

Off-Site Vendor Directions of the Preparation and Control of Engineering Drawings

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Fluor Hanford

P.O. Box 1000
Richland, Washington

Contractor for the U.S. Department of Energy
Richland Operations Office under Contract DE-AC06-96RL13200

Approved for Public Release
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Chris Millington 6/18/03
Clearance Approval Date

N/A
Release Approval (stamp)

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Further Dissemination Unlimited

For use with Technical Documents (when appropriate)	
EDC-	FMP-
EDT-	ECN-
Project No.:	Division:
Document Type:	Page Count:

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Abstract	Summary	Full Paper	Visual Aid
Conference Name:			
Conference Date:			
Conference Location:			
Conference Sponsor:			
Published in:			
Publication Date:			

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Off-Site Vendor Directions for Preparation and Control of Engineering Drawings

HNF-14660

Revision 1

Published: June 2003

Topic: Engineering

Off-Site Vendor Directions for Preparation and Control of Engineering Drawings

1.0 PURPOSE

This document provides mandatory directions for preparation and control of engineering drawings developed for Fluor Hanford (FH).

2.0 SCOPE

Engineering drawings developed specifically to depict permanent installation of structures, systems, and components shall comply with the FH drawing format herein described.

Drawings used to provide temporary construction designs are exempt from this instruction, except for those designed items abandoned in place, e.g., direct buried electrical lines and potable water lines.

Items purchased that are commercially available and used in a design are also exempt. Items requiring data for operation and maintenance are identified, maintained, and turned over as commercial vendor files to FH at final turnover of the engineering drawings depicting such vendor items.

3.0 CONTROL OF DRAWINGS AND DATA FILES

3.1 CAD Program

AutoCAD⁽¹⁾ Release 15 (AutoCAD 2000) or lower versions shall be used for preparing all engineering drawings that will be released into the Hanford drawing storage/retrieval system. Effective August 01, 2002, AutoCAD⁽¹⁾ Release 16 (AutoCAD 2002) or lower versions shall be used for preparing all engineering drawings that will be released into the Hanford drawing storage/retrieval system.

3.2 Control of Original CAD Data Sets and Manual Drawings

Vendors are responsible for maintaining configuration control of engineering drawings and associated data sets to ensure that the master CAD data file accurately reflects the plotted engineering drawing. This includes managing access to both the original computer-aided drafting (CAD) data sets and the plotted (original) engineering drawings.

3.3 Final Turnover of Engineering Drawings

All drawings identified for final turnover shall be vendor-approved drawings with all outstanding approved changes incorporated into the drawings prior to FH turnover. All identified drawings and master CAD files must be turned over before release of structures, systems, or components for FH use/operation. The following directions apply to all H-series drawings submitted to FH.

- Drawings developed on CAD programs other than AutoCAD shall be converted to the standard AutoCAD program "DWG" format prior to releasing the data files to Information Resource Management (IRM). Final plots shall be generated from the .DWG format.
- Final hard copy plot of engineering drawings and the associated CAD data files (those with a "DWG" extension used to develop the final plotted drawing) shall be concurrently provided to FH.
- All XREF data shall be bound before sending the data files to FH. See [Section 5.4](#), X-Reference Files.
- All hard copy drawings shall be plotted Black and White; colored plots will **not** be accepted. See [Section 5.2](#), Plotter Pen Assignments
- All scaled drawings, other than one-to-one scale, shall be in AutoCAD's Paper Space layout for the title block with appropriate view ports. The design shall be in full model

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space. No engineering data, except the title block data, shall be placed in the drawing layout area; e.g., drawing text, dimensioning (these data are placed into model space).

- All “layers” shall be turned on and plotted; extraneous data is to be removed, e.g. construction reference data, and except for view port layers and H-13 series maps.
- Any metadata (information about the drawing that is beneficial to future CAD users) shall be placed on the DEFPOINT layer; e.g., XP scale, and block information.
- An authorizing document number that releases the drawing into the Hanford drawing system shall be provided by the FH project point-of-contact (POC). This number is to be placed in the revision block of the drawing and noted, e.g., Drawing as-built per HNF-FMP-(Year-Number).
- All drawings shall be checked for adherence to these directions. See [Section 7.7](#), Drafting Approved.

4.0 DRAWING CATEGORIES

4.1 New Project Drawing Types

Drawings that document baseline information of structures, systems, and components are covered by this instruction. These include several different drawing types, such as arrangement, assembly, detail, schematic, electrical wiring diagram, block flow diagram, process flow diagram (PFD), installation, layout, plot plan, piping and instrumentation diagram (P&ID), loop sheet, envelope, and altered-item drawings. This list is not all-inclusive, and other types of drawings may be necessary for particular purposes.

These drawings are assigned unique Hanford H-series drawing numbers. The H-series drawing numbers are supplied by the project POC. These drawings are maintained as permanent records and may be subject to as-built requirements at the completion of construction/fabrication. The FH POC will provide as-built criteria for drawings and identify the drawings as determined by the life cycle of the depicted structure, system, and component.

4.2 Modification Drawings

Existing facility drawings impacted by vendor engineering designs shall have the changes identified and interfaced with the project engineering point of contact.

4.3 Altered Item Drawings

Altered-item drawings are developed for commercially available vendor-supplied items (off-the-shelf) that require modification to support a design. The original vendor data is maintained in a vendor item (VI) file and the altered item drawing developed to show the required alteration. See altered item definition in [Appendix A](#) and [Section 8.10.10](#), Altered Item.

5.0 COMPUTER-AIDED DRAFTING (CAD)

5.1 AutoCAD Discipline Layering

Uniform layering shall be used to make it easier to exchange AutoCAD data sets among organizations and companies. Consistency allows logical separation and identification of drawing data and permits the user to view and plot related aspects of a drawing separately or in combination.

5.1.1 Layering

Designating layers by color and line type is preferred. Layers may also be assigned on an entity basis. This section and [Appendix B](#) describe the steps used when assigning layers.

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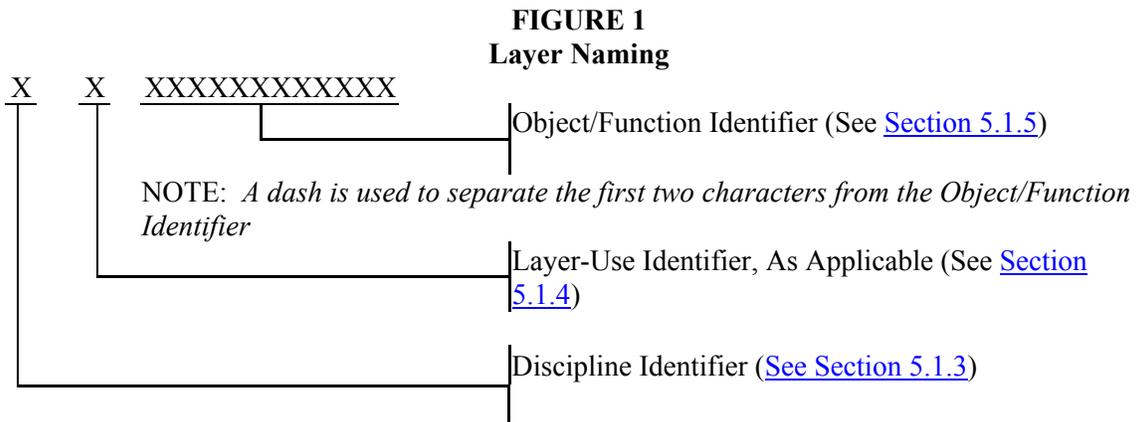
Drawing template files establish specific discipline layers for routine use. [Appendix B](#) and Tables 1 through 9 cover the following:

- [Table 1](#), General Layering for All Disciplines.
- [Table 2](#), Architectural Drawings.
- [Table 3](#), Civil/Structural/Environmental Drawings.
- [Table 4](#), Electrical Drawings.
- [Table 5](#), Fire Protection Drawings.
- [Table 6](#), HVAC Drawings.
- [Table 7](#), Instrumentation & Control (I&C) Drawings.
- [Table 8](#), Mechanical Drawings.
- [Table 9](#), Piping Drawings.

The FH CAD and Drafting Authority shall approve all third-party software with built-in layering before use.

5.1.2 Layer Naming

Figure 1 shows the layer-naming convention for FH AutoCAD-developed drawings.



5.1.3 Discipline Identifier

This identifier defines the specific discipline. A unique identifier enables users to quickly distinguish discipline layers within a drawing file and provides a logical separation of discipline information, as defined by [Figure 2](#). Also, see [Figure 1](#).

**FIGURE 2
Discipline Identifiers**

Identifier	Discipline	Identifier	Discipline
A	Architectural	H	HVAC
C	Civil	I	Control Systems
E	Electrical	M	Mechanical/Machine
F	Fire Protection	P	Piping
G	General (non-specific applications)	S	Structural

5.1.4 Layer-Use Identifier (As Applicable)

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The layer-use identifier designates what the layer depicts (e.g., primary objects, existing equipment, hidden objects, or text). The layer-use identifier is used only when a single line type and color is assigned to an individual layer as defined by [Figure 3](#). Also see [Figure 1](#). Normally, this identifier is not used for entity-based layers.

FIGURE 3
Layer-Use Identifiers

Identifier	Layer-Use	Line type
O	New or main object, visible lines, primary line work	Continuous
E	Existing equipment - For A/E use to depict existing	Phantom
F	Future items - For A/E use to depict future items	Dashed
D	Demolition - For A/E use to depict demolition information	Dashed
T	Text	Continuous
M	Dimensioning	Continuous
C	Center lines	Center
H	Hidden items/lines	Hidden
X	Hatching	Continuous
P	Mechanical details depicting repeated details (e.g., spring and screw thread details or alternate positioning of absent parts)	Phantom
V	Viewing and Cutting Planes	Varies

Certain conditions may make it desirable to link layer data together but still keep the data separate. For example, if a piping modification called for installation of new equipment after removal of old equipment, the layer-use identifier can be used to separate data as follows:

- Add auxiliary details as needed. Example: 3DET.
- PE-PIPING - Existing piping.
- PD-PIPING - Piping to be removed (demolition).
- PO-PIPING - New piping to be installed.
- PF-PIPING - Piping to be considered for future installation.

5.1.5 Object/Function Identifier

The object/function identifier provides a semi-descriptive name of layer contents or function. The identifier is limited to 28 characters in length and may contain letters, numerals, and special characters, such as \$ (dollar), - (hyphen), and _ (underscore). The layer name should assist the reader in understanding what is contained on the layer. See [Figure 1](#) and [Appendix B](#), Tables 1 through 9.

5.2 Plotter Pen Assignments

Plotters shall be configured to produce line widths based on colors. Designating specific AutoCAD colors to the plotter pens does this. This allows the plotter to generate specific line weights and minimizes the need to use AutoCAD Polylines for line work.

Care must be taken to ensure the selected color/line weight produces the desired line width on the final drawing plot. The final plot for approval shall be black on white; color plots shall **not** be allowed for approval or release to FH. The line type and color should provide optimum contrast with the visible/object line width on the drawing. See [Figure 4](#) for plotter color to line widths.

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NOTE: Selecting the Polyline feature limits the minimum Polyline width to the plotter line width that is established by the line color.

FIGURE 4
Plotter Pen Assignments

Pen No. 1 0.25mm (0.010in.)	Pen No. 2 0.35mm (0.014in.)	Pen No. 3 0.5mm (0.020in.)	Pen No. 4 0.7mm (0.028in.)	Pen No. 5 0.95mm (0.038in.)
Color Assignment	Color Assignment	Color Assignment	Color Assignment	Color Assignment
Primary Color	Primary Colors	Primary Color	Primary Colors	Primary Color
8 (8)	5 (Blue) 6 (Magenta) 7 (White)	4 (Cyan)	2 (Yellow) 3 (Green)	1 (Red)
Optional Colors	Optional Colors	Optional Colors	Optional Colors	Optional Colors
X3 (e.g., 13, 53, 123, 243)	X2 (e.g. 12, 32, 152, 222)	X1 (e.g., 11, 71, 181, 241)	X0 (e.g., 10, 90, 100, 230) X5, X6, X7, X8, X9	X4 (e.g., 14, 64, 134, 214)

5.3 New-Drawing Setup Files

5.3.1 New-drawing setup files

Template drawings (.dwt), also identified by previous AutoCAD documentation as Prototype drawings, have the layering convention defined in this instruction. See [Appendix B](#), Tables 1 through 9. The drawing templates for the various drawing types and disciplines are available through the FH project POC.

5.3.2 Additional Layers

The startup files are not an all-inclusive list of needed layers. Additional layers are developed as needed to provide for specific drawing needs. Development of additional layers are to comply with the specified naming convention described in [Figure 1](#).

5.4 X-Reference Files

Prior to final drawing turnover to FH, X-Reference files shall be bound to the AutoCAD "DWG" drawing file. See definition of X-Reference in [Appendix A](#). All layers shall comply with layering specified in [Sections 5.1.1 through 5.1.5](#).

5.5 Manual Modification or Revision of CAD-Generated Drawings

All drawings and associated CAD data sets shall be the latest revision. If a CAD-generated plotted drawing is changed (e.g., field of the drawing is changed) before the final drawing turnover, the CAD data set shall be updated to reflect the changes and the drawing re-plotted and re-approved before issuing the drawing for final turnover.

5.6 Third-Party CAD Software

Third-party software used in the development of AutoCAD-based drawings shall be the type that does not need access to the third-party software to view or revise the drawings. Exceptions may be requested in writing; the Drawing and CAD Technical Authority will review and approve the use of third party software on a case-by-case basis.

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5.8 Shape Files and Non-Standard Fonts

Nonstandard shape files and fonts (i.e., font files not supplied by AutoCAD) shall **not** be used. See [Section 8.7](#), Lettering.

5.9 CAD Auxiliary Support Files/Information

Auxiliary support files/information are available on request through the FH POC. The available files and information are:

- Drawing start models (AutoCAD template/prototype drawings). See [Section 5.3.1](#), New-drawing setup files.
- Drawing Title Block formats. See [Section 7.1](#), Title Blocks.
- Symbols (e.g., architectural, electrical, control systems; heating, ventilation, and air conditioning [HVAC]; and P&ID). See [Section 8.3](#), Symbology.

