TABLE OF CONTENTS

RECORDS OF REVISION

Rev.	Date	Description	POC	OIC
0	6/29/99	Rewritten and reformatted to support LIR 220-03-01, Facility Engineering Manual. Supersedes LANL Facility Engineering Standards Drafting Manual, Vol. 2, Rev. 7, dated 4/17/98.	Danny Nguyen, *PM-2*	Dennis McLain, *FWO-FE*
1	10/29/01	Acronym list deleted and national stds referenced; definition section added; symbol legends created & numbered; drawing revision procedures expanded.	Richard Trout, *FWO-SEM*	Mitch S. Harris, *FWO-SEM*
2	7/15/02	Minor Changes: Editorial changes for correction/clarification throughout, as indicated by revision bars. Additions to "General Definitions."	Richard Trout, *FWO-SEM*	Kurt Beckman, *FWO-SEM*
3	9/16/04	Minor editorial changes; changed LEM to the Engineering Standards Manual (ESM).	Richard Trout, *FWO-DECS*	Gurinder Grewal, *FWO-DO*
3 Chg 1	06/05/05	Minor change to reflect organizational name changes.	Richard A. Trout, *ENG-DECS*	Gurinder Grewal, *ENG-CE*
4	10/27/06	Admin changes only. Org and contract ref updates from LANS transition. ISD number changes based on new CoE IMP 341. Other admin changes.	Richard Trout, *FM&E-DES*	Kirk Christensen, *CENG*
5	4/27/15	Major update. Better defined applicability and requirements for free-hand and CAD sketches. Drawing numbers, revision, and as-built/as-found process clarified. Standards, terms, orgs, and other references updated or eliminated.	Scott Richardson, *ES-EPD*	Larry Goen, *ES-DO*

PLEASE CONTACT THE CAD STANDARDS POC
for upkeep, interpretations, and variance issues

CSM	CAD Standards Manual POC

This manual is online (LANL external) at http://engstandards.lanl.gov/index.shtml

100 GENERAL REQUIREMENTS

101 INTRODUCTION

The purpose of the LANL CAD Standards Manual is to establish a formal system of drawing requirements required by P342 Engineering Standards for LANL personnel and its subcontractors for nuclear and non-nuclear facilities.

Use of this manual is required when creating or modifying drawings and sketches for LANL facility, utility, infrastructure, and environmental programs projects.[1] This manual relies heavily upon and in some cases amends the National CAD Standard; use of the latest edition of the NCS is necessary to achieve compliance with this manual.[2]

Use of this manual is recommended for programmatic work, where appropriate. Also, this manual does not address weapons or machined parts work covered by other standards. *For these types of designs, most use the Drawing Requirements Manual[3] by Jerome H. Lieblich and accompanying LANL division procedures where applicable.*

This manual provides minimum requirements for applying CAD concepts to both the initial development of drawings and their subsequent modification. The requirements of this manual apply to new work **only** (doesn't force updating of existing drawings); one **exception** is the case of revisions, for which Section 103 applies. *The information contained herein is by no means all encompassing; however, this manual does present enough information to provide the user with a fundamental working knowledge level sufficient to understand the concepts presented.*

Applicability

This standard is applicable to, and mandatory for, LANL personnel engaged in preparing, coordinating, reviewing, approving, and controlling engineering drawings. Architect-engineering (AE) subcontractors are subject to the requirements of this standard except where specifically exempted herein.

Notes

1) Section references are to this manual unless otherwise noted.
2) Guidance statements (as opposed to requirements) appear in italics or are clearly indicated as such.
3) All stated fonts are AutoCAD.
4) CAD drawings such as details, regardless of their source, that are inserted in CAD drawings for project use are to be edited or modified as needed for the project's specific application.

1.0 ACRONYMS USED IN THIS MANUAL

Acronym	Description
ACI	American Concrete Institute
AE	Architectural Engineer
AISC	American Institute of Steel Construction Inc.

