

This QA Guide describes control requirements and methods for ensuring that these goals are reached.

3.0 SCOPE

These guidelines are for the corrective action control system in a QA plan for Wang NMR activities. Interfacing organizations and Wang NMR subcontractors are expected to have their own QA program that includes a suitable quality problem corrective action control system for the scope of work.

The kinds of quality problems considered in this Guide are :

* Hardware nonconformances, with respect to either specified requirement or necessary characteristics for the intended function.

* Specific problems in the application of administrative control procedures and practices.

* Persistent conditions that can cause a specific problem to recur.

Corrective action for QA audit and surveillance findings should be initiated by a person designated in the QA audit section of the plan. Design changes and revision to documents that prescribe design or activities should be fully addressed in the QA plan sections on design control (or configuration control) and document control, respectively.

4.0 RESPONSE TO A DETECTED QUALITY PROBLEM

The QA plan writer must decide whether to (1) define the responsibility and authority of those on the job to ensure response, (2) require that all quality problems be referred to a designated person, or (3) leave it to the designated person to set his own rules. Issues to consider in making this decision include :

* Assignment of responsibility for preventing escalation of the problem or use of nonconforming hardware

* The conditions under which to permit those on the job to "fix and continue." Suggested conditions include all of the following, as applicable :

  (1) The problem is localized - alerting others serves no purpose.

  (2) Items or conditions after corrective action will conform to existing requirements, configuration records, or normal practice.

  (3) The method of corrective action is straight forward - no complex interfaces, or extended corrective action schedule.

  (4) The problem and corrective action will not violate agreements, e.g., planning data, products, schedule, or costs.

  (5) Project management does not require a record for use in Trend analysis or Vendor monitoring.

  (6) Those in the work area can fix the problem - no written/telephone feedback is necessary to initiate action.

* When fix and continue by those on the job is not permitted :

  (1) Who is to be notified to initiate corrective action ?

  (2) Should anyone be alerted in the case of safety or functional problems ?

  (3) When should a record be started any by whom ?

(4) How complete and reliable is the feedback from those on the job ?

5.0 MINIMUM REQUIREMENTS FOR CONTROL OF CORRECTIVE ACTION

1. Responsibility for initiating, planning, authorizing and ensuring timely and effective correction with respect to (1) the specific problem, and (2) the cause (to prevent recurrence).

Designate one or more persons (by position) in the QA plan for this responsibility. If more than one person is designated, be sure that the interfaces is defined and their responsibilities do not overlap or leave a gap.

2. Quality Problem Notification (Feedback) for deviations from documented requirements that are caused by the problem and / or corrective action.

Define a form (for format and distribution system in the QA plan or implementing procedure, for this written notification should be assigned to those responsible for planning corrective action.

3. Management Approval for proposed corrective action that exceeds the authority of the person responsible for planning and authorization.

Requirements should be defined in the QA plan for approval by project management and the responding agency, along with guidelines for when this action is necessary.

Chapter V

Project Work Breakdown Structure (WBS) and Project Schedule

Project Progress Status : All tasks on time so far.

The project is broken down into many tasks. Task leader and performance schedule is planned according to proper time sequence and according to each task leader specialized talent. All design tasks are on schedule.

The conductor was delivered by LBL and received by Wang NMR in early August 2006.

LBL will need to order cryocooler and power supply and deliver to Wang NMR before end of February 2007. Wang NMR has ordered forging aluminum cylinder in August 06, Wang NMR need to order Hi-Tc lead and vacuum feed thru in September 06.