6.0 DRAWING SIZES AND MATERIAL

6.1 Sizes

6.1.1 General Drawing Standards

Drawings are sized in accordance with American National Standards Institute (ANSI) Y14.1-1980 (R1987), *Drawing Sheet Size and Format*, or ANSI Y14.1M-1992, *Metric Drawing Sheet Size and Format*, as applicable.

6.1.2 Preferred Drawing Sizes

The ANSI "F" size drawing (28" x 40") is the preferred inch size. The ISO "A1" size drawing (594 mm x 841 mm) is the preferred metric size.

6.1.3 Unacceptable Drawing Sizes

The ANSI "E" size, ISO "A0" size, and roll or elongated size drawings shall not be used.

6.2 Drawing Material

CAD drawings shall be plotted on bond paper that is a minimum 20 lb opaque paper.

7.0 DRAWING ARRANGEMENT

The general drawing arrangement conforms to ANSI Y14.1- 1995 or ANSI Y14.1M- 1995, as applicable, except for the location of the parts/materials list and the REVISION Block. Drawing arrangement is configured as shown in [Figure 5](#) and as defined in this instruction.

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7.1 Title Block

Discipline specific, AutoCAD start models developed for Hanford Site drawings shall be used (e.g., AutoCAD template/prototype drawings). The start models are available through FH project POC. See [Section 5.9](#) CAD Auxiliary Support Files/Information.

7.1.1 Title Block Configuration

FIGURE 6
Typical Title Block

The diagram shows a rectangular title block with various fields and dimensions. The top section contains the text "U.S. DEPARTMENT OF ENERGY" and "Richland Operations Office". Below this are several rows for "DRAWN BY", "DATE", and "COMPANY". A section for "DRAFTING APPROVED BY" is also present. The bottom section includes fields for "SIZE" (with the value "F"), "BLDG NO", "INDEX NO", "DWG NO", "REV", "SCALE", "FMP", "SHEET", and "OF". Dimensions "2" and "1" are indicated at the bottom, and "A" is indicated on the right side.

NAME		DATE	U.S. DEPARTMENT OF ENERGY				
DRAWN BY		COMPANY	Richland Operations Office				
DRAFTING APPROVED BY							
DESIGN AUTHORITY			SIZE	BLDG NO	INDEX NO	DWG NO	REV
COMPANY			F				
			SCALE	FMP	SHEET	OF	

7.1.2 Company Name

In the approval section of the title block the acronym of the contractor for each identified name is placed in the block next to the date. See [Figure 7](#). For A/E contract drawings, the name of the firm may be placed above the title block.

7.1.3 Drawing Title

- The title clearly identifies the subject matter.
- The title does **not** include capitol project numbers or building numbers (e.g., W-120).
- Hanford area numbers are only used for area-wide presentations.
- The total number of characters, including spaces, shall **not** exceed 60.
- Height of the lettering in the title is a minimum of 6 mm (.24") for ISO A1 and ANSI D and F size drawings. Height of the lettering is 3 mm (.12") for all other drawings.
- Titles are arranged in one, two, or three lines centered in the block. All sheets of multiple-sheet drawings shall have the same title. The title identifies the system/project, subsystem/subproject, and/or component, as appropriate, using the first and second lines of the title block. The drawing type is identified on the second line of a two line drawing title, or the third line of a three line drawing title.
- For capital projects, the project number and project title are entered in a supplemental block above the Title Block. See [Figure 7](#).

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**FIGURE 7
Capital Projects Title Block**

Project			THIS SPACE
CONTRACTOR'S NAME, INC. ANYWHERE, USA			
NAME	DATE	COMPANY	U.S. DEPARTMENT OF ENERGY Richland Operations Office
DRAWN BY			
DRAFTING APPROVED BY			

7.1.4 Building Number

- The building or area number is noted in the Title Block. The FH POC will provide the Hanford Site building numbers to be used for the project. See [Figure 6](#).
- If more than 12 buildings are depicted within the same area, the assigned building number is the area number followed by the letter G (e.g., 200G and 400G).
- If additional space is needed, the additional building number(s) are listed above the Title Block in the space reserved for Building and Index numbers. See [Figure 5](#).

7.1.5 Index Number

The appropriate index number is noted in the Title Block. The FH POC will provide the Hanford Site index numbers to be used for the project. See [Figure 6](#).

7.1.6 Multiple Index Numbers

If more that two index numbers are assigned to a drawing, the additional index numbers are listed above the Title Block in the Drawing Status area of the drawing. See [Figure 5](#).

7.2 Drawing Number

Drawing numbers are obtained through the FH project POC. The drawing number is placed in the title block using 6 mm to 8 mm (.24" to .35") high lettering. See [Figure 6](#).

7.3 Revision Number

7.3.1 In Process Revision Designations

All drawings under development use Alpha revisions, e.g., A, B, C. This process is used as the in process control and may be identified with the review cycle of the drawing, e.g., A=30%; B=60%; D=90%. For FH drawings placed into "project status" the alpha designator in place behind the formal revision number, e.g., 3A, 4B, etc

7.3.2 Formal Revision Designation

- At the point FH approves an engineering drawing, all alpha revisions are removed and the drawing is identified with a numeric revision designator beginning with "0" (zero).
- Revision "0" (zero) and higher drawings are identified as project baseline drawings and all subsequent revisions require FH approval. All revisions are completed using the next higher numerical revision indicator, i.e., 1, 2, 3, etc.

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7.3.3 Revision Approval and Designation

- Revision 0 approval signatures are placed in the approval block of the title block; no signatures are placed in the revision block of a drawing being approved at Revision 0.
- Approvals for Revision (1 and higher) require signatures or initials to be placed in the revision block. The current revision number is noted in the Title Block, as well as in the REVISION block. See [Figure 6](#) and [Figure 17](#). Also see [Section 11.0](#), Revisions.

7.4 Scale

- Enter predominant scale of the drawing or enter “NONE” when no scale is used.. See [Figure 6](#).
- If the predominant scale of the drawing cannot be determined, enter “SHOWN” and identify the scale under each graphic

7.5 Sheet Number

- For single sheet drawings, a “1” is entered in the SHEET block. See [Figure 6](#). For multiple-sheet drawings, the sheets are numbered in sequence starting with 1.
- The total number of sheets is entered on sheet 1 *only*. Each subsequent sheet only shows the next sequential sheet number, but *not* the total number of drawing sheets; only sheet 1 identifies the total number of sheets in the drawing set.

7.6 Drawn By

The initials and surname of the originator are printed. See [Figure 6](#).

7.7 Drafting Approved

All drawings shall be checked for compliance to this instruction. The initials and surname of the individual who checked the drawing for compliance is placed in the “Drafting Approved” block. The check includes electronic verification that the data file of the drawing complies with this instruction. Someone other than the individual(s) involved in the creation of the design or drawing is to complete the drawing check. The initials and surname are printed with the signature placed next or below the printed name. See [Figure 6](#).

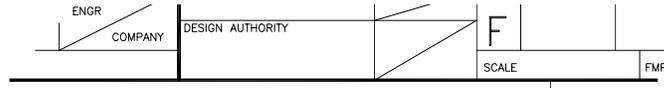
7.8 Approval Signatures

Approvals are in accordance with individual company procedures. The initials and surname are printed with the signature placed next to or above the names.

The FH Design Authority (DA) signs and dates the Title Block in the bottom approval space. See [Figure 9](#). The Design Authority’s approval signifies that all necessary reviews and approvals are completed and that the design is accepted. The company designator is identified and placed in the block provided next to the approver’s signature and date. The initials and surname are printed with the signature placed next or below the printed name.

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**FIGURE 9
Design Authority**

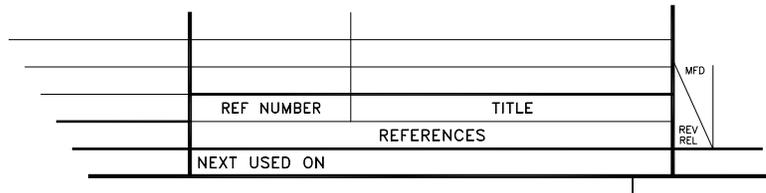


7.9 References Block

Only the reference documents needed by the construction contractors are listed. See [Figure 10](#). New drawings depicting new construction or definitive design are not listed in the REFERENCES block, but are shown on the drawing for continuation. The Vendor Information File number of supplied/existing equipment is also referenced. National consensus standards are *not* listed in the REFERENCES block

The reference document number is entered in the REF NUMBER block and the actual title is entered in the TITLE block; the may be abbreviated. See [Figure 10](#).

**FIGURE 10
Typical Reference Block**



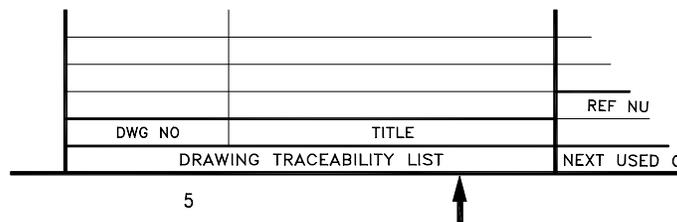
7.10 Next Used On Documentation

The NEXT USED ON block is used to document drawings that are linked together (e.g., a subassembly, detail and installation drawings); see [Figure 10](#). Drawings are linked by referencing the next higher level or generation drawing (e.g., a subassembly drawing lists the drawing number of the assembly or the installation drawing). If the drawing is the top drawing, the words “END ITEM” are entered.

7.11 Drawing Traceability List

The DRAWING TRACEABILITY LIST block itemizes the existing Hanford released drawings affected by changes in design. See [Figure 11](#). All affected drawings are shown. The drawings are *not* duplicated from the REFERENCES block. All drawings need to provide two-way traceability. See definition in [Appendix A](#), Glossary.

**FIGURE 11
Drawing Traceability List**



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7.12 General Notes

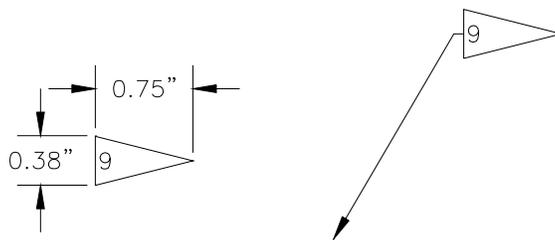
7.12.1 Location

The preferred location of the general notes is above the Title Block. Other locations may be used when additional space is needed. On multiple-sheet drawings, general notes start on sheet 1, but may continue on subsequent sheets, as necessary.

7.12.2 Flag Note

When a reference back to the general notes is required, a “flag note” or notation (for example, “SEE GENERAL NOTE 5”) shall be placed in the body of the drawing near the affected area. Leader lines from the flag note or notation shall be used when clarification of the reference is required. If a flag note symbol is used, it is sized and configured as shown in Figure 6. A flag note symbol is also placed in the general notes to indicate that a general note is flagged in the body of the drawing.

Figure 6. Flag Note Size and Configuration



7.13 Drawing Status Area

A space approximately 75 mm (3") high above the Title Block shall be reserved on the drawing for recording additional Title Block information and for the application of A/E stamps according to individual contractor procedures.

7.14 Parts/Material List

If required, the parts/material list is located, or begins, in the upper right-hand corner on the first sheet of the drawing. See [Section 8.10](#), Parts/Material List, for development information.

8.0 DELINEATION

8.1 General Practice

- Drafting is according to applicable ASME/ANSI Y14 series and nationally accepted national standards and industry discipline practices.
- Process Flow Diagrams (PFDs) shall comply with, [Appendix C](#), Preparation of Process Flow Diagrams. For symbology requirements see [Section 8.3](#), Symbology.
- Piping and Instrumentation Diagrams (P&IDs) comply with the Process Industry Practices (PIP), [PIP PIC001](#), *Piping and Instrumentation Diagram Documentation Criteria*. Where there is conflict between this instruction and PIP PIC001, this instruction takes precedence, including symbology; see [Section 8.3](#), Symbology.

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8.2 Abbreviations and Acronyms

8.2.1 Abbreviations

- Abbreviations conform to the latest edition of ASME Y14.38, *Abbreviations and Acronyms*, except where commonly accepted industry or specific discipline usage dictates a deviation from ASME Y14.38, for example: PFDs and P&IDs comply with the abbreviations and acronyms listed on Hanford drawing H-9-006015.
- Abbreviations on a drawing are used only when space does not permit the word(s) to be spelled out, such as in the drawing title, parts list, or a reference drawing list. Industry-accepted abbreviations, such as DIA, SCH, and REF are used to the fullest extent. The face of the drawing should be planned and drafted to provide ample space so that abbreviations can be held to a minimum, for clarity and interpretation.
- Punctuation marks, except the slant (/) and the hyphen (-), are not used when abbreviations are used on drawings. A period (.) is added to an abbreviation only if its context does not obviously represent an abbreviation (e.g., ADD indicates addition or addendum). Duplicate abbreviations are specified in the latest edition of ASME Y14.38. Before such abbreviations are used, care should be exercised to ensure the proper meaning will be correctly interpreted by the drawing end users.

8.2.2 Acronyms

- The use of acronyms for industrial and professional societies (e.g., ASME, ANSI, AWS [American Welding Society], and IEEE [Institute of Electrical and Electronic Engineers]) is acceptable. These professional societies' acronyms are used at all times in text and on the field of the drawing.
- Non-industry-accepted acronyms should be avoided. However, if repeated use of a word in text (e.g., general notes) makes the use of an acronym an obvious advantage, the acronym may be created. Hanford site-specific acronyms are clearly defined by spelling out the acronym in the LEGEND or in a general note.

8.3 Symbology

8.3.1. General Requirements

Symbology used on new drawings that defines components shall be traceable to a LEGEND placed on the drawing or a separate legend drawing maintained for the system or facility. See [Section 8.3.2](#). If additional symbology is needed which is not covered in Section 8.3.2, industry accepted standards are used to the fullest extent possible with the symbology placed in a LEGEND on the drawing. Revision to existing drawings shall utilize the existing drawing legend with additions as required. Symbols used with the metric system (e.g., mm, Pa) need not be identified or referenced.