[1] Defined in Engineering Standards Manual, Chapter 1, Section Z10
2 At time of writing, NCS v6.0 was available on LANL's IHS subscription (search NCS)
3 At time of writing, DRM 11th Ed available on LANL's IHS subscription (title search Drawing Requirements Manual)

Acronym	Description
ASME	American Society of Mechanical Engineers
ASTM	American Society of Testing and Materials
BIM	Building Information Modeling
CSI	Construction Specifications Institute
D	Delta
DC	Derivative Classifier
DCF	Design Change Form (an Engineering Change Notice is similar)
DCS	Document Control Services Group or Team (in LANL SI Division)
DRN	Design Revision Notice
EED	Emergency Evacuation Diagram
EPD	Engineering Project Delivery Group (in LANL ES Division)
ESM	LANL's Engineering Standards Manual
FCR	Field Change Request
FPR	Floor Plan of Record
I&C	Instrumentation and controls
ISA	Instrumentation Systems and Automation Society
L	Length
LANL	Los Alamos National Laboratory
LPS	Lightning Protection System
NCS	National CAD Standard, published by NIBS et al
NFPA	National Fire Protection Association
NMSPC	New Mexico State Plane Coordinate System
O&M	operations and maintenance
P&ID	piping and instrumentation diagram
PC	point of curvature
PFD	process flow diagram
PI	point of intersections
PT	point of tangency
R	radius
RPR	Roof plan of record
SI-DC	Service Innovations Division's Document Control Services Group
ST	standard drawing
T	tangent
UDS	Uniform Drawing System (subset of NCS)
VPC	vertical point of curvature
VPI	vertical point of intersection
VPT	vertical point of tangency

2.0 ACRONYM AND ABBREVIATION USAGE ON DRAWINGS

A. System and component name acronyms ("IDs") shall be per ESM Chapter 1 Sections 210 and 230 (including new acronym approval process).

B. Other abbreviations shall comply with ASME Y14.38, Abbreviations and Acronyms, or the National CAD Standard [NCS, which includes the CSI Uniform Drawing System (UDS)].

1. These standards are not intended to be a complete listing of all possible abbreviations required for a project. If additional abbreviations are required, use standard industry abbreviations. An abbreviation legend is required for abbreviations used in the drawing set that are not referenced in the LANL CAD Standards Manual.

C. Use the same system throughout drawing set. Minimize the use of acronyms whenever possible.

D. Do not abbreviate single words with four letters or less, except for some very commonly used abbreviations such as:

& and

@ at

E. Avoid using abbreviations with more than one meaning except where they occur in different disciplines or when used in a context that makes the meaning unequivocally clear.

F. In general, write abbreviations in capital letters with no lower case letters or punctuation (except H_2O, CO_2, etc.). Use punctuation only when the abbreviation can be interpreted as a word without the punctuation such as: NO. (number). In this case, a period is needed for clarity.

3.0 DEFINITIONS AND RELATED REQUIREMENTS

A. **Drawing Sheet Types:**

Note: These are used for drawing numbers and set organization (see Section 209).

Plans: Views of horizontal planes, showing components in their horizontal relationship.

Elevations, Profiles and Cross Sections: Views of vertical planes, showing components in their vertical relationship, viewed perpendicular from a selected vertical plane.

Sections: Views of vertical cuts through and perpendicular to components, showing their detailed arrangement. Sections shall be ¾" = 1'-0" scale or smaller.

Large Scale Views: Views of plans, elevations, or sections at a larger scale and with more detail than the referenced view.

Details: Plans, elevations, or sections that provide more specific information about a portion of a project component or element than smaller scale drawings. Details shall be ¾" = 1'-0" minimum scale.

Diagrams: (Schematics) Non-scaled views showing arrangements of special system components and connections not possible to clearly show in scaled views (e.g., one-lines, process flow, piping & instrument, grounding, instrument & control, point diagrams, logic diagrams, loop diagrams, lightning, wiring, riser, etc.).

