Title: Preparation & Issuance Of Engineering Drawing/Specifications.
CAD-QAP-601
Rev. A

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Signatures maintained on controlled copy in CAD QA office.

1.0 Purpose

Establish a design policy for the preparation and release of production drawings and specifications (excluding architectural/shielding drawings).

2.0 Policy

2.1 This standard has been prepared in consultation with the AGS Mechanical and Electrical Design Rooms.

2.2 AGS staff shall plan, develop, define and control the design of the AGS and its components in a manner that will assure the consistent achievement of the producibility, performance, safety, reliability, maintainability, and availability objectives.

2.3 The design criteria shall define, as required, the performance objectives, operating conditions, and requirements for safety, reliability, maintainability, and availability, as well as the requirements for materials, fabrication, construction, and testing.

2.4 A graded approach to quality will be employed to emphasize those items that could have the greatest effect upon personnel, environmental safety, performance, cost and schedule. The cognizant engineer or scientist (CE/CS) shall determine the proper QA Category for the item/material defined by the drawing/specification.

2.5 Specifications, drawings and other design documents shall define the design parameters and be reviewed/approved prior to issuance. Drawing/specifications which define items classified as QA Category A-1 will require approval by the Division Head, or designee, Department Chairman, or designee, and Safety (as appropriate).

2.6 The AGS drawing system consists of drawings and associated parts lists. A complete drawing package includes drawings, parts lists, and all referenced ancillary specifications.

2.7 Drawings and specifications changes shall be documented in accordance with AGS-QAP-603, Configuration Management.

2.8 Drawings, dated prior to 1989, which define items intended for use in the production or procurement of new research apparatus/equipment, must be reviewed/revised to comply with the requirements of this document.

3.0 Reference

3.1 AGS-QAP-403, Drawing and Specification Distribution.

3.2 AGS-QAP-603, Configuration Management.
3.3 ASME Y14.24M-1989, Types and Applications of Engineering Drawings.

4.0 Design Process

4.1 Design reviews permit an exchange of ideas among concerned individuals with expertise in required fields. These reviews will determine that design interface are compatible, that the design meets all of it's criteria, that the delineation is complete, unambiguous, and readily producible, and that the important parameters can be verified by inspection and/or test. Design reviews shall be summarized and documented.

4.2 The various phases of the design review process are described below.

Preliminary Design Phase
- Preliminary Safety Assessment (If Required)
- Preliminary Review - (Cost and Scheduling; Code Compliance, Outline of Design, Safety Considerations, QA Requirements, and Potential Impact on Other Systems)

Design Validation Phase
- Prototype Design Approval - (Cost and Scheduling, Layout of Prototype, Qualification, and Testing Proposal)

Detail Design Phase
- Safety Analysis
- Safety Committee Review
- Design Review -(Cost, QA Requirements, Code Requirements, Safety Requirements, Engineering Considerations, Compare to Preliminary Review Documents)
- Specification/Drawing Approval

Construction Phase (Configuration Control)
- Perform Periodic Design Reviews (as required)
- CE/CS Initiates/Reviews Engineering Change Notices (ECN's)

4.3 The following criteria determines whether a given project and/or procurement generated by such a project need be the subject of a formal design process review.

4.3.1 Engineering system or construction work which results in the generation of a single purchase order, change order, or ILR with a dollar value in excess of $50,000.

4.3.2 New system designated QA Category A1.

4.3.3 Additions or modifications to existing Category A1 level systems which involve changes of performance or mission. Specifically exempted from formal review requirements are changes which relate to adding or deleting units of like kind to those already in existence.

4.3.4 Projects which will result in the procurement of more than 25 modules/boards or which will purchase more than 500 unique, non-laboratory stock components.

4.3.5 AIP and CIP project with at least $350,000 in funding must have a review before detailed design begins. Projects with $1,000,000 or more of funding must also be reviewed at nine month intervals after the initial review.

4.3.6 Proposal for new departmental electronic/electrical or mechanical standards must be reviewed.

4.3.7 Development effort, design, or project which has a manpower component greater than five man years.

4.3.8 Proposals generated outside the AGS Department whose implementation would impact the operation, safety, or performance of the AGS complex.

4.3.9 Systems which could impact the radiation burden of the accelerator complex; all electronics items which operate in radiations field exceeding 100 mR/hr; all mechanical or electro-mechanical items which must operate in radiation fields exceeding 1 R/hr.

4.4 It is the responsibility of the CE/CS to notify division management that an element of their project will trigger the design review process.

4.5 The division management is responsible for final acceptance or rejection of proposals up to A2 and to recommend acceptance or rejection of the proposal to the Department Chairman for A1 proposals.

5.0 Drawing Preparation Process

Production drawings shall contain all of the detailed requirements necessary to manufacture, purchase, inspect/test parts, subassemblies, assemblies, modules, or units.

