LEGIBILITY NOTICE

A major purpose of the Technical Information Center is to provide the broadest dissemination possible of information contained in DOE's Research and Development Reports to business, industry, the academic community, and federal, state and local governments.

Although a small portion of this report is not reproducible, it is being made available to expedite the availability of information on the research discussed herein.

Los Alamos National Laboratory is operated by the University of California for the United States Department of Energy under contract W-7405-ENG-36

CONFIDENTIAL

1989

TITLE DESIGN AND DRAFTING DOCUMENT CONTROL PROCEDURES
FOR CPRE/ZETA EXPERIMENT

LA-UR--89-3261

DE90 002356

AUTHORS: POLIAT, L.L., CTR-4
KEWISH, R.W., CTR-4

SUBMITTED TO presented to the 13th IEEE Symposium on Fusion Engineering,
Knoxville, TN, October 2-6, 1989

In acceptance of this article the publisher recognizes that the U.S. Government retains a nonexclusive privilege to publish or reproduce
the published form of this contribution or to allow others to do so for U.S. Government purposes.

Los Alamos National Laboratory, therefore, requests that the publisher identify this article as work performed under the auspices of the U.S. Department of Energy.

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

MASTER

LA-UR-89-3261

**DESIGN AND DRAFTING DOCUMENT CONTROL
PROCEDURES FOR CPRF/ZTH EXPERIMENT**

L. L. POLLAT and R. W. KEWISH, JR.

Los Alamos National Laboratory, Los Alamos, NM 87545

Presented To

IEEE 13th Symposium on Fusion Engineering
Knoxville, Tennessee

October 2-6, 1989

DESIGN AND DRAFTING DOCUMENT CONTROL PROCEDURES FOR CPRF ZTH EXPERIMENT[†]

L. L. Pollat and R. W. Kewish, Jr.

Los Alamos National Laboratory, F644, Los Alamos, NM 87545

ABSTRACT

This paper will present, in general, the control procedures for design approval, review, changes, and release of engineering documents. It will also discuss interface control for tasks so that possible design interference does not occur. A document control procedure to insure that design criteria are met and technical specifications translate into workable drawings was instituted to support the Confinement Physics Research Facility (CPRF ZTH) construction program. Our goal, to eliminate any conflicts that might arise between various tasks as the final designs are developed, required tight control and up-to-date design information. Detailed procedure for reviews were instituted, since circumventing the process of design and drafting anywhere might have proven disastrous to the CPRF ZTH program. Design is a process of translating technical requirements, according to established standards, into drawings that are usable for fabrication and assembly. Both the designer and engineer are responsible for adhering to standards that have been established by the Mechanical Engineering Section for the CPRF ZTH program.

INTRODUCTION

The need for a documentation and control system became very evident as we produced drawing packages for the CPRF project. The documents provided direction for the control and preparation of engineering drawings and changes for documents generated within our Division. The possibility of costly mistakes or parts not interfacing with each other were greatly reduced if we followed the procedures. These procedures and controls were intended to provide a central and current file for ready retrieval of information and reference. This process of control created an up-to-date repository of working documents.

General

Design and drafting document control procedures were basically divided into four areas: design, approval, document control, and changes. The following is an outline of these areas for the CPRF ZTH project.

- A. Design
 - 1) Design origination
 - 2) Design verification
 - 3) Design review
 - 4) Drawing check
- B. Approval
 - 1) Design interface
- C. Document Control
 - 1) Drawing document control
 - 2) Archives
 - 3) Distribution
- D. Change
 - 1) Design changes

Because of the effort required in designing CPRF ZTH, and

the effect one task may have on another, the sequence of design activities must be carefully adhered to. A flow chart showing the sequence of activities in the project design control process is shown in Fig. 1.

Fig. 1. Project design control.

REQUIREMENTS

Method of Approving Design Packages

The following methods of approving the design packages corresponds with the flow chart shown in Fig. 1.

C.S.C. (CPRF Steering Committee). The C.S.C. is made up of physicists and engineers who define the technical design criteria for the CPRF ZTH experiment, and resolve physics and engineering issues. Also, the C.S.C. reviews significant design changes for the CPRF ZTH program.