8.3.2 New Process Flow Diagrams (PFD) and Piping & Instrumentation Diagrams (P&ID) Master Legend Drawings

New PFDs, P&IDs, Electrical Elementary and One-Line, and Electrical Plan drawings generated for use at the Hanford Site shall comply with the symbology specified by the following drawings and/or as specified by the system Design Authority. See [Section 5.9](#), CAD Auxiliary Support Files/Information

H-9-6010 Sheets 1 thru 6, Master PFD and P&ID Legend,

H-9-6015 Sheet 1, Master Abbreviations,

H-9-6020 Sheets 1 and 2, Master Electrical Elementary and One-Line Legend,

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H-9-6021 Sheet 1, Master Electrical Plan Legend.

These drawings are the master listing of symbols for new PFDs and P&IDs, Elementary and One-Line diagrams, and Electrical Plan drawings and are *not* to be used directly as legends for drawings. Each symbol on a PFD or P&ID shall be traceable to a legend. Unless otherwise directed by the FH Design Authority (DA) all drawing shall have a legend on the drawing or reference to a legend drawing developed using these criteria and prepared by the vendor.

Copies of the symbology master listing drawings are available through the FH project POC.

8.3.3 Optional Symbology (Drafting Aids)

The symbology specified by the following drawings is optional. It is provided as a drafting aid to increase efficiency in producing/revising drawings, and is not used for new PFD or P&ID drawing legends. See [Section 5.9](#), CAD Auxiliary Support Files/Information. There are a number of old legacy symbols in these drawings and care needs to be taken not to use the legacy symbology unless directed by the DA.

H-6-14982	Hanford Standard, General Symbology,
H-6-14983	Hanford Standard, Civil Symbology,
H-6-14984	Hanford Standard, Structural Symbology,
H-6-14985	Hanford Standard, Architectural Symbology,
H-6-14986	Hanford Standard, Machine Symbology,
H-6-14987	Hanford Standard, HVAC Symbology,
H-6-14988	Hanford Standard, Fire Protection Symbology,
H-6-14989	Hanford Standard, Control Systems Symbology,
H-6-14990	Hanford Standard, Electrical Symbology,
H-6-14991	Hanford Standard, Piping Symbology.

8.4 Criticality Dimensions

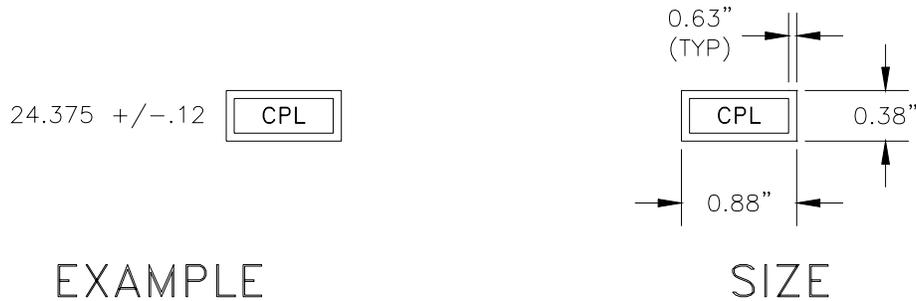
Under the direction of the DA, dimensions defined as Criticality Prevention Limit (CPL) dimensions are identified on the face of a drawing as illustrated in the Figure 12 below. A Criticality Engineer is responsible for critical dimensioning practices and determines the need for the placement of the criticality symbol on a drawing. When the symbol is included, a general note defining the symbol and a reference to definitions is added to the General Notes.

- Placement

The CPL symbol is placed immediately after the designed dimension. Each CPL dimension needs its own tolerance, for example, 3' -7" + 1/8" or 7" + 1/16".

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**FIGURE 12,
CPL Symbol**



- Size
The CPL symbol is drawn as a double-lined rectangle (1/16" line separation) with the letters "CPL" centered inside the symbol box, as shown.
- General Note
When the CPL symbol is used on a drawing, the following general note is added:

"THE CRITICALITY PREVENTION LIMIT DIMENSIONS (CPL) IDENTIFIED IN THE DOUBLE BOX SYMBOL ARE CRITICAL DIMENSIONS AND NEED VERIFICATION AND DOCUMENTATION IN THE WORK PACKAGE AND AT FABRICATION OR INSTALLATION BY QUALITY ASSURANCE INSPECTION."

8.5 Legibility

Drawings shall be prepared so prints are legible when reduced on microfilm and then re-enlarged. As an example, parallel lines have at least 1.5 mm (.06") spacing on the hard copy drawing to maintain distinction. The final released drawing has to be capable of passing a fifth-generation copy test. See definition in [Appendix A](#), Glossary.

8.6 Drawing List

A drawing list is placed on the first drawing in the project set of 20 or more drawings. The drawing list may be placed on a separate or title sheet. The list contains, as a minimum, the following information:

- Drawing numbers
- Drawing index number
- Building numbers (if more than one building is involved in the project)
- Title of each drawing
- Vendor information (VI) lists
- Specifications.

For multiple-sheet drawings, the number of sheets may be shown without repeating the rest of the information (e.g., H-1-12345, SH 6), provided all the information is identical. When listing specifications or vendor information, the Hanford retrieval number is listed next to the title.

8.7 Lettering

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For CAD-developed drawings, lettering is all upper case Gothic as defined in ANSI Y14.2M, *Line Conventions and Lettering* (i.e., AutoCAD's supplied fonts ROMANS and ROMAND are considered to be in compliance with ANSI Y14.2M). Letter height is a minimum of 3 mm (.12"), except where lower case letters or metric symbols are used (e.g., mm and g). Lower case letters and symbols are to be proportional. A minimum height of 2.5 mm (.1") is allowed in cases where smaller letter height is needed (e.g., mapping). Also, see [Section 5.8](#), Shape Files and Non-Standard Fonts.

8.8 Drawing Orientation (North Arrow)

North is oriented to the top or left side of the sheet. Exceptions are allowed where modifications are being made to existing facilities for which the orientation of the existing drawings is different or where industry practices dictate (e.g., civil drawings showing plan view strips with corresponding profiles). All plans on a given set of drawings are oriented the same and match the existing plant drawing orientation. A north arrow is placed and properly oriented on all maps, plans, layouts, and other drawings where applicable.

8.9 Coordinate System and Geodetic Elevation Data

For new construction, the coordinates and elevation is as follows:

- **Coordinates** - The Washington Coordinate System of 1983, south zone (1991) (WCS83S[1991]).
- **Elevation Data** - The North American Vertical Datum of 1988 (NAVD88).

8.10 Parts/Material List

A parts/material list are used on fabrication and assembly drawings, but not on project construction drawings where a separate specification control materials. See Figure 13. If additional clarification is needed, contact the CAD and Drawing Technical Authority through the FH project POC. For additional guidance see [Appendix D](#), Parts/Material List Recommended Practices.

**FIGURE 13
Drawing Types and Classifications**

Engineering Drawing Type	Parts/Mat'l List Not Used	Formal Parts/Mat'l List, Required (See Code Key Below)	Material Call-Out On Field Of Drawing (See Code Key Below)
Architectural			All
Civil			All
Structural		1	5
Electrical		1-4	5
Piping		1-2-3	5
Instrumentation		1-4-5	5
Heating, Ventilation, and Air Conditioning		1-2-6	5
Mechanical		1	5
Drawing Classification			
Fabrication		All	
Construction		4	5

NOTE: Before each use, check RMIS to ensure this copy is current.

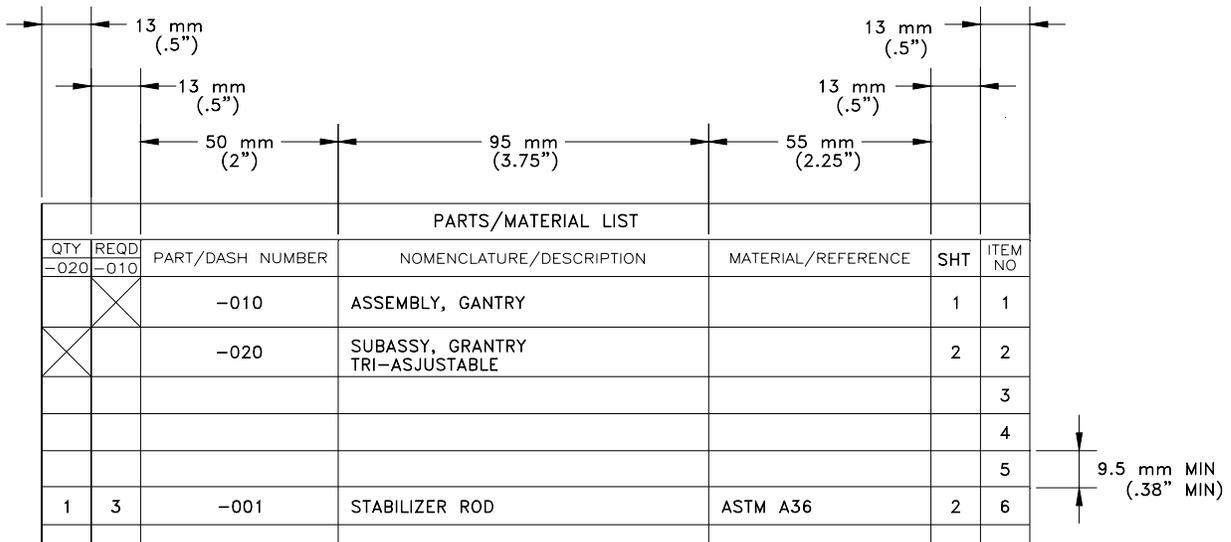
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Altered Item		1	5
Specification Control			All
Non-Fabrication/Construction, i.e., maps, conceptual layouts, cell arrangements, diagrams, schematics, wire run list, drawings made for operational use.	All		

Code Key for Figure 13

1. Fabrication or shop-oriented drawings
2. In parts/material list description column, enter all pipe ells, tees, etc., as "size of pipe and miscellaneous fittings"
3. Prefabricated
4. Electrical, instrumentation, and HVAC disciplines (non-project)
5. Project construction type drawings
6. Process hood systems (supply and exhaust) and process exhaust systems drawings only

**FIGURE 14
Parts/Material List Placement**



8.10.1 Arrangement and Size

The minimum width of the Parts/Material List block having one quantity column is 239 mm (9.5"). See [Figure 14](#). Quantity columns may be added as necessary. The parts/material list is located, or begins, in the upper right-hand corner on the first sheet of the drawing.

8.10.2. Contents

The parts/material list contains all material and separable components on the drawing. The individual pieces of weldments or other inseparable assemblies normally are not numbered separately.

8.10.3 Part Arrangement/Order

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The parts/material list should be arranged in a hierarchy (i.e., assemblies, subassemblies, detail parts, catalog items). It is unnecessary to rearrange the parts/material list merely to add a later entry.

8.10.4 Part Number

Unique part numbers are assigned where control of a design configuration (i.e., assembly, subassembly and detail) is controlled on an H series drawing. A part number is used to uniquely identify a specific item. Non-interchangeable items are identified with separate and unique part numbers.

The official part number is the drawing number and the assigned dash number. When a part number is referenced, both the drawing number and the dash number are needed. See definition of dash number in [Appendix A](#), Glossary

8.10.5 Parts and Assembly Numbers

Each assembly, subassembly, and detailed part is assigned a separate and unique part (dash) number. The primary assembly is assigned the -010 dash number. Additional assemblies and subassemblies are assigned every tenth number consecutively (i.e., -020, -030, -040, etc). The first detailed part is assigned the -001 dash number. Additional detailed parts are assigned -002, -003, -004, etc., with every tenth digit reserved for assemblies.

8.10.6 Interchangeable Parts

Interchangeable parts are equivalent in performance and durability. They are capable of being exchanged one for the other without alteration of the item or of adjoining items, except for nominal adjustment. They are also interchangeable in terms of fit and performance. Interchangeability is also explained in general notes with a statement in the parts/material list to see the applicable general note.

8.10.7. Part Number Revisions

The parts/materials list periodically need to be revised and/or material deletions due to fabrication changes or modifications to the original design. The following are accepted methods for changing the parts/material list, when accompanied by an Design Change Notice (DCN), or Facility Modification Package (FMP):

- Remove a part or material item by placing a double line through the part or material item (e.g., CAD or manual drawings).
- Remove a part or material item and add the word “Deleted,” in place of the part or material item (e.g., CAD revision).

10.8.8 New Part Number

New part numbers, including applicable altered item part numbers are assigned when the design of a part, fabricated assembly, or procured item is changed, see [Section 8.10.4](#), Part Number. The following conditions determine if a new part number is needed:

- Performance or durability is affected to the extent superseded items have to be discarded for reasons of safety, failure, or malfunction.
- Parts, assemblies, or subassemblies are changed so the new designs are not directly and completely interchangeable with respect to installation and/or specified performance.

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- When replaced/redesigned parts are limited to use in specific applications and the newly designed items are not so limited.
- When an existing Hanford item, or vendors' purchased item, needs alteration.
- When existing items cannot be reworked to be directly and completely interchangeable with the new design.

NOTE: New materials are added at the end of the parts/materials list using sequential part numbers. Part numbers are not to be reused for new or different parts/material. New part numbers are assigned.

10.8.9 Purchased Items

Purchased items are identified in the parts/materials list with the manufacturer's part number or vendor information (VI) number as applicable. These items are normally controlled by the vendor, by industrial or government codes, standards, or file number.

10.8.10 Altered Item

If the design of a vendor-supplied item is altered after purchase for an existing Hanford Site application (documentation may be contained in a VI file), or for use in a new engineering design, the following applies:

“ALTERED FROM (manufacturer's part number and part name or existing Hanford part number and part name)” is recorded in the description column of the parts list.

A new Hanford part number is assigned and placed in the part number column.

The alteration is detailed by visible lines in accordance with ASME Y14.2M-1992, *Line Conventions and Lettering*. Reference features (features not needing alteration) are limited to orientation for describing where designated alterations are being made. Reference features are shown by phantom lines in accordance with ASME Y14.2M.

10.8.11 Quantities and Customary Trade Units

Quantities are counted accurately and shown in customary trade units.

10.8.12 As Required (AR) Designation

The letters AR (as required) is used where the quantity is not known, or where the quantity could vary.

10.8.13 Part Description

The part description is to be generic, except where a specific item is needed, and the design depends on or is tailored to the specific item. The name of the item is listed first with supplemental descriptive words following. The description of an item is to be complete and provide specifications sufficient to procure the item.