Schedules: Tables or charts that includes data about materials, products, and equipment (e.g., panel schedules, mechanical equipment lists, door and window schedules, submittals).

3D Representations: Perspectives, isometric drawings, and CAD models.

B. **Drawing Formats**

Note: P&IDs, fabrication, construction, and architectural drawings can be presented using one of several different formats. The standard formats are cutaway, double-line, one-line, and pictorial. Each format provides specific information about a component or system.

Cutaway Drawings: A cutaway drawing is another type of pictorial drawing. In a cutaway, as the name implies, the component or system has a portion cut away to reveal the internal parts of the component or system. This type of drawing is extremely helpful in the maintenance and training areas where the way internal parts are assembled is important. Although not common, these drawings may be ordered by the client upon request (e.g., 3D representations, diagrams).

Double Line Drawings: Double line drawings present the same type of information as a one-line. Double line drawings are useful in layouts and details where space restrictions and retrofits involve tight installations. (e.g., plans, elevations, details)

Electrical One-Lines: Designed to present functional information about the electrical design of a system or component. They provide the same types of information about electrical systems that P&IDs provide for piping and instrument systems. Electrical one-lines are not drawn to scale. Examples of typical one-lines are site or building power distribution, and motor control centers. (These are sometimes called single-lines.) (e.g., diagrams) See ESM, Chapter 7, Section D5000 and example drawing D5000-2.

Pictorial Drawings: Pictorial or double line drawings present the same type information as a one-line, but the equipment is represented as if it had been photographed. It requires much more effort to produce than a one-line drawing and does not present any more information as to how the system functions. (e.g., details, large scale views).

C. **Categories of Drawings**

Note: These categories are commonly encountered in industry practice and may be referred to throughout this manual. However, drawing sheet numbering (refer to Section 209) is based upon drawing sheet types defined by subpart 3.0A above.

As-Built: Documentation (e.g., Drawings, etc.) verified by physical inspection as depicting the actual physical configuration and verified as consistent with the design requirements.[4] These are the normal outcome of a construction project that follows AP-341-519 Design Revision Control in which drawings are updated after field work is complete to reflect all known significant interim amendments (i.e., FCRs and DRNs but not FCNs unless specifically required in the design agency's scope). This is the expected completion condition for submission of "record drawings" to LANL Document Control (as-builts can also be produced during operations phase with great effort to field verify against design requirements).

As-Built Process: The process of determining the as-found condition, resolving discrepancies, producing the as-built documentation and obtaining approval from the design authority.

As-Found Drawing: Information, often in the form of marked-up documents that reflects the actual physical configuration and identifies any discrepancies with currently-approved facility documentation.[4]

[4] DOE STD-1073-03

Assembly Drawings: The assembly drawing is an "exploded" perspective of the object with all the components shown as they go together. This type of pictorial is usually found in vendor manuals and is used for part identification and general information relative to the assembly of the component. Although not common for facility work, these drawings may be ordered by the client upon request (e.g., 3D representations, diagrams).

Construction Architectural Drawings: Designed to present the detailed information required to construct or fabricate a part, system, or structure (plans, elevations, sections, details, large scale views, double line drawings, single line diagrams, etc.).

Construction drawings present the detailed information required to assemble a structure on site.

Architectural drawings present information about the conceptual design of the building or structure. Examples are building plans, building elevations (outside view of each side of a structure), equipment installation drawings, foundation drawings, and equipment assembly drawings.

Electrical Schematics: Designed to provide more interconnection information about an electrical component than the one-lines. Electrical schematic drawings present information such as the individual relays, relay contacts, fuses, motors, lights, and instrument sensors. Examples of typical schematics are valve-actuating circuits, motor starter circuits, and breaker circuits. (e.g., diagrams) See ESM Chapter 7 and example drawing D5020-1.