Design Criteria. The physics and engineering criteria are established by the C.S.C. These criteria are the basis for all mechanical and electrical specifications.

Task Leader. Task leaders are program managers for specific tasks; the CPRF ZTH construction program has nine. Task leaders interact with one another to resolve common design issues, and direct design engineers on design issues within each of their tasks.

Originating Engineer. This is the engineer who originates the design concepts that are translated into working drawings. The originating engineer works with designers and drafters to produce the preliminary design of assembly and detailed drawings.

Interface Control. The CPRF ZTH Interface Control Document defines the physical and functional interface parameters between major CPRF ZTH tasks. In addition, the "Drawing Control Procedures" document has established procedures to interface various participating organizations, both inside and outside the Laboratory. See "Design Interface Control Matrix," Fig. 2, and "Engineering Review Interface Distribution," Fig. 3.

[†] Work performed under the auspices of the US DOE.

ORGANIZATIONS OF DOCUMENTS & DRAWINGS	REVIEWERS										
	1 FRONT-END	2 COILS & BUSSING	3 POWER SYSTEMS	4 CONTROLS & DATA ACQUISITION	5a FACILITIES	5b FACILITIES INTEGRATION	6 DIAGNOSTICS	7 VACUUM - GAS FILL	8 SUPPORT STRUCTURE	12 PROGRAM OFFICE	CSC CRRP STEERING COMMITTEE
1 FRONT-END											
2 COILS & BUSSING											
3 POWER SYSTEMS											
4 CONTROLS & DATA ACQUISITION											
5a FACILITIES											
5b FACILITIES INTEGRATION											
6 DIAGNOSTICS											
7 VACUUM - GAS FILL											
8 SUPPORT STRUCTURE											
12 PROGRAM OFFICE											
CSC CRRP STEERING COMMITTEE											
SI SYSTEMS INTEGRATION											

* NUMBERING CORRESPONDS TO THE MANAGEMENT PLAN FOR THE CRRP CONSTRUCTION PROGRAM (38)

** THE "CSC" AND "SI" IN THE MANAGEMENT PLAN ARE INCLUDED AS PART OF MANAGEMENT AND SUPPORT IN THE WBS NUMBER 10

■ REVIEW & COMMENT REQUIRED

□ INFORMATION ONLY

DATE JAN 1, 1988

Fig. 2. Drawing interface control matrix.

The interface control process, which assures that given designs are reviewed by all necessary persons, ideally follows a pre-defined routine. From the Interface Control Matrix, Fig. 2, designs from a given task must be reviewed by a technical person from other tasks as indicated by the shaded boxes. For instance, Front-End designs must be reviewed by the following tasks: Front-End (of course), Coils and Bussing, Diagnostics, Vacuum-Gas Fill, Support Structure, The Program Office, The C S C, and Systems integration.

Each task has one or more persons to review the drawings from other tasks. The persons to do those reviews are listed on the Distribution list, Fig. 3, in the column "Reviewers". As an example, suppose a design is generated by the personnel of the Front End Task. The Control Matrix shows that the design must be reviewed, among others, by a reviewer from the Coils and Bussing task. Those reviewers are listed on the Interface Distribution chart in the Coils and Bussing reviewers box.

The one person that is most involved in the interface control process is the drafting room supervisor. He is the person who has a strong influence on the efficiency of this process because of his interaction with task leaders, design engineers, and draftspersons. Once a task leader or design engineer has determined that a drafted design is complete enough so that it may be reviewed, the drafting room supervisor assembles a design package for each reviewer. It is expected that reviewers review and return the designs, with comments, in a timely manner. One week is usually requested.

Often there has been sufficient interaction between task leaders so that there are few comments, thus minimizing changes to the design. In such a case where changes are minor, the design (originating) engineer may have changes drafted then have an Approval Document, Fig. 4, routed with the drawing package to the necessary task leaders for sign off.

The usual case, however, is more involved. At the same time that the design package is routed for review an interface meeting is scheduled, to be held after each task has reviewed the design and the design engineer has had a chance, himself, to review the comments. At the interface meeting comments are discussed, and an action list generated. Action lists are the changes that must be incorporated into the design before it can be approved. Several of these interface meetings may be required before all compromises are worked out on the design. When it is clear that all other tasks have been satisfied, and design requirements met, then final changes may be made through drafting. The Approval Document may then be signed by the necessary task leaders, etc.