Standard industry language is used to define the item. If the item can be completely described in the parts/materials list, it is not delineated on the drawing. If description/specification is lengthy, it may be in the general notes or in a separate specification. If the description/specification is placed in the general notes or in a separate specification, the general note or separate specification is referenced in the description column of the parts list, as needed.

Off-Site Vendor Directions for Preparation and Control of Engineering Drawings

9.0 COMPONENT NUMBERING

Off-site architect/engineers obtain component numbers from the appropriate contractor's point-of-contact.

10.0 METRIC MEASUREMENT SYSTEM

The following is applicable for all drawings where the metric system measurement is specified in the contract.

- Metric designations (e.g., mm) are considered symbols and are used to the fullest extent possible.
- Where metric system (SI) symbology, as identified in the latest edition of ANSI/IEEE Standard 268, *American National Standard for Metric Practice*, differs from what appears in ASME Y14.38, the appropriate metric symbols are used.
- Modifications to drawings containing English units may continue to use the English system unless otherwise specified by the DA.

10.1 Metric Measurement

In designs specifying metric system of measurement, hard metric measurements are used to the fullest extent (i.e., the inch/pound system is **not** used in the design development and then applied to the design by converting the inch/pound measurements to metric measurements). This is considered "soft metric conversion," as opposed to hard metric conversion. See definitions in [Appendix A](#), Glossary.

10.2 Metric Dimensioning

- Linear dimensions on engineering drawings are shown in millimeters, except on large site plans and civil drawings. Large site plans and civil drawings show linear dimensions in meters, which are always carried to one, two, or three decimal places.
- Commas are **not** used in metric system numbers. Spaces are used in place of commas to separate digits into groups of three (e.g., 1 500 000 mm). However, four-digit numbers are not separated by a space (e.g., 5000 m). A space always separates the numeric value from the measurement unit, but the number and the unit are **never** separated between the lines of text.
- Metric dimensions and unit symbols are always in upright type (i.e., vertical lettering), even when the surrounding text is in italics.
- When area is being specified, square meters or sub-multiples are used (e.g., m², cm², and mm²). Fluid volumes are specified in liters (symbol is upper case L), except large volumes may be expressed in cubic meters (m³) (e.g., 1000 L = 1 m³).
- Dual dimensioning (both inch/pound and metric shown for the same dimension) should be avoided. In cases where dual dimensioning is determined to be needed, the following applies:
 - Metric dimensions are shown first with the inch/pound equivalent shown in parentheses
 - A general note is added to the drawing stating the inch/pound dimensions shown in parentheses are equivalent to the metric dimensions they follow
 - Tolerances for the inch/pound dimension, where necessary, are shown at each occurrence

10.3 Metric Notation

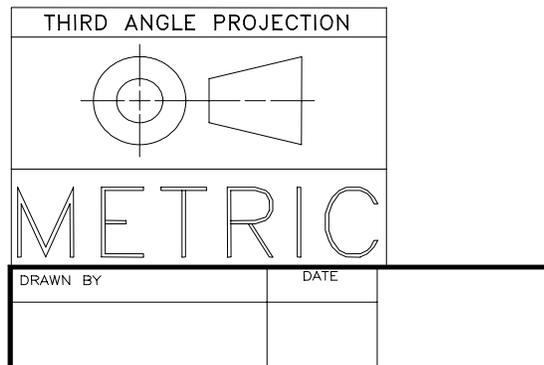
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Drawings delineated in the metric system have the word “METRIC” placed directly above the Title Block in 6 mm bold gothic lettering as defined by ANSI Y14.2M-1992. See [Figure 16](#) and [Figure 5](#).

10.4 Third Angle Projection

All drawings developed using the multi-view system of orthographic presentation as specified in ASME Y14.3M-1994, *Multi and Sectional View Drawings*, use the third angle projection method. On metric drawings, the international projection symbol and the words “THIRD ANGLE PROJECTION” is placed directly above the metric notation. See [Figure 16](#) and [Figure 17](#).

FIGURE 16
International Projection Symbol



10.5 Converted Metric Designations

Converted metric designations are designations of materials and parts converted from the inch/pound system (e.g., 2" pipe converted to DN 50 pipe; 2x4 lumber stud converted to 50 x 100 mm lumber stud). These conversions are made where items can be equivalently identified by metric designation.

Many industrial products have been given metric designations by the appropriate industry organizations. In some cases where designations lose their proper meaning, inch or metric equivalents are never shown (e.g., 1/4-20 thread loses its proper meaning if designated as 6.35 mm-20 thread; conversely, a 6 mm-20 thread loses its proper meaning if designated as a .236-20 thread)

11.0 REVISIONS

- When a drawing is revised, the complete authorizing change document number is placed in the revision description block, e.g., ECN and or FMP.

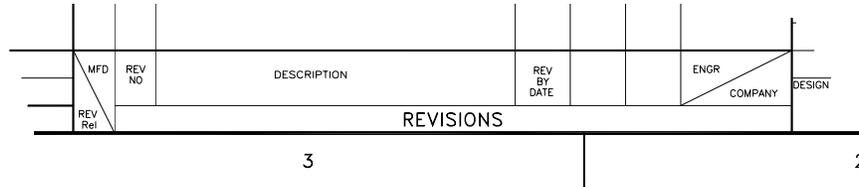
11.1 Revisions Block Size and Location

REVISION blocks on new drawings are sized according to ANSI Y14.1, and configured as shown in [Figure 17](#). Location of the block is according to the drawing arrangement format. See [Figure 5](#).

FIGURE 17

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Typical Revision Block



11.2 Description

The authorizing engineering change document is identified in the revision description (e.g., Engineering Change Notice). Conservation of space is essential; therefore, ANSI abbreviations are used to the best advantage.

11.3 Revision Numbers

When revising multiple-sheet drawings, each sheet is considered a separate drawing. Revision numbers are advanced only on the sheet or sheets being affected by the change.

11.4 Change Incorporation - For Drawings that are Maintained in the Hanford Drawing System

The authorizing FMP/ECN number is shown in the REVISIONS Block (e.g., REVISED PER FMP/ECN [number]).

12.0 Working References

- ANSI/ASME Y14 Series, *Drafting Practices*
- ANSI/IEEE Standard 268-1992, *American National Standard for Metric Practice*
- ANSI Y14.1-1980 (R1987), *Drawing Sheet Size and Format*
- ASME Y14.1M-1995, *Metric Drawing Sheet Size and Format*
- ANSI Y14.5M (R1982), *Dimensioning and Tolerance*
- ASME Y14.1M-1992, *Metric Drawing Sheet Size and Format*
- ASME Y14.2M-1992, *Line Conventions and Lettering*
- ASME Y14.3M-1994, *Multi and Sectional View Drawings*
- ASME Y14.38-1994, *Abbreviations and Acronyms*
- Data Value Standard, Protocol Standard, Plane Coordinates
- Data Value Standard, Protocol Standard, Geodetic Elevation Data
- Federal Standard 376B, *Preferred Metric Units for General Use by the Federal Government*

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Altered-Item Drawing: An engineering drawing used to control and depict the alterations to a commercial item. An altered-item drawing reflects only the change and is not intended to show complete fabrication details.

Applied Material: Material that is not normally shown on the graphic presentation of a drawing (e.g., glues, adhesive, paint, cleaner). It may or may not have a manufacturer's identification number. Applied material normally is identified in the General Notes and its application explained, as needed. Weld rod is excluded from this definition.

Archive: Off line storage of previous document revisions

Arrangement/Installation Drawing: The top level drawing where multiple related details, assemblies, subassemblies, and certain connecting parts and/or instructions are shown depicting the final arrangement.

As Required (AR): A notation used when an exact quantity is not known or cannot be easily predetermined. The notation is placed in the "Quantity Required" column of the parts list.

Assembly: A term used to describe parts and/or subassemblies joined to complete a designed relationship.

NOTE: In view of the difficulty, in some cases, in establishing a clear distinction between the terms "assemblies" and "subassemblies," these two terms may be considered to have the same meaning and may be used interchangeably.

Brand Name: For the purpose of this guideline, brand name implies the manufacturer, model, catalog name/number, trademark, or identifying name other than generic.

EDMS Check In: Copy a new unreleased/unapproved version of the document to the system and change of status so that others may check out and modify the document.

EDMS Check Out: Copy the document to an individuals work space and the change of status that locks the file so others may not modify it.

Component Number: A component number consists of letters and/or numbers that initially serve to uniquely identify a type of equipment/instrument. The component number identifies the relative location of the component on a schematic, flow diagram, one-line, or similar type of engineering drawing. After completion of fabrication/construction and installation, the component number serves as a key in various maintenance and operational activities.

Computer-Aided Design (CAD) Data Set: The CAD data set is the computer data file used to produce a hard copy engineering drawing.

Dash Number: A dash number is a unique numerical identification assigned to an item whose design is controlled by the drawing. When suffixed to the drawing number, the dash number provides a unique part number (see Part Number definition) for that item. A dash number is assigned where two or more items or an assembly are depicted on a drawing. The dash number consists of three digits and is assigned as follows:

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Assemblies. Every tenth number is reserved for assemblies (e.g., -010, -020, -030, -040). **Parts.** -001 for the first part and consecutively for all others, reserving every tenth number for assemblies (e.g., -001 through 009; -011 through -019; etc.).

Design Authority: The engineer that has the authority to authorize changes to a design documents; see HNF-RD-1819, *FH Engineering Requirements*.

Detailed (Piece Parts) Item: An individual item or units of material needing a specific part (dash) number identification because of traceability and accountability needs for that item.

Document Control: The Records Information Management (RIM) contractor that maintains configuration management of engineering documents that are approved and released into the Hanford Document Control System (HDCS).

Engineering Document: An approved and released engineering specification, criteria, graphic representation of a facility system, structure and/or component that needs lifetime retention. This can be the original signed document and/or the electronic version of an engineering document.

Engineering Drawing: An engineering drawing, including architectural and civil, prepared either manually or on a CAD system, that depicts by means of graphics, pictorial, and textual presentations, the form, fit, and function needs of an item.

Fifth-Generation Copy Test: For the purposes of this guideline, a fifth-generation copy test consists of making a full size copy (first-generation copy) from the original document, using a high quality copier. Then making a copy of the copy (second-generation); then a copy of that copy (third-generation copy), etc., until the fifth-generation copy is achieved. The graphics and text of the fifth-generation copy have to be clearly legible without magnification, special lenses, or editing.

Final Plot: The plotted version of an engineering drawing that is the original document used for approval, release and microfilmed.

Hard Copy Drawing: The plotted/printed copy of an engineering Drawing.

Hard Metric Conversion: The process of changing measurement language to nonequivalent metric units, usually necessitating changes in the actual physical size and configuration of the part, product, or process that exceed those permitted by established measurement tolerance. Also see glossary for soft metric conversion, inch/pound measurement, and International System of Units (SI).

Hardware Item: Fasteners that may or may not need material identification (e.g., ASTM, and SAE).

Inch/Pound Measurement: Inch/pound measurements are units of the English measurement system (e.g., inches, pounds, degrees Fahrenheit, gallons). The formally recognized inch/pound units are the foot and the pound as defined by the National Institute of Standards and Technology (NIST).

Inseparable Assembly: Parts/material joined in such a manner that they are incapable of being disassembled without destroying the intended function of the item (e.g., weldments, bonded assembly).

International System of Units (SI): SI is the name of the modern metric measurement system approved by the 11th General Conference on Weights and Measures (CGPM) in 1960. It is adopted by worldwide

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standard setting organizations such as ISO, ANSI, German Institute of Standards (DIN), Japan Instrument Society (JIS), and Center for Studies of Nuclear Energy (CEN).

Item Number: A number assigned to every line entry of a Parts/Materials Lists to tabulate items in the list. It is also used to locate an item in the field of the drawing and is not used for unique identification purposes.

Material Item: Material used in an inseparable assembly whose final configuration is contained within the configuration of that assembly (e.g., a weldment). Also, see Inseparable Assembly definition.

Master File: The last formally released CAD data file containing the electronic drawing used to plot/print the hard copy drawing that is approved and released. This file needs special handling to ensure that it is available for subsequent revision of the engineering drawing.

Metadata: Data embedded in a document that provides information about the data file (data about data). Examples include Drawing Number, Sheet Number, and revision number.

Microfilm: A photographic copy of a document that is stored on 35 mm film. There are two types of microfilm, silver halide and diazo. The silver halide negative is used as the record file copy and the diazo is called the working copy that is normally placed in microfilm files and used to produce half size blow back copies of the photographed original approved drawing.

Part Number: A part number consists of letters, numbers, or combinations of letters and numbers that may or may not be separated by dashes and are assigned to uniquely identify a specific item. Part Numbers assigned to Hanford “H” series drawings consist of the drawing number plus a dash number.

EXAMPLE: <i>H-3-60670-010</i>
<i>-010</i> is the Dash Number
<i>H-3-60670</i> is the Drawing Number

Parts/Materials List: A tabulation of parts and/or material needed for constructing, fabricating, or procuring the items depicted on a drawing.

Release: The formal process of making an engineering drawing the current controlled revision and placing the original approved hard copy in formal drawing storage and retention of the associated CAD data set in the Hanford Engineering Document Management System.

Revision: The formal act of changing an engineering drawing. Revisions are formally approved and released into the Hanford drawing system to complete the action. The revised drawing replaces the previously approved and released drawing, which is placed into archive. Revisions are represented by a whole number, such as Revision 3, 4, 5,

Scan: The creation of a raster image of a document that is stored in an electronic data file.

Soft Metric Conversion: The process of changing measurement language from inch/pound measurement units to equivalent metric units within acceptable measurement tolerances without changing the actual physical size of the configuration of the part, product, or process. Also, see Hard Metric Conversion and Inch/Pound Measurement definitions.

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Subassembly: An assembled unit designed to be incorporated with other units. See definition of Assembly.

Thumbnail: A very small raster image of an electronic file that is used for recognition purposes and used to locate electronic files of sheets of electronic files.

Two-Way Traceability: Two-way traceability is cross-referencing existing engineering drawings affected by a new design or modification and vice versa.