Instrument Loop Diagrams: Are an extension of P&IDs, and illustrate control philosophy and confirm the completeness of submitted data in design, construction, startup, operation, maintenance and modification. For an example, refer to ISA 5.4. These diagrams will be located in the mechanical discipline, 6000 series; see Section 210 of this manual.

Isometric Projection: The isometric projection presents a single view of the component or system. The view is commonly from above and at an angle of 30 degrees. This provides a more realistic three-dimensional view. This view makes it easier to see how the system looks and how its various portions or parts are related to one another. Isometric projections may or may not be drawn to a scale (e.g., 3D representations).

Logic Diagrams: Logic diagrams can be used to depict several types of information. The most common use is to provide a simplified functional representation of an electrical circuit. It is easier and faster to figure out how a valve circuit works using logic symbols versus using the electrical schematic with its complex relays and contacts. These drawings do not replace schematics, but they are easier to use for certain applications. (e.g., diagrams) For an example refer to ISA 5.2. These diagrams will be located in the electrical discipline, 6000 series; see Section 210 of this manual.

Orthographic Projections: Orthographic projection is widely used for components and assemblies. Orthographic projections present the component or assembly through the use of three views. These are a Top view, a Side view, and a Front view. Other views, such as a bottom view, are used to more fully depict the component or system when necessary. (e.g., 3D representations)

Piping and Instrumentation Diagrams (P&ID): Designed to present functional information about a system or component. Piping configuration, flowpaths, pumps, valves, instruments, signal modifiers, and controllers are represented on P&IDs; flow diagrams do not show instrumentation. These drawings are not drawn to a scale and present only the relationship or sequence between components. Common synonyms for P&IDs include EFDs (Engineering Flow Diagrams), UFDs (Utility Flow Diagrams) and MFDs

(Mechanical Flow Diagrams. For an example, see ESM I&C Chapter 8 (*Appendix I*) and example drawings D6000 through D6025).

Priority Drawings: Priority drawings include the small set of "upper-tier" design drawings that are necessary to support the safe performance of facility operations within the facility's approved safety envelope. These drawings typically include piping & instrumentation diagrams, emergency evacuation maps (e.g., floor plans of record), and electrical one-lines, and may include other drawing types depending on the facility.

Process Flow Diagrams (PFD): PFDs provide functional information about a system or component. PFDs depict piping configurations, flow paths, pumps, and valves. Flow diagrams do not show instrumentation. These drawings are not drawn to a scale and present only the relationship, mass flow, or sequence between components. (e.g., diagrams) See ESM I&C Chapter 8 (*Appendix I*) and example drawings D6000 through D6025).

Technical Baseline Drawing: Drawing used in operational phase of a facility lifecycle to identify, justify and demonstrate the physical, functional or operational requirements of configuration-controlled SSCs. Drawings necessary for this purpose are selected from the larger set of project as-built (record) drawings. TB drawings are then maintained for the life of the facility using a change process (e.g., DCF) as opposed to projects proliferating drawings.[adaptation of P341]

D. **Reference Drawings: General Definitions**

General Note: A word, number, phrase, sentence, or group of sentences that is applicable to, involving, related to, or characteristic to, several, a group, many, or the majority involved. See Section 213 for an example.

Geo-spatial Information: Data that is referenced by geographic coordinates.

Keyed Note: A word, number, phrase, sentence, or group of sentences that gives specific explanation, identification, or task that provides a solution. See Section 213 for an example.

Sketch (SK): A rough preliminary, draft, or informal drawing that loosely follows LANL CAD Standards Manual, but does not involve quality assurance procedures. Sketches are not standalone documents but are associated with a formal change control document such as a Design Revision Notice, Field Change Request or Design Change Form. These sketch packages are only acceptable for certain projects and/or project modifications; see Section 103, Article 4.0 for requirements. Sketches are also used for engineering studies, engineering reports, conceptual design reports, conceptual design plans and design criteria documents.