As can be seen in Fig. 1, Interface Control has three points in the flow chart. Granted, this process may be time consuming, but with cooperation serious losses in scheduling will have less of a chance of occurring.

TITLE _____					
DRAWING NUMBER: 1271					
REVIEW PERIOD _____					
RETURN TO _____ DATE _____					
BY: _____					
TASKS	TASK LEADERS	REVIEWERS	INFO	COMMENT	MS
1 FRONT-END					
2 POWER SYSTEMS					
3 FACILITIES					
4 COILS & BUSSING					
5 SUPPORT STRUCTURE					
6 CONTROLS & DATA ACQUISITION					
7 DIAGNOSTICS					
8 VACUUM - GAS FILL					
9 FACILITIES INTEGRATION					
11 CSC					
12 PROGRAM MANAGER					
13 SYSTEMS INTEGRATOR					

Fig. 3. Engineering review interface distribution

Design Reviews. Design reviews are called by the task leader or originating engineer, and consist of a preliminary and a final design review. Reviews are done by a design review board consisting of personnel working on the design and at least one other person who has expertise in that area of design. Reviewers external to the Laboratory have helped achieve the best compromise between functional design and cost. Reviewers, both internal and external, have access to pertinent information regarding designs so that adequate reviews may be done.

Preliminary Design Review. This review is to assure design criteria is met, and to make suggestions concerning all aspects of design.

Final Design Review. This review is done to make sure that recommendations of the preliminary review are followed.

Completion of Design. Engineer, designer, and drafter complete drawings to comply with the design reviews. Verifying CPRF/ZTH design will be accomplished by several methods:

- a) Design Reviews,
- b) Component development, and
- c) Testing

These three are, in practice, interrelated steps that also interface with the process of design change control.

Checker. The checker will check such items as dimensioning and drawing according to standards adopted by the program, ref. D.

Interface Control. After checking, the drawing package must again go through the interface process. It is imperative drawings be checked and rechecked for possible design conflicts. Usually, secondary interface control is a more rapid process than the initial one discussed above.

Approval. All task leaders whose task interfaces with the design in question must approve the design. The "Interface Control Matrix" form, see Fig. 2, is a sign-off sheet that assures that management needing to see the drawing package has a chance to sign-off on it.

Sign-off Approval. As indicated on the Drawing Approval sign-off document, Fig. 4, initials are required by the appropriate task leader (only task leaders indicated by the control matrix), and signatures by the program construction manager, and the systems integration officer.

Release. After the design has been through all of the approval steps successfully, the task leaders sign off on specifications and design reports, then the drafting room supervisor signs the drawings thus releasing the drawing package.

Drawing Document Control. The function of this aspect of the design control process is to assure that documentation of any design shows the most current drawings and that copies of those drawings are received by all people whose areas may be affected by the design. Document control is the responsibility of the drafting supervisor.

- a). **Drawing Numbers.** All drawings that pertain to the CPRF/ZTH program have drawing numbers that readily identify them as part of the program. All of the drawing numbers are in the series: "127Y-xxxxxx" where "xxxxxx" is a six digit number issued by the drafting room supervisor.
- b). **Drawing Titles.** Each drawing has a title block for identification, archival, and retrieval. For identification, CPRF/ZTH drawing "CPRF" or "ZTH" is included as the first title in the title block.

Distribution. The most recently completed designs are distributed by the originating engineer, or drafting supervisor to the task leaders of other tasks for several reasons: information only and designs affect some, but not necessarily all, other design areas.