5.1 The CE/CS shall provide the Design Group with the information necessary to prepare the drawing. Design criteria approved by the Chief Mechanical/Electrical Engineer should include as applicable: performance objectives; operating conditions; and requirements for safety, reliability, maintainability, availability, ease of manufacture, inspection, special handling, age control requirements, etc.

5.2 Appropriate codes, standards and practices for material, fabrication, construction, testing, and process shall be defined in the design documentation. Where feasible, nationally recognized codes, standards and practices should be used. When these documents fall short of defining the requirements, they are to be modified, supplemented, or replaced with BNL specifications.

5.3 The Design Room Supervisor shall review the drawing to verify that the descriptions and notes are unambiguous, correct and complete, and that the drawing conforms with the proper format and design standards.

6.0 Drawing Numbering System

Each Design Room is responsible for the assignment and control of drawing numbers.

6.1 The AGS drawing system shall use a variable length (due to tabulation), alpha-numeric numbering system for drawings and parts lists.

6.2 When feasible, tabulated drawings depicting similar items (which as a group, have constant & variable characteristics) will be utilized. The use of tabulated drawings precludes the preparation of an individual drawing for each item tabulated.

6.3 The first three digits of the drawing numbers are derived from the following Job Category Index:

D00 Miscellaneous Engineering and Development
D01 Electron Analogue
D02 Accelerator Department Buildings
D03 Magnet and Coils
D04 Power and Cooling
D05 Vacuum System
D06 R.F. System & BLIP)
D07 Injection System
D08 Special Equipment
D09 Controls
D10 General and Miscellaneous
D11 Beam Extraction
D12 Experimental Magnets
D13 Experimental Equipment
D14 Experimental Facilities
D15 Power Supplies and Cooling
D16 Vacuum Systems (Experimental)
D17 Remote Handling
D18 Cryogenic Systems
D19 Superconducting Devices (Muon G-2)
D20 Linear Accelerator Building & Building for Conversion
D21 Power and Cooling Services
D22 Preinjection (LINAC, LEBT)
D23 200 Mc Accelerating Structure
D24 200 Mc R.F. System
D25 Linear Accelerator 200 MeV Beam Transport System (HEBT & BLIP)
D26 800 Mc Accelerating Structure
D27 800 Mc R.F. System
D28 Linac Remote Controls & Overall Systems
D29 Unassigned
D30 Superconducting Power Transmission
D31 BNL Superconducting Power Line (Tentative)
D32 Heavy ION Beam Transport System to AGS
D33 AGS Booster, Tunnel & Building Additions
D34 Linac-Booster 200 MeV Transfer Line
D35 Heavy Ion-Booster Transfer Line
D36 Booster Ring
D37 Booster-AGS Transfer Line
D38 Radiation Effects Facility
D39 MP6 Bypass to TTB (Tandem)
D40 Access Control System

6.4 In addition to the Job Category Index, the drawing numbers contain a letter designation for mechanical or electrical drawings, and a drawing serial number (a sequential number assigned, by the Drawing Office Supervisor, to identify individual drawings).
For example, the breakdown of drawing number D03-M-6046-5 is:

Job Category Index — M (Mechanical) or E (Electrical)
D03-M-6046
Drawing Serial Number

Note: Due to specific requirements, the Spallation Neutron Source (SNS) will follow the drawing numbering system outlined in Appendix A.

6.5 A drawing number log will be maintained by each design room. Each Job Category Index Number will become a "directory" with consecutive engineering drawing numbers assigned. As a minimum, the drawing number log should contain the drawing title; name

of designer; drawing size; and date of drawing number assignment.

6.6 If a number has been assigned to a drawing, and the item represented by that drawing is not used in the end product, that particular number can not be reassigned to another drawing.

6.7 The appropriate drawing revision is entered in the revision column/box. Upper case drawing revision letters shall be used in alphabetical sequence. The letters "I","O","Q-","S", "X", and "Z" shall not be used. When revisions are numerous enough to exhaust the alphabet, the revision following "Y" shall be "AA", then "AB", etc.

6.8 For prototype drawings, preface the drawing numbers with the letters "RD". As a minimum, "RD" drawings shall contain the signatures of the designer, Design Group Supervisor, and the CE/CS. When approved for production, the “RD” preface will be removed from the drawing. Drawing revision will comply with paragraph 9.3.

7.0 Parts Lists

A parts list is a tabulation of parts and materials required to fabricate the assembly shown on a drawing. All assembly drawings will have a parts list which is integral to the drawing.

8.0 Drawing Format

8.1 All AGS production drawings will be guided by the latest revisions of ASME Y14.24M, Types and Applications of Engineering Drawings.