Freehand and AutoCAD: A rough preliminary, draft, or informal drawing, sketched well enough to be understood by others. The sketch shall be neat, simple, and the message clear. The sketch may by drawn on any type of reproducible medium, minimum size 11"x17" (hand drawn sketches may also use 8 ½"x11") and attached to a DCF, FCR, or DRN document for later upgrading to standard CAD drawings or existing CAD drawings per LANL CAD Standards Manual. Sketches are also used for Engineering Studies, Conceptual Design Reports, Conceptual Design Plans and/or Design Criteria documents but for these uses shall be CAD sketches. Sketches may contain Plans, Elevations, Orthographic (3D), Dimensions, and Notes to concisely convey the idea. The information on the sketches may be shown in any order and on any page and disciplines may be mixed. In an AutoCAD sketch, the line types, colors, fonts, and symbols shall conform to the LANL CAD Standards Manual.

Floor Plan of Record (FPR): The controlled set of architectural drawings identifying the architectural layout for a building. The FPR is used as a baseline drawing for developing Emergency Evacuation Plans and by/for Space Planning and Management, Interior Design, geo-spatial information for the Geographic Information System (GIS), and final design. This is the "drawing of record" upon which the Authorization Basis of the building is based.

Standard Drawing (ST): A LANL-produced formal drawing depicting standard details to provide a consistent method of construction and installation of equipment for all disciplines and achieve standardization. The STD-342-400 Standard Drawings & Details collection is online at http://engstandards.lanl.gov/Dwgs_Details.shtml.

102 PLANNING AND COMPOSITION OF DRAWINGS

1.0 GENERAL FORMATTING GUIDELINES

A. Proper planning and presentation of the drawing sheets is very important. Make every effort to anticipate and plan for the drawing space layout now and for future modifications: the symbols required, use of consistent terminology, and coordination of disciplines.

B. Map space in advance for each plan, section, elevation, detail, schedule, etc.

2.0 GENERAL FORMATTING REQUIREMENTS

A. AutoCAD files may be developed in TAB format (each drawing sheet is a tab versus a single file) such that each TAB represents a single drawing and a single DWG file contains all sheets of a single discipline. However final CAD drawing submittals to LANL must be in the format of a single DWG file containing a single drawing sheet.

B. Drawing content shall utilize Model Space (for physical subject objects) and Paper Space (for all annotations – notes, text, dimensions, leaders, symbols, hatching, etc.) to the maximum extent possible. With advance approval, design and design output generated from 3-D, BIM, or other design software can be exempted from this since these software products generally work in Model Space only. In such cases, the LANL standard title blocks shall be used and all other content of the hardcopy output shall closely resemble that of this Standard.

C. Arrange each drawing so that it appears balanced and uncrowded.

D. Use CAD conventions that are clear and readable, e.g., when a 24x36" sheet is reduced to 11x17" (e.g., Arch D size to ANSI B size).

E. Use consistent line widths, text height, and line types in a drawing set for clarity and accuracy.

F. Do not combine different disciplines or systems on the same drawing sheet.

G. Show or call out typical information the least number of times possible, preferably once.

H. Coordinate embodiments, inserts, block-outs, and penetrations with all disciplines to ensure that the drawing set conveys consistent information.

I. Use terminology in the drawing set that is consistent with the terminology in the related specifications and throughout the drawing set.

J. When they occur, vendor drawings shall be part of a document drawing set, but are used only as reference drawings used for fabrication, installation, or as-built by the vendor. These drawings need not conform to the LANL CAD Standards Manual and are to be labeled as "reference drawings" 1/4 inch text height placed in an obvious location on each sheet.

K. Do not show calculations in the drawing set unless otherwise noted in this manual.

L. Ensure room numbers are shown visibly on all building plan drawings.

M. Do not hide, overlap or conceal text in hatching, line types, symbols, etc.

N. Do not combine sheet types on the same drawing sheet unless otherwise specified in this manual.

O. Include only information that is necessary and pertinent to serve the drawings' purpose.

P. Dimension styles shall be consistent within each discipline unless otherwise noted in this manual. Proper dimensioning provides all/only those dimensions needed for fabrication and construction – do not provide unnecessary dimensions.

