HNF-14660
Revision 2

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

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

Project Hanford Management Contractor for the
U.S. Department of Energy under Contract DE-AC06-96RL13200

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Richland, Washington

Approved for Public Release;
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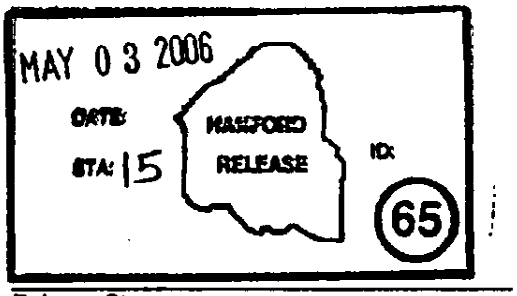

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Off-Site Vendor Direction for Preparation and Control of Engineering Drawings

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.

Special emphasis is placed on Process Flow Diagrams (PFDs) in Addendum C and Piping and Instrumentation Diagrams (P&IDs) in Addendum D. Also, see Glossary –Addendum A for definitions of these drawing types.

Drawings used to provide temporary construction designs are exempt from this instruction, except for drawings identifying buried items, for example, direct buried electrical lines and potable water lines.

Vendor Information (VI) describing commercially available items and associated data covering such items as installation, operations and maintenance where the criteria of the item is in the engineering design are also exempt from this standard, except for the requirement to reference the VI file number assigned by FH for configuration control of engineering VI data. The Statement of Work and Submittal Register provide the criteria for handling VI data.

3.0 CONTROL OF DRAWINGS AND DATA FILES

3.1 CAD Program

Use AutoCAD [1] Release 2006 or lower versions for preparing all engineering drawings identified as engineering baseline documentation.

3.2 Control of Master CAD Data Files and Approved Plotted (Original) Drawings

Vendors are responsible for maintaining configuration control of approved engineering drawings and associated data files to ensure that the Master CAD data file accurately reflects the plotted and approved engineering drawing. This includes managing and limiting access to approved drawings (original) and Master CAD data files to ensure safekeeping of the latest approved revision.

While it is important to maintain in process control of design versions of CAD data files, this standard ***does not*** address requirements or actions of in process design development, which is the responsibility of the contractor.

3.3 Final Turnover of Engineering Drawings

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

- Convert all drawings developed on CAD programs other than AutoCAD to AutoCAD "DWG" format prior to releasing the data files to the Hanford. See Section 3.1 CAD Program
- Generate Final plots from the .DWG format. See Section 3.1 CAD Program

- Final turnover, requires both engineering drawing originals and associated Master CAD data files (those with a "DWG" extension used to develop the final plotted drawing).
- Bind all AutoCAD X-Reference data before submitting the data files to FH. See Section 4.9, X-Reference Files.
- Plot all drawing originals in Black and White; colored plots are ***not*** acceptable for the final turnover. See Section 4.7 Line Widths and Plotter Pen Assignments
- Develop all drawings in full scale, using model space. See Section 4.14 PaperSpace/Model Space.
- All "layers," except the view port layers and MEDADATA layer (explained below), shall be turned on and plotted; extraneous data is removed, for example, construction reference data,.
- Any metadata (information about the drawing that is beneficial to future CAD users) is located on a layer titled "MEDADATA"; for example, XP scale, and block information. See 4.15, Metadata.
- Each drawing shall have a drawing number (H-Series Drawing) (provided by the FH project point of contact [POC]. See 7.2, Drawing Number).
- Place the authorizing Facility Modification Package (FMP) number in the revision block of the drawing with a brief description, for example, "DRAWING AS-BUILT PER HNF-FMP-(YEAR-NUMBER)," see 7.3.3, Formal Revision Designation.
- Check all drawings for adherence to these directions. See Section 7.7 Drafting Approved.

4.0 COMPUTER-AIDED DRAFTING (CAD)

4.1 AutoCAD Discipline Layering

Uniform layering makes exchange of AutoCAD data files among organizations and companies easier through logical separation and identification of drawing data. It also permits the user to view and plot related aspects of a drawing separately or in combination.

4.2 Layering

Designating layers by color and line type is preferred. It is acceptable to assign layers on an entity basis. This section and ADDENDUM –B– Layer Naming for AutoCAD Drawings by Discipline, describe the steps used when assigning layers. Drawing template files establish specific discipline layers for routine use. See 4.8, New Drawing Set Up Files.

Tables 1 through 9 in ADDENDUM –B– cover the following:

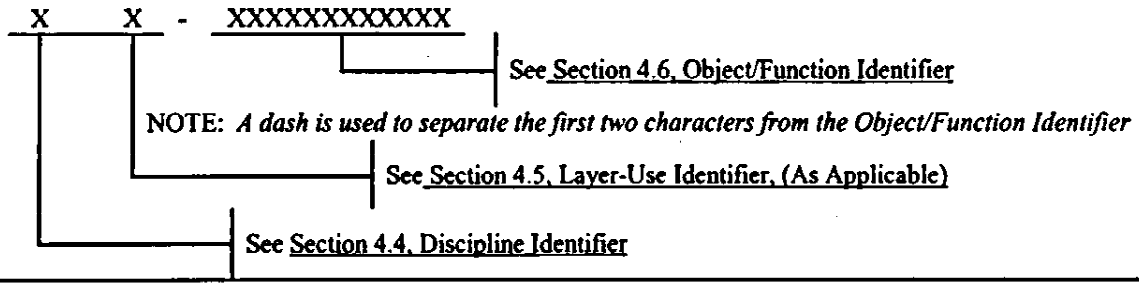
- Table B1, General Layering for All Disciplines
- Table B2, Architectural Drawings
- Table B3, Civil/Structural/Environmental Drawings
- Table B4, Electrical Drawings
- Table B5, Fire Protection Drawings
- Table B6, HVAC Drawings
- Table B7, Instrumentation & Control (I&C) Drawings
- Table B8, Mechanical Drawings
- Table B9, Piping Drawings