Vendor Drawing: A drawing prepared by a vendor according to his/her drawing requirements that provides information on configuration, installation, maintenance, and/or operation.

Vendor (Supplier) Item: An item procured from an off-site manufacturer that has specific functional and physical features needed to obtain the end-product and has a specific part number identification assigned by the manufacturer.

Versions: An in process control mechanism used to control revisions before the revision is formally approved and released. The electronics files of a document are called versions and are maintained in the Engineering Document Management System (Work in Process, see definition). Example 1.2, 3.1 5.2

Work In Process: The process of saving and restoring working versions of an electronic document before its final approval and release into the Hanford document system.

Workflow: The electronic movement of a document through a defined process to assure that specified actions are completed before advancing the electronic file on to the next reviewer or to the originator.

X-Reference: This is an AutoCAD program feature that allows drawing data to be shared between data files. The shared data is not permanently part of the drawing until the X-Reference data is bound into the master (main) data file.

APPENDIX B
Layer Naming for AutoCAD Drawings by Discipline

TABLE 1
Startup Layer Naming
General Layering For All Disciplines

NOTE: Selected layers from the general layering for all disciplines are added to the drawing setup models as determined appropriate and necessary to define and separate drawing data.

Layer Name	Description	Line Color	Line Type	Plotter Pen Number
AutoCAD Program				
0	AutoCAD generated. Not for project drawings; used for symbol creation	White	Continuous	Pen No. 2
DEFPOINTS	AutoCAD generated; associative dimensioning definition points automatically on this layer; used for display, only, as AutoCAD does not print this layer.	White	Continuous	Pen No. 2
General Layers				
*?O-BRD	Title block, associated blocks, and drawing border	132	Continuous	Pen No. 2
*?M-DIM	Dimensioning	253	Continuous	Pen No. 1
*?T-TXT	General text not associated with a specific layer	White	Continuous	Pen No. 2
*?T-BTXT	Bold text	Yellow	Continuous	Pen No. 4
*?T-REF	Reference items and notes that aid CAD uses during construction of the drawing	213	Continuous	Pen No. 1
*?T-CHK	Checker's marks (informal only)	11	Continuous	Pen No. 3
*?O-VPT	Paper space Viewport border	White	Continuous	Pen No. 2
*?O-CLD	Clouded areas for Hold, FMP/ECN, and revision	White	Continuous	Pen No. 2
*?E-EXST	Anything existing to remain	8	Phantom	Pen No. 1
*?D-DEMO	Existing items /equipment required to be removed or demolished	Cyan	HiddenX2	Pen No. 3
*?C-CLINE	Center line	Blue	Center	Pen No. 2
*?X-HATCH	Cross-section lines	Blue	Continuous	Pen No. 2
*?H-HIDL	Hidden lines	Blue	Hidden	Pen No. 2
*?V-MLN	Matchlines	Red	Phantom	Pen No. 5

* The "?" in the layer name is replaced with the correct Discipline Identifier. See section 2.3.1.c.

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Layer Naming for AutoCAD Drawings by Discipline

TABLE 2
Startup Layer Naming
Architectural Drawings

NOTE: When additional layers are created to specify discipline information, other than architectural, the object/function identifier from the appropriate discipline table should be used to define the drawing data. As appropriate, the architectural discipline identifier should be used and the applicable plotter pen number assigned.

Layer Name	Description	Line Color	Line Type	Plotter Pen Number
General Layers				
AO-BRD	Title block, associated blocks, and drawing border	132	Continuous	Pen No. 2
AM-DIM	Dimensioning	253	Continuous	Pen No. 1
AT-TXT	General text not associated with a specific layer	White	Continuous	Pen No. 2
AT-BTXT	Bold text	Yellow	Continuous	Pen No. 4
AT-REF	Reference items and notes that aid CAD users during construction of the drawing	213	Continuous	Pen No. 1
AO-VPT	Paper space Viewport border	White	Continuous	Pen No. 2
AO-CLD	Clouded areas for Hold, FMP/ECN, and revision	White	Continuous	Pen No. 2
AE-EXST	Anything existing to remain	8	Phantom	Pen No. 1
AD-DEMO	Existing items /equipment required to be removed or demolished	Cyan	HiddenX2	Pen No. 3
AX-HATCH	Cross-section lines	Blue	Continuous	Pen No. 2
AV-MLN	Matchlines	Red	Phantom	Pen No. 5
Specific Layers				
AO-ACCESSORY	Accessory items - including furniture, HVAC equipment, plumbing fixtures, people, trees, vehicles, etc.	White	Continuous	Pen No. 2
AO-CEILING	Ceiling - SATC, hanger wires, etc.	White	Continuous	Pen No. 2
AC-COLUMN	Building column lines	White	Center	Pen No. 2
AO-DOOR	Interior and exterior	Magenta	Continuous	Pen No. 2
AO-DOORSPEC	Door tag (Architectural Steering Group users only)	White	Continuous	Pen No. 2
AO-FLOOR	Floor plan and background	8	Continuous	Pen No. 2
AO-HEADER	Door header (use with ceiling plan)	White	Continuous	Pen No. 2
AO-SCHEDULE	Room, door, finish, and window	Cyan	Continuous	Pen No. 3
AO-STAIR	Interior and exterior	White	Continuous	Pen No. 2
AO-TAG	Tags for miscellaneous equipment, windows, etc.	White	Continuous	Pen No. 2
AO-WALLS	Interior and exterior	Cyan	Continuous	Pen No. 3
AO-WINDOWS	Interior and exterior	White	Continuous	Pen No. 2

APPENDIX B

Layer Naming for AutoCAD Drawings by Discipline

TABLE 3
Startup Layer Naming
Civil/Structural/Environmental Drawings

NOTE: When civil and structural items exist in the same drawing, use both layer naming as applicable.

Layer Name	Description	Line Color	Line Type	Plotter Pen Number
General Layers				
*?O-BRD	Title block, associated blocks, and drawing border	132	Continuous	Pen No. 2
*?T-TXT	General text not associated with a specific layer	White	Continuous	Pen No. 2
*?T-REF	Reference items and notes that aid CAD users during construction of the drawing	213	Continuous	Pen No. 1
*?O-VPT	Paper space Viewport border	White	Continuous	Pen No. 2
*?V-MLN	Matchlines	Red	Phantom	Pen No. 5
* Specified general layers are used in both the civil and structural drawings. The "?" is replaced with the correct Discipline Identifier; see Section 2.3.1.c.				
Civil Drawing Specific Layers				
CO-GRID	Site Grids, Profile Grids, etc.	253	Continuous	Pen No. 1
CO-SITE	Property lines, boundaries, fences, etc.	60	Continuous	Pen No. 4
CO-ROAD	Roads, trails, parking, etc.	10	Continuous	Pen No. 4
CO-STRL	Structural work	210	Continuous	Pen No. 4
CO-GND	Contours, grade breaks, etc.	Green	Continuous	Pen No. 4
CO-PIPE	Pipelines and piping	Yellow	Continuous	Pen No. 4
Structural Drawing Specific Layers				
SC-GRID	Building column grid	253	Center	Pen No. 1
SO-GND	Grade or earth shown on sections	Green	Continuous	Pen No. 4
SO-CONC	Concrete	Yellow	Continuous	Pen No. 4
SO-FRWK	Framework	Cyan	Continuous	Pen No. 3
SO-RBR	Rebar	130	Continuous	Pen No. 4
SO-MECH	Piping or other mechanical	11	Continuous	Pen No. 3
SO-EMBED	Embedments	131	Continuous	Pen No. 3
SO-STL	Steel	130	Continuous	Pen No. 4

APPENDIX B

Layer Naming for AutoCAD Drawings by Discipline

TABLE 4
Startup Layer Naming
Electrical Drawings

Layer Name	Description	Line Color	Line Type	Plotter Pen Number
General Layers				
*EO-BRD	Title block, associated blocks, and drawing border	132	Continuous	Pen No. 2
EM-DIM	Dimensioning	253	Continuous	Pen No. 1
ET-TXT	General text not associated with a specific layer	White	Continuous	Pen No. 2
ET-BTXT	Bold text	Yellow	Continuous	Pen No. 4
* Specified general layers are used in both the LGT/SITE and DIAG/SCHED drawings.				
Lighting/Site Drawing Specific Layers				
EE-BKG	Background	8	Phantom2	Pen No. 1
EO-BLD	Building	171	Continuous	Pen No. 3
EO-CND	Conduit, cable, raceway, boxes, ductbanks	51	Continuous	Pen No. 3
EO-CPT	Cathodic protection	11	Continuous	Pen No. 3
EO-EQP	Equipment	211	Continuous	Pen No. 3
EO-LTG	Lighting	Cyan	Continuous	Pen No. 3
EO-MS1	Electric miscellaneous 1	32	Continuous	Pen No. 2
EO-MS2	Electric miscellaneous 2	51	Continuous	Pen No. 3
EO-OHD	Overhead lines	11	Continuous	Pen No. 3
EO-RCP	Receptacles, (120, 208, 480V)	Cyan	Continuous	Pen No. 3
EO-SGD	Signaling devices	211	Continuous	Pen No. 3
EO-UGD	Underground lines (hidden)	13	Hidden	Pen No. 1
Diagram/Schedule Drawing Specific Layers				
EO-DIA	Diagrams, one-line, elementary, etc.	91	Continuous	Pen No. 3
EO-MS1	Electric miscellaneous 1	32	Continuous	Pen No. 2
EO-MS2	Electric miscellaneous 2	51	Continuous	Pen No. 3

APPENDIX B
Layer Naming for AutoCAD Drawings by Discipline

TABLE 5
Startup Layer Naming
Fire Protection Drawings

Layer Name	Description	Line Color	Line Type	Plotter Pen Number
*General Layers				
FO-BRD	Title block, associated blocks, and drawing border	132	Continuous	Pen No. 2
*FM-DIM	Dimensioning	253	Continuous	Pen No. 1
FT-TXT	General text not associated with a specific layer	White	Continuous	Pen No. 2
FT-BTXT	Bold text	Yellow	Continuous	Pen No. 4
FE-EXST	Anything existing to remain	8	Phantom	Pen No. 1
FD-DEMO	Existing items /equipment required to be removed or demolished	Cyan	HiddenX2	Pen No. 3
**FC-CLINE	Center line	Blue	Center	Pen No. 2
FV-MLN	Matchlines	Red	Phantom	Pen No. 5
Fire Detection Drawing Specific Layers				
FO-AD	Alarm and detection system	211	Continuous	Pen No. 3
FO-FW	Fire water underground	211	Hidden	Pen No. 3
Sprinkler Drawing Specific Layers				
FO-FW	Fire water underground	211	Hidden	Pen No. 3
FO-SS	Sprinkler system	211	Continuous	Pen No. 3
FO-HS-1	Standpipe hose system	211	Continuous	Pen No. 3

* Specified general layers are used in both the fire detection and sprinkler drawings, except as noted.

** Sprinkler drawing only.

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Layer Naming for AutoCAD Drawings by Discipline

TABLE 6
Startup Layer Naming
HVAC Drawings

Layer Name	Description	Line Color	Line Type	Plotter Pen Number
*General Layers				
HO-BRD	Title block, associated blocks, and drawing border	132	Continuous	Pen No. 2
HM-DIM	Dimensioning	253	Continuous	Pen No. 1
HT-TXT	General text not associated with a specific layer	White	Continuous	Pen No. 2
HT-BTXT	Bold text	Yellow	Continuous	Pen No. 4
*HT-REF	Reference items and notes that aid CAD users during construction of the drawing	213	Continuous	Pen No. 1
**HO-VPT	Paper space Viewport border	White	Continuous	Pen No. 2
HV-MLN	Matchlines	Red	Phantom	Pen No. 5
* Specified general layers are used in both the HVAC and HVAC/Instrumentation Drawings, except as noted.				
** HVAC drawing only.				
HVAC Drawing Specific Layers				
HO-EQP	HVAC or piping equipment	51	Continuous	Pen No. 3
HO-EXH	HVAC exhaust system	171	Continuous	Pen No. 3
HO-PIP	Piping and piping fixtures and hardware	51	Continuous	Pen No. 3
HO-PLM	Plumbing and plumbing fixtures and hardware	201	Continuous	Pen No. 3
HO-RTN	HVAC return system	Cyan	Continuous	Pen No. 3
HO-SUP	HVAC supply system	51	Continuous	Pen No. 3
HVAC/Instrumentation Drawing Specific Layers				
IO-ELEC	Electrical equipment	71	Continuous	Pen No. 3
IO-DCS	Distributed control system instruments	Cyan	Continuous	Pen No. 3
IO-ELINE	Electrical signal lines	42	Hidden	Pen No. 2
IO-ILINE	Instrument lines, such as pneumatic	Magenta	Continuous	Pen No. 2
IO-CVAL	Control valves	Cyan	Continuous	Pen No. 3
IO-SLINE	Software link line	Magenta	Continuous	Pen No. 3

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Layer Naming for AutoCAD Drawings by Discipline

TABLE 7
Startup Layer Naming
Instrumentation & Control (I&C) Drawings

NOTE: When creating additional layers to specify existing and future layers, the preferred color is 8, which is designated to Plotter Pen No. 1.