Q. In instances where software conflicts occur with AutoCAD formatting (e.g., LANL UMAP, LANL survey drawings), the drawings must follow as closely as possible formats outlined in this manual. In order for this to occur, the CAD Standards Manual POC must have a written agreement with the producer of the drawings (i.e., grandfather clause in effect). Fonts and text styles should be matched as close as possible and text placement must not interfere with lines in drawings as outlined in Sections 102.2, 211, and 212.

Note: When design agencies use drawings generated by firms that have grandfather clauses in effect, it is the responsibility of the AE firm to inform the CAD Standards Manual POC of where the drawings originated by placing a general note on each affected drawing explaining origin of base map.

3.0 DRAWING LEGEND

A. Provide a standard legend of symbols and line treatment on the first drawing sheet of each discipline for the drawing set.

Note: A drawing legend will occur on the first sheet for each discipline identified by the discipline designator, followed by a "- " then followed by numerical sequence (e.g., A-0001), see Table 210-1.

B. The drawing legend should be developed showing both existing and proposed features. Legends that show the same symbols for existing and proposed are confusing and make it hard to read the drawing. This includes proposed and existing line types.

C. For information on the location of General Notes, see Section 213 (*10.B).*

103 DRAWING REVISIONS

1.0 DRAWING REVISION

Guidance: For existing facility modifications, designers shall make every effort to locate and revise existing drawings rather than create new drawings that result in unnecessary effort and documentation issues.

A. When a drawing is approved and submitted as an **initial issue**, enter a "0" in the revision block located within the drawing title block. Additionally, enter a "0" in the "NO" column and "INITIAL ISSUE FOR [DCF-XYZ]" in the "DESCRIPTION" column of the revision block. The DCF # is not utilized if the project is a new facility.

B. For subsequent revisions, indicate **revisions** by numbers, beginning with the number "1." Use a sequential number for each revision on a sheet.

1. Number each revised sheet independently.
2. Enter the appropriate information in the revision block of the drawing title block. The description shall include "REVISIONS PER [DCF] [DRN] [FCR] and the appropriate document number, and a summary of the revisions.
3. In the Title Sheet, indicate each revised drawing sheet by drawing a revision cloud around the current revision number shown in the list of drawings "Revision Column," see Figure 203-1, Item 15.
    a. Use the AutoCAD "cloud" (or other similar graphic symbol) for revisions (layer-X-ANNO-cloud, pen weight 0.35 mm, line-type continuous) to completely encircle the revised drawing elements. On subsequent revisions, delete the previous revision clouds. A revision cloud is illustrated in Figure 103-1.
    b. A revision cloud is not required on a drawing sheet if the whole sheet was revised or it is a new sheet added to the drawing set.
4. Indicate the current revision number in the "NO." column of the revision block and "REV." block of the drawing title block (Figure 103-1).
5. Indicate the current revision date in the "DATE" column of the revision block.
6. Hand written initials or signatures are not required in the drawing title block or on previous revision block entries, but are required in the revision block for the current revision.

C. The following are graphic examples of the Title Block modifications required and sample revision cloud when revisions have been made on a Drawing sheet.

1	8–30–14	UNCLASSIFIED	MN	REVISIONS PER [DCF] [DRN] [FCR] – RELOCATE EXHAUST FAN FE–4	DM	AT	MN	MN	GL
0				INITIAL ISSUE [FOR DCF–XYZ]					
NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DES	CHKD	SUB	APP