WBS# and Project Schedule - MICE PROJECT

WBS#	Task Description	Jun '06	Jul '06	Aug '06	Sept '06	Oct '06	Nov '06	Dec '06	Jan '07	Feb '07	Mar '07	Apr '07	May '07	Jun '07	Jul '07	(PIC)*
1.1.0	**PROJECT MANAGEMENT & REPORTING**															A
1.1.1	Design Review & Report															E
1.1.2	Procurement Administration															E
1.1.3	QA/ QC Administration & Test Report															B/F
2.1.0	**4.2K COIL DESIGN & CALCULATION**															A
2.1.1	Field Design of Central Field Profile & Peak Field on Conductor															E
2.1.2	Conductor Design, Design Operating Current, $_eIB_e$ & Load Line Design															A
2.1.3	Conductor Insulation Design															A
2.1.4	Layer-to-Layer Insulation Design															A
2.1.5	Coil Sidewall Design & Coil Mandrel Insulation Design, & Design of Voltage Breakdown from Coil to Ground															A
2.1.6	Design of Turn-to-Turn Width & Layer-to-Layer Thickness															A
2.1.7	Coil Winding Pack Design															A
2.1.8	Design of Coil Former															A/D
2.1.9	Coil Winding Specification & Winding Instruction															A/E
2.1.10	Calculation of Coil Self Inductance, Mutual Inductance, & Coil Stored Energy															E
2.1.11	Coil Protection Hardware Design															B
2.1.12	Coil Assembly Design, Design of Conductor Splicing, & Design for the Leading Conductor and Support and Insulation															A/D
2.1.13	Coil Precool Design															A/D
2.1.14	Design of Magnet Protection System															B
2.1.15	Coil Quench Analyses															A/F
2.1.16	Finite Element Coil Stress Analyses															D
2.1.17	Coil Instrumentation Design															A/B
2.1.18	Coil Cooldown Analyses															A/C
2.1.19	Cold Mass Suspension Design															D
2.1.20	Helium Vessel Shell Design															D
2.1.21	4.2K Heat Leak Analyses															A
2.1.22	4.2K Vacuum Penetration Feedthru Design for 300A, 50A, & Instrumentation															A/D
2.1.23	Helium Inlet & Outlet Piping Design															A/D
2.1.24	Helium Recondenser Design															C
2.1.25	ΔT Analyses															A
2.1.26	Superinsulation Design for 4.2K Surface															A
2.2.0	**50-60K MAGNET THERMAL SHIELD DESIGN**															A
2.2.1	Inner Shield Design with Flux Break & Superinsulation															A/D

WBS#	Task Description	Jun '06	Jul '06	Aug '06	Sept '06	Oct '06	Nov '06	Dec '06	Jan '07	Feb '07	Mar '07	Apr '07	May '07	Jun '07	Jul '07	(PIC)*
2.2.2	Outer Shield Design with Flux Break & Superinsulation															A/D
2.2.3	End Shield Design with Flux Break & Superinsulation															A/D
2.2.4	Conduction Cooling & Maximum ΔT for Magnet Thermal Shield															A/D
2.2.5	Thermal Shield Cold Mass Suspension Design & Thermal Intercept Design															A/D
2.2.6	Instrumentation Design for Thermal Shield															B
2.2.7	Superinsulation Design for Thermal Shield															A
2.3.0	**HIGH T_c LEAD DESIGN & SPECIFICATION**															ADBE
2.3.1	300A Hi-T_c Lead Design & Specification															A
2.3.2	50A Hi-T_c Lead Design & Specification															A
2.3.3	300A Thermal Intercept Design & ΔT Calculation at Hot End and Cold End															A/D
2.3.4	50A Thermal Intercept Design & ΔT Calculation at Hot End and Cold End															A/D
2.3.5	Fringing Field Calculation at Hot End and Cold End of Hi-T_c Leads															E
2.3.6	Installation Design, Thermal Contraction, & Thermal Stress Assessment of Hi-T_c Leads															A/D
2.3.7	Instrumentation Design for Hi-T_c Leads															B
2.4.0	**VACUUM VESSEL DESIGN**															A/D
2.4.1	ASME Pressure Vessel Code Calculations & Vacuum Vessel Pressure Rating															A
2.4.2	High Current (300A & 50A) Vacuum Feedthru Design															A
2.4.3	Instrumentation Feedthru Design for Vacuum Vessel															A
2.4.4	Cold Mass Support Design															D
2.4.5	Finite Element Stress Analyses of Vacuum Vessel															D
2.4.6	Service Port (Neck) Design for Cryogen Feed & Vent & Pressure Relief															A/D
2.4.7	Vacuum Pumping Ports Design, Vacuum Gage, & Pressure Relief															A
2.4.8	Vacuum Vessel Support Design															D
2.4.9	Vacuum Vessel Service Tower for Cryocooler Installation															A/D
2.4.10	Interface Design for Attached Device (Spec. 3.10)															D
2.5.0	**CRYOCOOLER SERVICE TOWER DESIGN**															D
2.5.1	Vacuum Tight Interface Design for Cryocooler & Vacuum Vessel															D
2.5.2	Thermal Intercept Interface Design for 1st Stage, Thermal Shield, & Hi-T_c Lead															D
2.5.3	Thermal Intercept Interface Design for 2nd Stage & Recondenser															D
3.1.0	**WRITE SPECIFICATION & PROCUREMENT**															A/E
3.1.1	Write Specification & Procure Conductor (Done by LBL)															
3.1.2	Procure Coil Formers															A/E
3.1.3	Write Specification & Procure Hi-T_c Leads															A/E
3.1.4	Procure High Current Feedthru, Instrumentation Feedthru, and Vacuum Gage															A/E
3.1.5	Procure Temperature Sensors & Readout for 4.2K and Thermal Shield															A/E
3.1.6	Procure Liquid Helium Level & Readout															A/E