Layer Name	Description	Line Color	Line Type	Plotter Pen Number
*General Layers				
IO-BRD	Title block, associated blocks, and drawing border	132	Continuous	Pen No. 2
**IM-DIM	Dimensioning	253	Continuous	Pen No. 1
IT-TXT	General text not associated with a specific layer	White	Continuous	Pen No. 2
IT-BTXT	Bold text	Yellow	Continuous	Pen No. 4
IT-REF	Reference items and notes that aid CAD users during construction of the drawing	213	Continuous	Pen No. 1
IT-CHK	Checker's marks (informal only)	11	Continuous	Pen No. 3
IO-VPT	Paper space Viewport border	White	Continuous	Pen No. 2
IO-CLD	Clouded areas for Hold, FMP/ECN, and revision	White	Continuous	Pen No. 2
IE-EXST	Anything existing to remain	8	Phantom	Pen No. 1
ID-DEMO	Existing items /equipment required to be removed or demolished	Cyan	HiddenX2	Pen No. 3
IC-CLINE	Center line	Blue	Center	Pen No. 2
IX-HATCH	Cross section lines	Blue	Continuous	Pen No. 2
IH-HIDL	Hidden lines	Blue	Hidden	Pen No. 2
IV-MLN	Matchlines	Red	Phantom	Pen No. 5
* Applicable to all instrumentation and control drawings, except as noted.				
** Plans, Elevations, Details, and Assembly drawing only.				
P&ID Drawing Specific Layers				
IO-ELEC	Electrical equipment	71	Continuous	Pen No. 3
IO-INS	Instruments	211	Continuous	Pen No. 3
IO-DCS	Distributed control system instruments	Cyan	Continuous	Pen No. 3
IO-ELINE	Electrical signal lines	42	Hidden	Pen No. 2
IO-ILINE	Instrument lines, such as pneumatic	Magenta	Continuous	Pen No. 2
IO-CVAL	Control valves	Cyan	Continuous	Pen No. 3
IO-SLINE	Software link line	Magenta	Continuous	Pen No. 3
IO-EQP	Equipment	141	Continuous	Pen No. 3
IO-MAJ	Major process lines	Red	Continuous	Pen No. 5
IO-MIN	Minor process lines	Yellow	Continuous	Pen No. 4
IO-PROC	Process line	152	Continuous	Pen No. 2
IO-PIP	Piping valves and fittings	121	Continuous	Pen No. 3
Plans, Elevations, Details, and Assembly Drawing Specific Layers				
IO-TUBE	Tubing	52	Continuous	Pen No. 2
IO-BGND	Background	8	Continuous	Pen No. 1
IO-PIPE	Piping	12	Continuous	Pen No. 2
IO-BLDG	Building	8	Continuous	Pen No. 1
IO-EQP	Equipment	143	Continuous	Pen No. 1
IO-INS	Instruments	210	Continuous	Pen No. 4
IO-FRM	Panels, racks, cabinets	32	Continuous	Pen No. 2
IO-WRG	Wiring	92	Continuous	Pen No. 2
IO-CVAL	Control valve	130	Continuous	Pen No. 4
Wiring/Tubing Diagram Drawing Specific Layers				
IO-WRG	Wiring	Green	Continuous	Pen No. 4
IO-INS	Instruments	Magenta	Continuous	Pen No. 2
IO-DCS	Distributed control system instruments	132	Continuous	Pen No. 2
IO-TBLK	Terminal blocks	152	Continuous	Pen No. 2
IO-SLINE	Software lines	12	Continuous	Pen No. 2
IO-TUBE	Tubing	Yellow	Continuous	Pen No. 4
Logic/Block Diagram Drawing Specific Layers				
IO-GATE	Logic gate/memory latch	Green	Continuous	Pen No. 4
IO-SPATH	Software signal path	12	Continuous	Pen No. 2
IO-HPATH	Hardware signal path	152	Continuous	Pen No. 2
IO-INS	Instruments	211	Continuous	Pen No. 3
IO-DCS	Distributed control system instruments	Cyan	Continuous	Pen No. 3

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Layer Naming for AutoCAD Drawings by Discipline

TABLE 8
Startup Layer Naming
Mechanical Drawings

Layer Name	Description	Line Color	Line Type	Plotter Pen Number
General Layers				
MO-BRD	Title block, associated blocks, and drawing border	132	Continuous	Pen No. 2
MM-DIM	Dimensioning	253	Continuous	Pen No. 1
MT-TXT	General text not associated with a specific layer	White	Continuous	Pen No. 2
MT-BTXT	Bold text	Yellow	Continuous	Pen No. 4
MT-CHK	Checker's marks (informal only)	11	Continuous	Pen No. 3
MO-VPT	Paper space Viewport border	White	Continuous	Pen No. 2
MC-CLINE	Center line	Blue	Center	Pen No. 2
MX-HATCH	Cross-section lines	Blue	Continuous	Pen No. 2
MH-HIDL	Hidden lines	Blue	Hidden	Pen No. 2
MV-MLN	Matchlines	Red	Phantom	Pen No. 5
Specific Layers				
*MO-1DET	Detail	Yellow	Continuous	Pen No. 4
MO-2DET	Detail	Green	Continuous	Pen No. 4
MO-FAST	Fasteners	Cyan	Continuous	Pen No. 3
MO-VEND	Vendor information	8	Continuous	Pen No. 1
MP-PHANT	Moving parts, alternate positions, simplified drafting techniques, e.g., screw threads, springs	8	Phantom	Pen No. 1
MO-LAYOUT	Layout and/or construction lines	Magenta	Continuous	Pen No. 2

* Add auxiliary details as needed. Example: 3DET, etc.

APPENDIX B

Layer Naming for AutoCAD Drawings by Discipline

TABLE 9
Startup Layer Naming
Piping Drawings

Layer Name	Description	Line Color	Line Type	Plotter Pen Number
Piping Drawing, Jumper Assembly 1 Drawing, Jumper Assembly 2 Drawing, and Jumper Assembly 3 Drawing General Layers				
PO-BRD	Title block, associated blocks, and drawing border	132	Continuous	Pen No. 2
PM-DIM	Dimensioning	253	Continuous	Pen No. 1
PT-TXT	General text not associated with a specific layer	White	Continuous	Pen No. 2
PT-BTXT	Bold text	Yellow	Continuous	Pen No. 4
PT-REF	Reference items and notes that aid CAD users during construction of the drawing	213	Continuous	Pen No. 1
PO-VPT	Paper space Viewport border	White	Continuous	Pen No. 2
PO-CLD	Clouded areas for Hold, FMP/ECN, and revision	White	Continuous	Pen No. 2
PE-EXST	Anything existing to remain	8	Phantom	Pen No. 1
PD-DEMO	Existing items /equipment required to be removed or demolished	Cyan	HiddenX2	Pen No. 3
PC-CLINE	Center line	Blue	Center	Pen No. 2
PX-HATCH	Cross-section lines	Blue	Continuous	Pen No. 2
PH-HIDL	Hidden lines	Blue	Hidden	Pen No. 2
PV-MLN	Matchlines	Red	Phantom	Pen No. 5
Specific Layers				
PO-PIPINGS	Single-line pipe, valves and fittings	Yellow	Continuous	Pen No. 4
PO-PIPINGD	Double-line pipe, valves and fitting	52	Continuous	Pen No. 2
PO-EQP	Pumps, vessels, etc.	Magenta	Continuous	Pen No. 2
PO-GND	Grade	8	Continuous	Pen No. 1
PO-CONC	Concrete	8	Continuous	Pen No. 1
PO-STRUCT	New structures	8	Continuous	Pen No. 1
PO-PSUPT	Supports	White	Continuous	Pen No. 2

APPENDIX C

Preparation of Process Flow Diagrams

1.0 PURPOSE

This appendix applies to all new PFDs produced for FH. Modifications to existing PFDs may not be required to follow these directions; the FH project engineering point of contact shall be consulted for determination of whether or not to follow these directions. The direction shall be documented by the responsible FH engineering point of contact (email is acceptable).

2.0 SCOPE

This practice includes the following major sections:

- DEFINITIONS
- RESPONSIBILITY
- PROCESS
- MISCELLANEOUS PFDs
- REVIEW CYCLE
- REFERENCES
- ATTACHMENTS

3.0 APPLICATION

This practice applies to any project that requires development of a PFD.

The PFD accomplishes the following:

- Serves as a starting point for defining the process.
- Establishes interrelation between equipment and controls that will accomplish the process goal.
- Establishes material and energy balances and process conditions.
- Provides information to other disciplines actively involved in the design work.
- Provides a basis for equipment list and datasheets, line sizing, modes of control, instrument datasheets, P&IDs, safety evaluations, and material selection.
- Provides a check for overall process continuity and integrity.
- Serves as a basis for other system sketches, diagrams, and engineering documentation that includes the following:
 - Operating and design conditions
 - Materials selection, Materials Selection Diagram
 - Line sizing
 - Temperature and pressure profiles
 - Safety and isolation
 - Process Control philosophy
 - Control and non-control instrumentation
 - Winterization and insulation
 - Environmental emissions diagram
 - Preliminary safety review
- Provides a means to develop and review operating procedures.
- Provides a basis for a proposal.

APPENDIX C

Preparation of Process Flow Diagrams

4.0 DEFINITIONS

PFD: A simplified schematic description of a process, including the following:

- Basic equipment and stream flows necessary to define the process.
- Temperatures, pressures, flow rates, and duties that define normal operation.
- Material balances that define the quantities of raw materials and products, and the physical and thermal condition of every major stream in the process.
- Instrumentation sufficient to illustrate the basic Process Control concept.

5.0 RESPONSIBILITY

The FH Design Authority is responsible for the PFD. The DA may request assistance from the FH Process and FH Control Systems discipline lead engineers.

The vendor and FH Design Authority are responsible for ensuring that the PFD meets technical and graphic standards of Fluor Hanford. PFDs must be approved by FH before subsequent detail design proceeds.

PFDs should be updated even after P&IDs are issued. They should be kept current because they record process information used to coordinate and design the project and to ensure that the proper process variables will be specified for the process piping, equipment, and instrumentation.

6.0 PROCESS

When creating a PFD, particular attention should be paid to the following areas:

- 6.1 Format and Overall Arrangement
- 6.2 Drawing Issuance
- 6.3 Equipment Arrangement
- 6.4 Material Balance
- 6.5 Lines
- 6.6 Relief Headers
- 6.7 Symbols
- 6.8 Instrumentation

6.1 Format and Overall Arrangement

- PFDs are created on standard drawing sizes stipulated in the drawing development instructions. They must be readable when reduced to 11 inches by 17 inches.
- Fluor Hanford standard drawing border and title block must be used.
- Process flow on the drawings is generally from left to right.
- PFDs must be arranged to allow for future revisions.
- Limit detail to a level appropriate with project status. Excessive detail at an early stage only complicates changes. Details are picked up on P&IDs.
- An overall PFD may be made for processes with many PFDs to enhance understanding of the process. Only major equipment and flows are shown, with many equipment items such as pumps and small drums not shown. These PFDs should be presented on only 1 sheet. A BFD (Block Flow Diagram) may be appropriate and serve the intended purpose just as well.

6.2 Drawing Issuance

Process drawings are normally issued FA (For Approval) and AFD (Approved For Design) to FH through the FH engineering point of contact. The actual issue and distribution of drawings is normally done by the Project Document Control. Drawings released for approval or FH review

APPENDIX C Preparation of Process Flow Diagrams

and comment will be noted as "Preliminary" on the Revision Description Block, with revision level starting with A - First Draft. Subsequent approval releases before Rev. O (zero) issue will note revision B, C, or D.

When the drawing is revised to incorporate comments from disciplines, FH, and Project Management, it is to be issued as a Rev 1 issue with AFD noted in the revision description block. The Rev 1 AFD issue is treated by Vendor as an approved issued design and placed under configuration control.

The following table shows a typical method of annotating revisions on PFDs. Letter designations denote internal document issues only, both before and after final issues. Number designations denote external issues and distributions. Project Procedures will determine actual issuance procedures.

Annotation of PFD Revisions	
<i>Revision Designator</i>	<i>Revision Description</i>
A, B, C . . .	Internal issue and distribution.
0 and 1	Issued for approval, and when signed, issued AFD.
2, 3, 4 . . .	Subsequent issues.
2A, 2B, 2C . . .	Issued for internal interim. Use only after initial external issue.

6.3 Equipment Arrangement

- Major process equipment should be shown and arranged on the PFD using the normal sequence of flow. Where possible, relative equipment elevations should be maintained, particularly where gravity flow is involved.
- Relative equipment sizes should be shown such as when tower diameters change size.
- Major internals of equipment are to be shown only if improved understanding of the process results. Do not show detail items such as vortex breakers, flanges, or man ways. Do show decanting baffles, strategic trays (top, bottom, and feed), and demisters. Number trays from bottom to top. Identify tube side flow through exchangers. Control valves and seal legs can also be shown to clarify operation and control scheme.
- Pumps, compressors, and blowers can be located where convenient. The preference is to locate pumps slightly below their suction vessels.
- The diagram should not be too crowded. Limit the number of equipment items on a drawing so that it does not appear cluttered.
- If more than 1 frame is required for the process, equipment should be grouped into logical sections; for example, reaction and product recovery.
- Show equipment numbers within the outline of the equipment, if possible, or next to the item.
- Item numbers and names of equipment are generally shown on the top of the drawing above the equipment except for pumps, compressors, and exchangers. Other information can be added if it is necessary for understanding the process.
- Designations must match the equipment list, equipment datasheets, and P&IDs.
- Operating pressures and temperatures should be shown within equipment outlines.

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Preparation of Process Flow Diagrams

- Usually, only 1 of multiple identical train units and spared equipment should be shown. The equipment item number will indicate the other trains or spares.
- Typical equipment items which should not be shown on the PFD are utility systems (for example, refrigeration, cooling water, tempered water, and hot oil) or chemical feed systems. These can be shown on separate PFDs, if sufficiently complicated or if considered necessary.
- Packaged units can be shown as boxes if they are not important to understanding the process. If important, the essential details can be shown enclosed by dotted lines or by appropriate labeling.
- Drives are not normally shown on PFDs unless they are part of a control loop. An exception may be made when a drive is part of a standard equipment symbol.
- Equipment design conditions with material of construction are sometimes shown on separate PFDs.

6.4 Material Balance

- The material balance for normal operating conditions is shown as a table in the lower portion of the drawing to the left of the title block. If space is not available on the PFD, it can be shown on a separate drawing. If the material balance is produced as a separate document, it should have the same drawing number as the Flow Diagram. Refer to Material Balance Format table below.

Material Balance Format					
Component	Stream No.	1		8	
		Benzene Feed		Reactor Product	
	MW	Mol/hr	Lb/hr*	Mol/hr	Lb/hr*
Hydrogen	2.0				
Methane	16.0				
Nitrogen	28.0				
Benzene	78.1				
Heavies	200.0				
Total					
Total (lb/hr)*					
SCFM					
GPM, at operating conditions					
Density at operating conditions, (lb/ft ³)					
Viscosity, (cP)					
Pressure, psig					
Operating Temperature, degrees F					
* Component mass flow listing is optional. If not listed, show the total mass flow on a separate line.					