DRAWING NO	REV
C76391–DWG–031400–M–3000	1

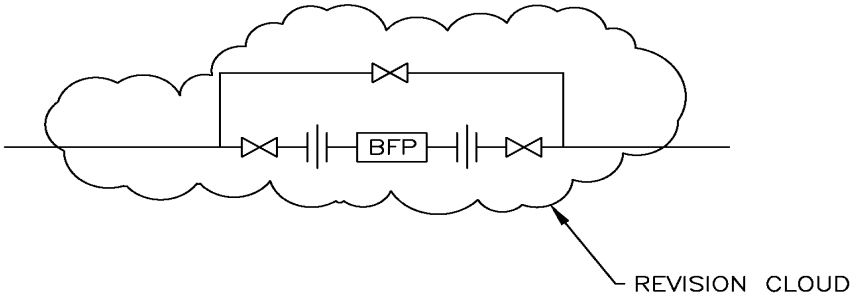

Figure 103-1. Revision Block, Number, and Clouding

D. Non-CAD drawings with major changes (affecting 50% or more[5]) shall be completely upgraded following the current LANL CAD Standards Manual.

Note: Revisions to "Priority Drawings," CAD or non-CAD, shall be generated to the current LANL CAD Standards Manual.

E. Projects involving existing facilities and systems: the assigned design agency is required to research and locate all existing drawings pertaining to the project if the LANL Responsible or Project Engineer has not done so. Contact Document Control Group (*SI-DC*) for the drawing database location. ***Note:*** *All existing drawings may not reside in the Document Control/Records center. Satellite records centers within the facility(s) may contain the essential documentation. Should this be the case*, report these findings to a Document Control Team representative. These documents shall be collected and entered into the LANL master document database by SI-DC in conjunction with the FDAR.

[5] The 50% threshold appearing in this manual for CAD drawings has been in place for more than a decade and proven appropriate. By coincidence, it is the same threshold for IEBC Level 3 Alterations (which trigger major upgrades to current expectations in most cases).

F. Modify CAD drawings per the following criteria:

1. Existing technical baseline drawings shall be revised versus generating new drawing(s) for a modification or suite of modifications. Exceptions to this rule shall be approved in writing by the Facility DAR.

2. For all CAD drawings:

   a. Minor changes (affecting less than 50%) can be modified using the existing drawing format and symbology and current revision procedure.

   b. Major changes (affecting 50% or more) shall be completely upgraded to the current standards and depict the area changed by the revision. When the actual design has changed greater than 50%, it is acceptable and appropriate to also update the title block body fields to reflect current participants (including AE firm logo) and note this was done in the revision block (along with description of design changes).

3. If the proposed modification requires more space than is provided on the existing drawing, the following options, listed in order of descending preference, shall be followed:

   a. Generate a new drawing that **supersedes** an existing drawing, and cancel the **superseded** drawing, **OR add a general note** on the new drawing indicating the superseded drawing C#, title, PI #, and date.

   b. Generate a new drawing that **augments** the existing drawing, and cross-reference the drawings to each other, with an explanatory Note above the Title block of both the original drawing and all augmenting drawings, providing a clear identification of and cross-reference to the original drawing.

G. Revisions to existing drawings with an assigned PI# which are revised under a different PI# shall be noted in the revision block by the new PI# assigned to that change.

H. Use the Conduct of Engineering Administrative Procedure AP-341-517, Design Change Form or AP-341-519, Field Change Request and Design Revision Notice, as applicable.

I. Submit all DCN, FCR, or DRN documentation to the Document Control Group with the final revised drawings. Projects must follow turnover procedures in LANL Master Spec Section 01 7839 Project Record Documents.

J. A Derivative Classifier/Reviewing Official must review, classify, and sign each revision.

K. DCF/FCRs/DRNs with sketch attachments may also include revised existing drawings associated with the document package. Provide proper information for cross-referencing data.

2.0 AS-BUILT AND AS-FOUND REVISION

Note: "As-Built" vs. "As-Found" - "As-Built" drawings have a pedigree: a paper trail documenting justification/rationale for each modification made; "As-Found" drawings reflect actual field configuration for which there is either no documentation or complete documentation is lacking.