8.2 Standard size drawing formats A (1) through E (5) will be used. Figure 1 is a typical mechanical sheet one, Figure 2 is a typical electrical sheet one.

8.3 Cross reference information is added to the drawing title block on sheet one. The "Used On Drawing No." column contains the drawing number(s) of the assembly(s) to which the detail or assembly pertains. A "Qty. Per Assy." column contains the quantity/amount required to complete a single article. The symbol "AR" (as required) may be used in lieu of exact quantity of a bulk material. Symbols other than "AR" may be used, provided they are explained by an appropriate note or reference document.

8.4 When multi-sheet drawings are used, each sheet is to be sequentially identified, e.g. SHT. 2 of 4.

8.5 Item numbers on assembly drawings will be enclosed in a .50 inch diameter circle (balloon) with no leading zero on single digit numbers.

8.6 When it becomes necessary to cross-reference specific notes, the field of the drawing will state "SEE NOTE-1" etc.

8.7 When material certification is required for a part, it should be noted on the drawing or referenced specifications.

8.8 Examples of General Notes

8.8.1 Applicable documents, standards, and/or specifications.

8.8.2 Indicate part number located approximately as shown, using XX inch characters.

8.8.3 All items listed with part number and manufacturer can be substituted with a BNL approved equivalent part.

9.0 Release process for New Drawing

9.1 The CE/CS will, after resolution of any outstanding issues, authorize the Design Group to obtain drawing approval signatures.

9.2 Indication of review/approval of initial release drawing(s) is satisfied when the designer, checker, Design Group Supervisor, CE/CS, and Engineering Supervisor sign/date the drawing. At the discretion of the CE/CS, drawings will be reviewed by a quality assurance and/or safety representative. A copy (hard copy or microfilmed) is maintained by the design room.

9.3 The revision level assigned to the initial release of baselined engineering drawings and parts lists is at the discretion of the cognizant design room. Revisions may be the same as the prototype (RD) revision, be one greater than the prototype (RD) revision, or revert back to an A revision. The revision history box on the drawing must clearly indicate at what revision the drawing was officially released.

9.4 The Design Group will provide copies of released drawings upon request.

10.0 Computerized Drawing Databases

10.1 It is the responsibility of the Design Room Supervisor to ensure that the design databases, including equipment required to read the data bases, are maintained.

10.2 Drawing databases, describing equipment to be placed in or necessary for the operation of AGS, shall be created by a Computer Aided Design (CAD) system utilizing AutoCAD. If the engineering drawings are electrical in nature, PCAD or AutoCad are the accepted software. If the database requires translation to fulfill the above requirement, the translated data and a paper copy must be provided by the vendor who performed the translation.

10.3 Drawing databases shall be secured to prevent unauthorized changes. The release directories are controlled by the design room supervisor. In order to revise the file it must be transferred back to the working directory and changed as directed by an ECN. All drawing revisions will be incorporated by the AGS Design Group.

10.4 Drawing files will be archived prior to implementation of an approved ECN. This will insure that previous revisions are retrievable without modifications.

10.5 Backup files and tapes shall be located in at least one other location other than where the data bases are generated or changed.

10.6 The Design Room shall maintain, for a minimum of 2 years, hard copies and/or microfilmed copies of the latest revision engineering drawings and parts lists. This file shall furnish traceability to approval signatures on initial release or to approved ECN's for subsequent releases.

11.0 Specification Preparation

11.1 The CE/CS is responsible for the preparation, review, approval, and distribution cycles of AGS specifications. Specifications required for the procurement of items and/or materials, should describe the item/material, performance objectives (when applicable), and acceptance criteria.

11.2 As a minimum, the document cover page should contain a title/subject, unique number, a means of identifying the current revision, QA Category, and the authorization/concurrence (as appropriate) of the CE/CS, Division Head or designee, Chief Mechanical/Electrical Engineer, Safety, and QA. Subsequent pages shall contain the document number and a method for tracking revision, e.g. date and/or letter.

11.3 The general arrangement or layout of AGS specifications should include the major sections defined below. Section headings may be altered as necessary to accommodate the subject matter.

1. Scope
2. Applicable Documents
3. Requirements - Includes requirements for Preproduction (Qualification), Parts, Materials, Processes, Design, Construction and Workmanship.
4. Quality Assurance Provisions - Includes requirements for identifying responsibility for Inspection and Tests, Define the procedures and acceptance criteria for Preproduction (qualification), Acceptance (Production) and Special Inspections and/or Tests
5. Preparation for Delivery
6. Notes - Includes information pertaining to Intended Use of item, Ordering Data, Precedence of Documents, Performance Objectives, Definitions, Testing Ground 1Rules, Seller's Article Uniformity, and a list of Associated Equipment.

To be added.

Figure 1