- If more than 1 operating case is presented, completely separate PFDs should be used. Where only minor differences exist between 2 or more cases, they may be shown on the same PFD with the appropriate designations.
- Stream numbers and descriptions should be consistent with calculations and computer simulations.
- The order for components should be from the lowest to the highest molecular weight (from top to bottom of the material balance). If a component is not present on a sheet (even if it is on others), it could be deleted from the material balance if the space is needed.
- Stream numbers should increase from left to right on the material balance. Identical numbers

APPENDIX C

Preparation of Process Flow Diagrams

- and descriptions should be maintained on any stream shown on more than 1 sheet.
- The following data are typically provided on a PFD material balance table:
 - Component molecular weight
 - Component molar flow (moles per hr to nearest 100th)
 - Component mass flow (optional, lb per hr to nearest lb)
 - Total mass flow, lb per hr
 - Total volumetric flow
 - Gases, scfm
 - Liquids, gpm at operating conditions
 - Stream density (substituting specific gravity for liquids is optional)
 - Stream viscosity, cp
 - Operating pressure, psig
 - Utility flows are not shown in the material balance table, unless they become part of a process stream. Utility flows are sometimes shown on the utility line. The following data are typically provided on a PFD material balance table:
 - Batch processes should utilize batch quantities and cycle times in the Material Balance Table. Refer to Material Balance Format table above, operating temperature, degrees F.

6.5 Lines

- Main process streams are shown in heavy lines for ease of following the process.
- Minor lines such as intermittent flows, startup lines, shutdown lines, and blowdowns are generally not shown.
- Where lines are designated by stream numbers, pressure and temperature information at that point should also be given.
- Utility lines are pigtailed to indicate tie-points and type of utility only. They are not carried to the edge of the page. Next to the pigtail, show appropriate utility abbreviation symbol. Steam lines are to be identified with pressure in psig.
- Minimize crossing of lines. Process lines have priority over utility lines and utility lines have priority over instrument lines. Utility lines are broken when they cross process lines, and instrument lines are broken when they cross process or utility lines. Otherwise, vertical lines are broken when they cross horizontal lines.
- Flow arrows are used liberally to indicate flow direction. Arrows should be located at the end of a line and at changes in direction.
- The following lines should not be shown:
 - Startup and shutdown
 - Decommissioning
 - Sewers
 - Vents and drains

6.6 Relief Headers

- Lines showing the transition to and from multiple trains are shown on the PFD.
- Lines entering and leaving the flow sheet are identified by the commodity, source or destination, equipment name and number, and drawing number.
- Process tie-ins should extend to and from the edge of the drawing.
- Normal operating temperatures are indicated on inlet and outlet process streams associated with heat exchangers.
- Valves (except control valves) are generally shown as gate valves.

APPENDIX C Preparation of Process Flow Diagrams

6.7 Symbols

Use the symbology shown in the Master PFD and P&ID Legend Drawing, H-9-006010 and Master PFD and P&ID Abbreviations, H-9-006015. Create a project-specific legend using the CAD files provided by Fluor Hanford to depict the applicable symbols.

6.8 Instrumentation

- Only the loops and instruments required to understand normal process operation and control should be shown.
- No alarms, safety instrumentation, or indicators are shown unless required to understand normal process operations.
- Instrument control lines are shown dashed regardless of signal type such as pneumatic and electronic.
- Do not show whether a controller is indicating or recording, local or panel, hardware or software, unless it is important to understanding basic control philosophy.
- Continuous online analyzers are shown according to ISA (Instrument Society of America) standards.
- The type of flow measurement device is not shown.
- The location of instrumentation on trayed columns must be clearly shown as to which tray it is on.

7.0 MISCELLANEOUS PFDS

- PFDS that show feed and product tankage may be required.
- PFDS may be required for special process situations such as startup, catalyst conditioning, regeneration, and cleaning.
- Additional PFDS can be required to describe complex systems associated with the main process.
- PFDS can be modified to show air and water (liquid waste) emissions. These diagrams are usually renamed and become part of the Environmental Permit Package.

8.0 REVIEW CYCLE

A typical review cycle for PFDS includes the following:

- | | |
|--|------------------------|
| ▪ Internal Review and | Rev. A . . . (alpha) |
| ▪ Formal FH Review | Rev. 0 (zero) |
| ▪ Approved by FH (Comment incorporation and approved for design) | Rev. 1 . . . (numeric) |

9.0 WORKING REFERENCES

ISA (Instrument Society of America)
PIP (Process Industry Practices)

Hanford Drawings

H-9-006010	PFD and P&ID – Legend and Symbology
H-9-006015	PFD and P&ID – Abbreviations

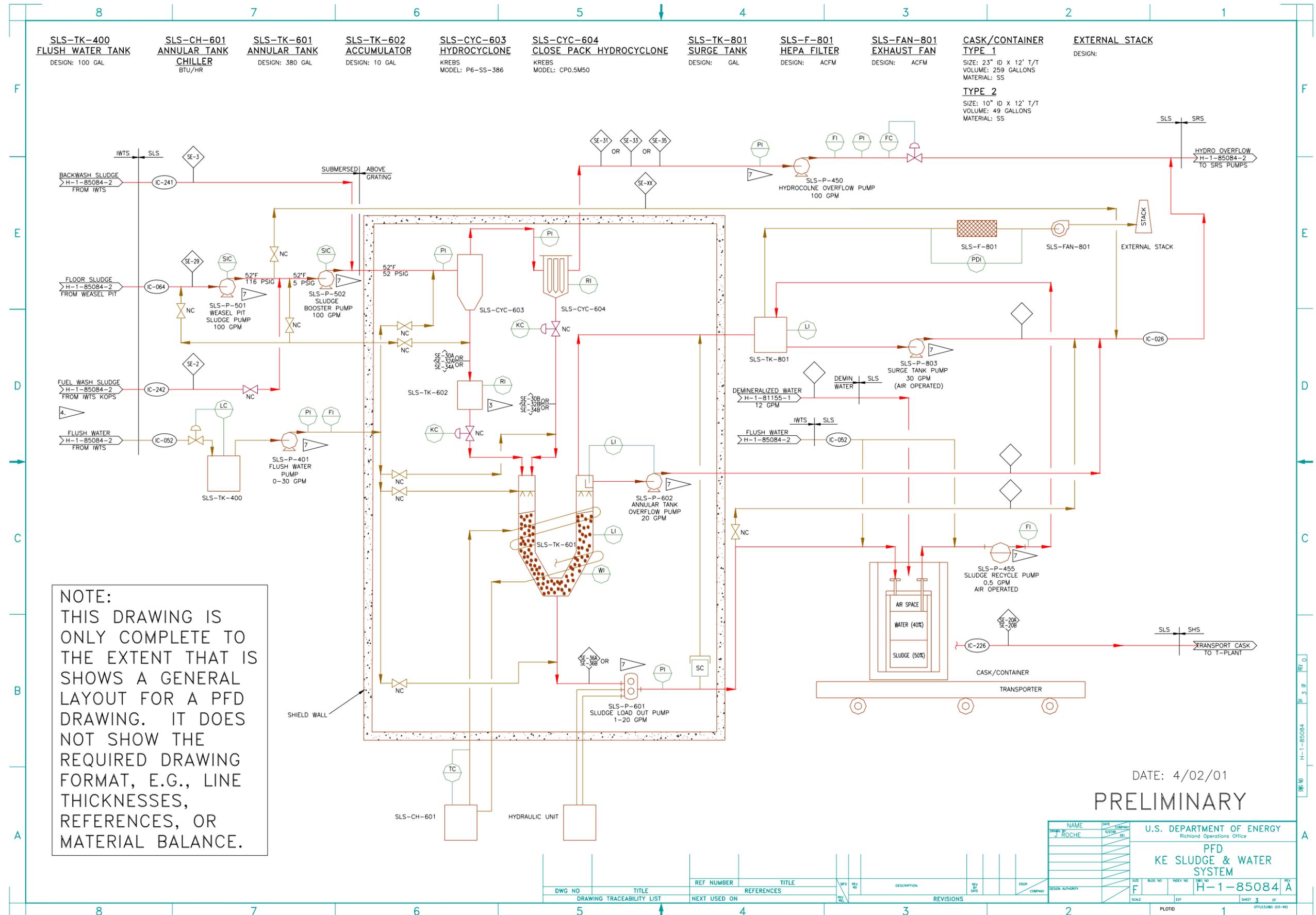
10.0 ATTACHMENTS

Sample Process Flow Diagram Drawing

Project Hanford Management System
APPENDIX C
Preparation of Process Flow Diagrams
 Published: June 2003

HNF-14660, Revision 1

Page 7 of 7



NOTE:
 THIS DRAWING IS ONLY COMPLETE TO THE EXTENT THAT IS SHOWS A GENERAL LAYOUT FOR A PFD DRAWING. IT DOES NOT SHOW THE REQUIRED DRAWING FORMAT, E.G., LINE THICKNESSES, REFERENCES, OR MATERIAL BALANCE.

DATE: 4/02/01
PRELIMINARY

U.S. DEPARTMENT OF ENERGY Richland Operations Office	
PFD KE SLUDGE & WATER SYSTEM	
DWG NO: H-1-85084	REV: A
SCALE: 1" = 1'-0"	SHEET 3 OF 3

DWG NO	TITLE	REF NUMBER	TITLE	REV	DATE	DESCRIPTION	ENGR	COMPANY
	DRAWING TRACEABILITY LIST		REFERENCES					

DWG NO: H-1-85084

ATTACHMENT D
Parts/Materials List Recommended Practices**1. Arrangement**

The Parts/Materials List should be arranged according to the following hierarchy:

- Arrangement/installation or assembly.
- Subassemblies.
- Detailed items.
- Designed items.
- Commercial/catalog items.
- Hardware, e.g., bolts and nuts.
- Material items.

Three spaces should be provided between each category for future entries. See [Example 1](#). The sequence of items in the Parts/Materials List may be broken when items added by drawing development, progress, or revisions have used all reserved spaces.

2. Item Number/Find Number System

Items listed in the Parts/Materials List (assemblies, subassemblies, detailed items, commercial items, and material items) should be identified/located on the field of the drawing by item number as shown in [Example 2](#) and [Example 3](#). Using this system allows the part number to be located in the Parts List and ensures that unique part numbering is maintained.

The item number is placed in a nominal 13 mm (.50") diameter circle with a radial leader pointing to the depicted item. See Figure 15a.

FIGURE 15
Part Call-outs.

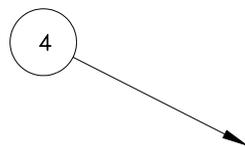


Figure 15a



Figure 15b

Views detailing parts or assemblies should always have the item number centered below the primary view in a nominal 16 mm (.63") circle. The nomenclature/description shown in the Parts List should always be used. The lettering height should be 6 mm (.24") high and underlined. See Figure 15b.

All associated items are to be located on the primary view where possible. Duplicate item number call-outs needed for clarification may be used but held to a minimum and identified as reference call-outs by adding "REF" beside the circle.

3. Multiple Item Call-outs

Where more than one item is called out at one location, circled item numbers connected to one leader line may be stacked and quantities indicated as shown in [Example 2](#) and [Example 3](#).

4. Items Not Needing Pictorial Depiction

Items that do not need pictorial description for detail are completely described, including dimensions, in the Parts/Materials List.

ATTACHMENT D
Parts/Materials List Recommended Practices

EXAMPLE 1a
Parts List

PARTS/MATERIAL LIST						
QTY	REQD	PART/DASH NUMBER	NOMENCLATURE/DESCRIPTION	MATERIAL/REFERENCE	SHT	ITEM NO
-020	-010					
	X	-010	ASSEMBLY, GANTRY		1	1
X		-020	SUBASSY, GRANTRY TRI-ASJUSTABLE		2	2
						3
						4
						5
1	3	-001	STABILIZER ROD	ASTM A36	2	6
	8	-002	HOLD DOWN CLAMP	ASTM A36	2	7
	1	-003	INSTRUMENT RACK	ASTM A36	2	8
	6	-004	MOUNTING BRACKET	ASTM A36	3	9
						10
						11
						12
	3	H-1-48149-020	SCAFFOLD ASSEMBLY			13
						14
						15
						16
	1	FR211-73	DUPLEX PUMP	MILTON ROY CO		17
	2	(SSS60TF8)	VALVE, BALL, 12 mm FNPT, CL 150	ASTM A275 (WHITNEY)		18
						19
						20
						21
						22
	4		SCREW, SCHD CAP, HEX M6X1-4g6gX50 mm L	ASTM A574M		23
AR	AR		TUBING, TS, 101.6 mm X 101.6 mm X 6.35 mm (4"X4"X.25")	ASTM A500, GR B		24
AR	AR		PLATE, 6.35 mm (.25") THK	ASTM A36		25
2	1		CONTINUOUS HINGE, BLANK, W/PIN 1.52 mm (.060") THK X 38.1 mm (1.50") WIDE X 1828.8 mm (72") LONG	TP 304 SST		26