Follow Section 1.0 with the following additional requirements in order to revise an as-built or as-ound drawing:

A. Delete all revision clouds, demolition details, and Subcontractor notes from the drawing sheet.

B. Do not use revision clouds to denote as-built or as-found changes.

C. Enter the next sequential revision number in the drawing title block. Enter that same number in the revision block.

D. In the "DESCRIPTION" column of the revision block enter either "As-Built (or As-Found) with Changes," or "As-Built without Changes," if there were no red-lines to incorporate (Table 202-1, Item 4 "Revision Description" of this manual).

E. A detailed description of the "As-Built" (or As-Found) changes is not required; however, the date and change control document (DCF, FCR, and/or DRN) number of origination is required.

F. Guidance: The as-built drawing package is delivered to LANL document control as an official record of construction for the project. This process ends the construction and as-built phase of the project and allows for the operational phase.

3.0 TECHNICAL BASELINE DRAWINGS (OPERATIONAL PHASE)

Note: For operating facilities, CAD **copies** of certain sheets from the as-built (record) drawings are modified to create technical baseline and support drawings for the facility. *Technical Baseline Documents are described and controlled in accordance with AP-341-405 "Identification and Control of Technical Baseline, Variances, Alternate Methods, and Clarifications in Operating Facilities" (internal only).*

A. Modifications for each selected sheet shall include:

- Converting all existing features on the selected sheets (copied from the as-built/record drawings) to a 0.35mm line weight and a "continuous" line type.
- Entities of the drawing (line color, line type, etc.) are to be "by layer".
- Previous revision entries are to be deleted so that the drawing becomes "REV 0".
- The "C" portion of the drawing number is to be deleted so that the drawing number is in the format of "DWG-TABLDG-X-XXXX". See Figure 202-2 for further information.

4.0 SKETCHES

A. Sketches are not "stand-alone" documents and must be accompanied with an approved DCF, DRN, FCR, engineering study or report, design criteria document, or conceptual design report. DCF/DRN/FCR sketches may be used for construction-type projects when determined by the FDAR through approval of the Preliminary Project Determination Form, ESM Chapter 16 IBC-GEN (*Form 1*). The ES-EPD Group Leader may also allow other approaches by written agreement in advance (with "cc:" to the CSM POC).

B. Sketches are often used to revise, update or modify an existing condition on existing drawings.

1. Sketches may be hand-generated or CAD-produced.

2. Sketches shall contain all information required to represent a complete design for the project or task. The sketch shall be technically correct, engineered properly and constructible.
3. CAD sketches may be drawn on an ANSI "B" (11"x17") or Arch "D" (24"x36") size sheet. Hand drawn sketches may, in addition to above, be drawn on an ANSI "A" (8 ½"x11") size sheet.
4. Sketches shall have a unique sketch number associated with the originating DCF/DRN/FCR or other parent document number (engineering study, conceptual design report, design criteria document, etc.).
5. See Section 202 for an example of the standard Sketch Title Block and required information including sketch numbering.
6. CAD-produced sketches shall comply with these sections of the CAD Standards Manual:
   a. Section 103, General Requirements
   b. Section 201.1, Drawing Sheet Sizes and Format; and 201.5, Grid System
   c. Section 202, Title Blocks
   d. Section 204, Plan Orientation
   e. Section 205, North Arrow Symbol
   f. Section 206, Partial Plans
   g. Section 207.2, Drawing Scales
   h. Section 208, Dimensioning & Leaders
   i. Section 211, Line Work
   j. Section 212, Standardization of Text
   k. Section 213, Sections, Elevations, Details, and Callouts
   l. Section 214, CAD File Conventions
   m. Section 301, Symbols.
7. Hand-produced sketches shall comply with the requirements set forth in this Manual specifically for hand sketches.

C. Once construction or as-built modifications have been incorporated, pertinent documentation [DCF/DRN/FCR, sketches, revised drawings (hardcopy and CAD)] shall be submitted to LANL Document Control and Records Management (*SI-DC)* if not already sent.