Archiving Design drawings and documents must be archived for use in the future. They must also show the latest revisions. Drafting procedures are implemented by the drafting supervisor, and detail archival rules which include keeping drawing hardcopies and software copies

- a). Archiving
 - 1 Drawing approval document
 - 2 Drawing originals filed in CTR archives
 - 3 Originals photographed and made into 35mm aperture cards

DRAWING TITLE: _____

DRAWING NO: 127Y-
127Y-

ESTIMATED COST: _____

TASK LEADERS		DWG. PKG.	INITIALS	DATE
E. BALLARD	☐	☐	<input type="text"/>	<input type="text"/>
H. BOENIG	☐	☐	<input type="text"/>	<input type="text"/>
V. STEPHENS	☐	☐	<input type="text"/>	<input type="text"/>
J. ROGERS	☐	☐	<input type="text"/>	<input type="text"/>
R. WILKINS	☐	☐	<input type="text"/>	<input type="text"/>
A. HABERSTICH	☐	☐	<input type="text"/>	<input type="text"/>
J. DOWNING	☐	☐	<input type="text"/>	<input type="text"/>
C. HAMMER	☐	☐	<input type="text"/>	<input type="text"/>
SYSTEM INTEGRATOR	☐	☐	<input type="text"/>	<input type="text"/>

CPHF CONSTRUCTION
PROGRAM MANAGER

SIGNATURE

CHAIRMAN OF CTR IF
STEERING COMMITTEE

SIGNATURE

Fig. 4. Drawing approval document.

Engineering Change Request (E.C.R.). Drawing changes require a formal "Engineering Change Request" form, Fig. 5, and a justification for the change.

Task Leader. Any engineer can submit a E.C.R. to the responsible task leader for sign-off.

Interface Control. All areas affected by the change must have opportunity to give input to the change, so the interface control process must again be included.

Drawing Document Control. To make sure that changes are reflected on all drawings, the Document Control process must be included. The steps from completion of design are repeated for changes before new drawings are distributed and archived.

CONCLUSION

The "Design and Drafting Document Control Procedures" document has established procedures to interface various participating organizations, both within and outside the Laboratory.

Procedures for design, approval, review, change and release are documented. The "Interface Control Procedures" document defines what tasks must necessarily communicate with each other so that possible design interference does not occur. Systems integration introduces interface control drawings that show details of how these interfaces are to occur. If these procedures are adhered to we feel we have put together a flexible system that will save project money by reducing costly interference errors and duplication of effort.

Project Engineer		DRAWING TITLE	
Project Engineer	_____	DRAWING TITLE	_____
Design Requester	_____		_____
Drawing No.	_____		_____
Rev. No., Letter	_____		_____
Cost Code	_____		_____
File Name	_____		_____
Cost Estimate	_____		_____
CHANGE DESCRIPTION			

JUSTIFICATION			

Assigned To _____		Date _____	
Date Completed _____			

ECR APPROVALS		Form Change Yes _____ No _____	
ENGINEER	_____	TASK LEADERS APPROVAL	_____
REQUESTING	_____	E BALLARD	_____
TASK LEADER	_____	M BOENIG	_____
SYSTEMS	_____	V STEPHENS	_____
INTEGRATOR	_____	J ROGERS	_____
CPRF STEERING	_____	B WILKINS	_____
COMMITTEE CHAIRMAN	_____	A HABERSTICH	_____
	_____	J DOWNING	_____
	_____	C RAMMER	_____
CPRF CONSTRUCTION	_____		
PROGRAM MANAGER	_____		

DISTRIBUTION	DRAWING CONTROL CHECKLIST
	DRAWING FILE REVISED
	CENTRAL DRAWING FILE
	DISTRIBUTION COMPLETED

ACKNOWLEDGEMENTS

The authors wish to express their gratitude to Will E. Fox for work in developing the design control documents and Edwin Vigil for the illustration graphics.

REFERENCES

- LANL CTR-Division QA and QC program, Los Alamos National Laboratory, Sections; III, Jan 1988
- CPRF/ZTH Technical Steering Committee for CPRF/ZTH, LANL Report LA-UR-Draft, Feb. 1987.
- Interface Criteria Procedures, CPRF-QA, CPRF/ZTH Quality Assurance Program, Los Alamos National Laboratory.
- Drawing Control Procedures, Mechanical Design Section, Group CTR-4, Los Alamos National Laboratory.
- Drawing Requirements Manual, compiled and edited by Jerome H. Lieblich, Sixth Edition, Global Engineering Documents, Santa Ana, Ca., C. 1986.
- CPRF/ZTH Work Breakdown Structure, ERA-MFE Office of the Los Alamos National Laboratory.

Fig. 5. Engineering Change Request.