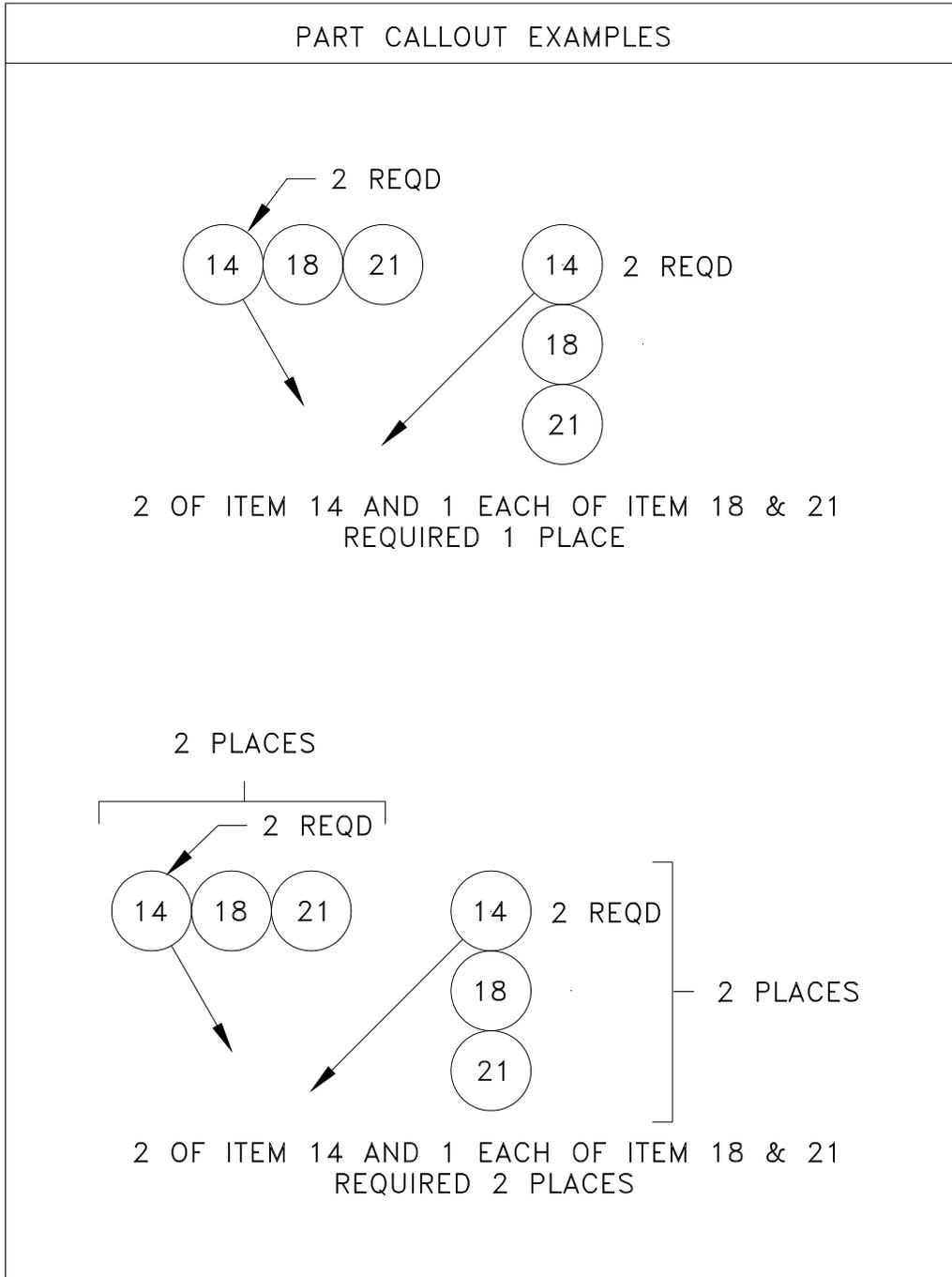
**ATTACHMENT D
Parts/Materials List Recommended Practices**

**EXAMPLE 1b
Materials List**

QTY	REF DES	PARTS / DASH NUMBER	NOMENCLATURE/DESCRIPTION	MATERIAL/REFERENCE	SHEET	ITEM NO
AR			11 GA. (.120) SHEET	300 SERIES SST	2	1
AR			ANGLE, 2 X 2 X 1/8	300 SERIES SST	2	2
24			NUT, HEX 3/4-10UNC-2B	300 SERIES SST	2	3
1			FLAT BAR 3/4 X 2 X 14"L	300 SERIES SST	2	4
1			PLATE 1/4 X 3 1/2 X 14"L	300 SERIES SST	2	5
AR			SCREW, HEX HEAD CAP 1/4-20UNC-2A X 1"L	300 SERIES SST	1	6
AR			NUT, HEX 1/4-20UNC-2B	300 SERIES SST	1	7
AR			WASHER, FLAT 1/4	300 SERIES SST	1	8
AR			SCREW, HEX HEAD SHEET METAL #14 X 1 1/2"L	18-8 SST	2	9
AR			ROD, 1/8" DIA	300 SERIES SST	2/3	10
10			THUMBSCREW 1/4-20UNC X 3/4"	MCMaster-CARR	3	11
1			ANGLE, 1 1/2 X 1 1/2 X 1/8	300 SERIES SST	3	12
12			STUD, 3/4-10UNC-2A X 3 1/2" L	300 SERIES SST	3	13
A/R			1/8" TUBING	300 SERIES SST	1	14
1		SS-200-6-1BT	1/8" TUBE COUPLING	SWAGELOK	1	15
2		SS-200-2BT	1/8" TUBE X 1/8" FNPT	SWAGELOK	1	16
1			ANGLE, 1 X 1 X 1/8 X 1'-11 3/4" L	300 SERIES SST	2	17
1		4596K153	3/4" 150# FLANGE THREADED	MCMaster-CARR	1	18
A/R			3/4" SCH 80 PIPE (TOE)	PVC	1	19

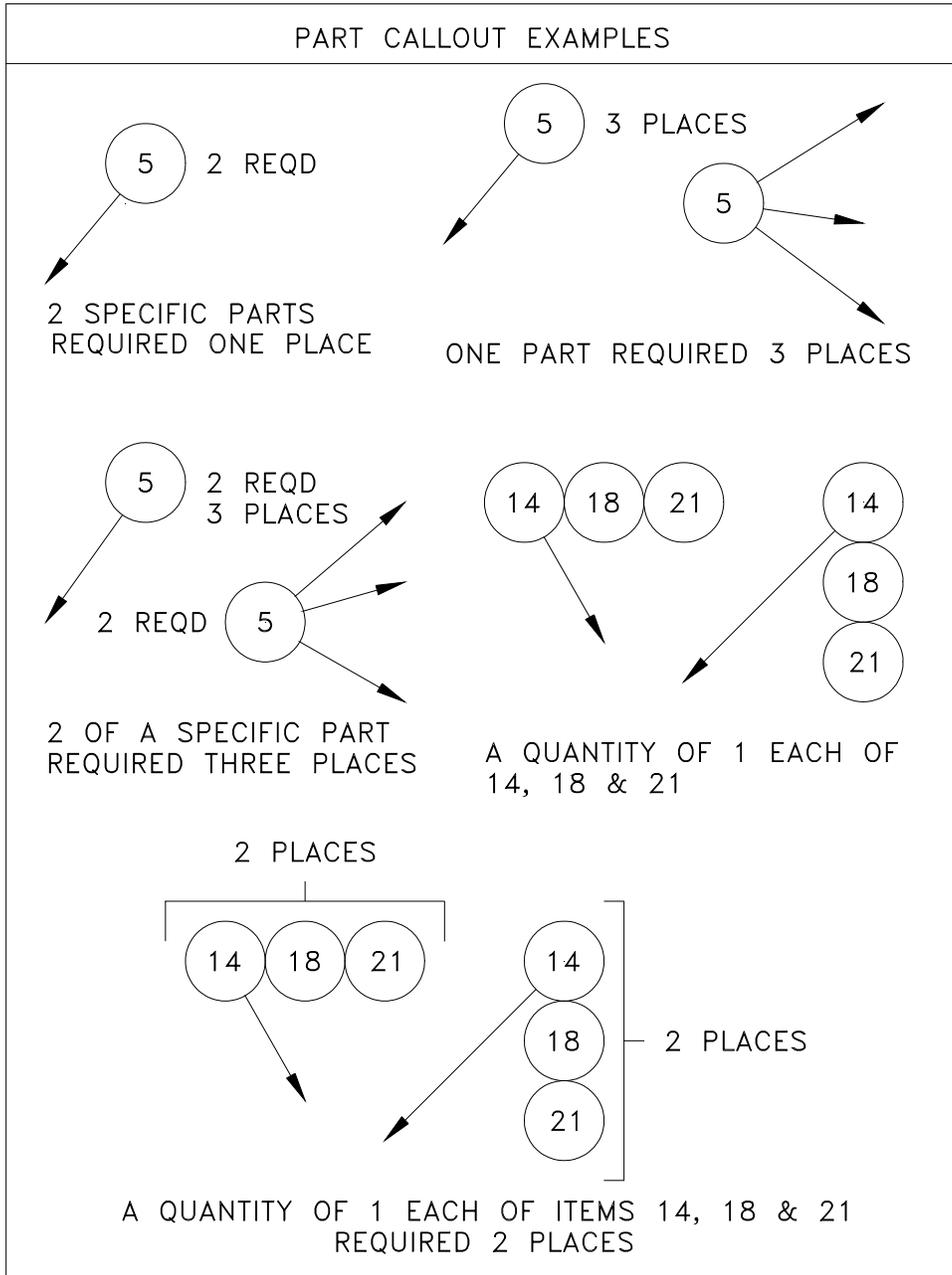
ATTACHMENT D
Parts/Materials List Recommended Practices

EXAMPLE 2
Single/Stacked Item Call-Outs



ATTACHMENT D
Parts/Materials List Recommended Practices

EXAMPLE 3
Single/Stacked Item Call-Outs



ATTACHMENT D
Parts/Materials List Recommended Practices

5. Parts List Vertical Spacing

To describe the part adequately, the Parts/Materials List vertical spacing may vary as needed. Minimum spacing should not be less than 10 mm (.38") as shown by [Example 1](#).

6. Applied Material

Applied material when needed for fabrication, assembly, or installation, should be identified in the General Notes with application instructions, unless covered by a separate specification. See [Appendix A](#), Glossary.

7. Optional/Alternate Parts/Materials

The words "or equal" are *not* used for parts or material substitution on drawings. Optional or alternate materials may be provided for on engineering drawings in the following ways:

- By referencing multiple brands/materials in the Parts List and/or in the field of the drawing, as applicable.
- By specific instructions for optional or alternate items placed in the General Notes.

8. Quantity - Quantity Required Column

The quantities (number of items required) are always for one arrangement, one installation, or one assembly only.

9. Counted Quantities

Counted quantities are to be accurate and described in customary trade units.

10. As Required (AR)

Use AR only when an exact quantity is not known or cannot be easily predetermined (e.g., piping, structural steel shapes, tubing, shims, gasket material).

11. Identifying Assemblies

For ease in identifying assemblies, place an "X" in the quantity (QTY) column where the assembly is placed. The "X" can be used to quickly identify the items needed for the assembly and to indicate all the quantities in that column are for that assembly.

12. Reference Designation Column (Electrical, Electronic, and Instrumentation Applications Only)

This column should be used when unique identifiers are needed for electrical, electronic, or instrumentation items. When used, the designator corresponds with the designator used in the field of the drawing. The width of the column is determined by the information needed in the column. See [Example 4](#).

**ATTACHMENT D
Parts/Materials List Recommended Practices**

**EXAMPLE 4
Parts/Materials List Example (Reference Designation)**

PARTS/MATERIAL LIST							
QTY	REQD	REF DES	PART/DASH NUMBER	NOMENCLATURE/DESCRIPTION	MATERIAL/REFERENCE	SHT	ITEM NO
-020	-010			INSTALLATION			1
							2
1		SW-EV-CS-2	10250T1371	SWITCH, OPR, 3 POSN, SPR RTN FR RIGHT	CUTLER HAMMER		3
3		SW-P-X37 SW-P-X36-1 SW-P-X36-3	10250T20KB	SWITCH, SELECTOR, 2 POSN MAINTAINED, 1 NO-1 NC CONTACT OIL TIGHT	CUTLER HAMMER		4
7		DS-11,13,16,18, 19,20,21	10250T37R	INDICATING LIGHT, 120 VAC, XFMR TYPE WITH 6V LAMP & RED LENS, OIL TIGHT, PRESS TO TEST	CUTLER HAMMER		5
2		DS-12,14	10250T37G	INDICATING LIGHT, 120 VAC XFMR TYPE WITH 6V LAMP & GREEN LENS, OIL TIGHT, PRESS TO TEST	CUTLER HAMMER		6
1		BQ-C5	G0-405	TOTALIZER, DIGITAL, 110 VAC WITH EXTERNAL RECTIFIER	MOORE INDUSTRIES		7
1		PS2	111-24-125	POWER SUPPLY, 115 VAC/24 VDC, 125 WATT	RONAN		8
1		LELL-X37	4130-0X-601	PROBE, LEVEL ASSY WITH CABLE PROBE, WITH ENCLOSURE LENGTH: 145.5"	ENDRESS HAUSER		9

13. Part/Dash Number Column

See [Section 8.10.4](#), Part Number and [Appendix A](#), Glossary.

14. Vendor Part Number

Vendor part numbers are the manufacturer's part numbers. See definition of "Vendor (Supplier) Item" in [Appendix A](#), Glossary.

NOTE: The manufacturer's part number is to be used for commercial items. When only a distributor/vendor (e.g., McMaster Carr, Hanford Stores) is known as a source, catalog numbers are noted as reference (in parentheses) in the Description Column or Material/Reference Column.

15. Nomenclature/Description Column

Enter the basic name (a noun name) first. The noun name is a noun or noun phrase best establishing the basic concept of the item. It describes what the item is and what it is used for, not the material or method of fabrication. A compound noun or noun phrase is used only when a single noun is inadequate.

Basic Name Example	
Bracket	(noun)
Piston	(noun)
Gear Box	(noun phrase)

ATTACHMENT D
Parts/Materials List Recommended Practices

Terminal Board

(noun phrase)

Use modifiers only when there is more than one type of the basic item used in the assembly (e.g., where two brackets are identified in an assembly, identified as bracket, mounting, and bracket, support).

16. Description (Vendor [Supplier] Item)

Specify parts to obtain the most cost-effective item. Where possible, use generic descriptions rather than brand names. The description is to specify characteristics that are sufficient for intended end use, but still broad enough in definition to permit open purchasing.

17. Hardware and Material Items

List basic names with modifiers for fasteners and materials (e.g., SCH CAP SCR, 1/4-20-UNC-2A, etc). As needed, list material items by form and size description (e.g., TUBE STEEL, 4 X 4 X 1/4; PLATE, 1/2 THK).

18. Material/Reference Column

List the controlling specification for the material (e.g., ASTM, ACI) followed by the kind of material (e.g., SST, 6061-T6A, CS). Never use the word "COMMERCIAL" to indicate any acceptable grade. The words "ANY GRADE" may be used where the grade of material is not a design factor. Always identify the specific material grade when welding.

List names of supplier for commercial items, other separate documents controlling material, general notes, etc.

19. Sheet Column

For improved readability, always use this column to note where assemblies, arrangements, or detailed items are depicted on a multi-sheet drawing.

20. Item Number Column

Enter consecutive numbers starting with the numeral 1. An item number should always be used for each vertical space, including spaces left blank for future use.