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

4.3 Layer Naming

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

Figure 1 - Layer Naming



4.4 Discipline Identifier

This identifier defines the specific discipline. A unique identifier enables users to distinguish discipline layers within a drawing file and provides a logical separation of discipline information, as defined by Figure 2 - Discipline Identifiers. Also, see Figure 1 - Layer Naming.

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

4.5 Layer-Use Identifier (As Applicable)

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

Figure 3 - Layer Use Identifier

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 (for example, 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, it is allowable to use the layer-use identifier to separate data as follows:

- Add auxiliary details as needed. As an 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

When the modification is completed, remove extraneous layers (for example, demolition data), which deletes all the data along with the layer.

4.6 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 is understanding what is contained on the layer. See Figure 1 – Layer Naming and ADDENDUM –B– Layer Naming for AutoCAD Drawings by Discipline, Tables 1 through 9.

4.7 Line Widths and Plotter Pen Assignments

All line widths and line colors are to comply with Figure 4. Users need to assure the selected color/line weight produces the desired line width on the final drawing plot. The color and line thickness in Figure 4 provides optimum contrast between lines. Also, see ADDENDUM –B–, Layering Naming for AutoCAD Drawings by Discipline, for assign thickness to the line types.

Configure Plotters to produce line widths based to colors (using an AutoCAD, CBT file) or assigned line widths through AutoCAD. Designating specific AutoCAD colors to the plotter pens and using the same color that corresponds with the color by line allows use of either plotting method.

Use of Polylines where there is a justified need is acceptable. Specific line weights generated by the plotter minimize the need to use AutoCAD Polylines within a drawing.

NOTE: Selecting the Polyline feature limits the minimum Polyline width to the plotter line width established by the line color when configured to plot line weight by color.

Figure 4 - Plotter Pen Assignments

Pen No. 1 0.25 mm (0.010")	Pen No. 2 0.35 mm (0.014")	Pen No. 3 0.5 mm (0.020")	Pen No. 4 0.7 mm (0.028")	Pen No. 5 0.95 mm (0.038")
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 (for example, 13, 53, 123, 243)	X2 (for example 12, 32, 152, 222)	X1 (for example, 11, 71, 181, 241)	X0 (for example, 10, 90, 100, 230) X5, X6, X7, X8, X9	X4 (for example, 14, 64, 134, 214)

4.8 New-Drawing Setup Files

4.8.1 New-drawing setup files

The FH supplied template drawings (.dwt) have the basic layering convention as defined in this instruction. See ADDENDUM –B– Layer Naming for AutoCAD Drawings by Discipline, Tables 1 through 9. The drawing templates for the various drawing types and disciplines are available through the following Internet link:
http://www.hanford.gov/pmm/downloads/CAD_Reqs.htm

4.8.2 Additional Layers

The startup files may not contain an all-inclusive list of needed layers. Develop additional layers as needed. Development of additional layers complies with the specified naming convention described in Figure 1 – Layer Naming.

4.9 X-Reference Files

Prior to final drawing turnover to FH, all X-Reference files shall be bound to the AutoCAD "DWG" drawing file.

4.10 Manual Modification or Revision of CAD-Generated Drawings

All plotted and approved drawings and the Master CAD Data Files shall be the latest revision and contain identical graphical data. Inaccurate engineering graphical data found before or during final review and approval, requires the contractor to update the Master CAD data file to reflect the changes and the drawing re-plotted and re-approved before issuing the drawing for final turnover.

4.11 Third-Party CAD Software

Third-party software used in the development of AutoCAD-based drawings shall be the type that ***does not*** require access of the third-party software to view or revise the drawing.

The contractor may request an exception for third-party software that automatically assigns/establishes layers. Make these requests in writing with justification to the FH CAD and Drafting technical Authority who will review the exception and approve the use of third-party software.

4.12 Shape Files and Non-Standard Fonts

Do NOT use nonstandard shape files or fonts (font files ***not*** supplied by AutoCAD). Also see Section 8.7, Lettering.

4.13 CAD Auxiliary Support Files/Information

Auxiliary support files and information are available for download at http://www.hanford.gov/pmm/downloads/CAD_Reqs.htm. The available files and information are as follows:

- The complete file of this instruction
- Drawing Title Block formats with the drawing dimvars and setvars setup by discipline. These .dwt templates include the drawing start models (AutoCAD template/prototype drawings), see Section 4.8.1, New-drawing setup files
- Symbols (for example, PFD, P&ID, architectural, electrical, control systems; and HVAC), see Section 8.3, Symbology
- Extra drawing blocks for convenience

4.14 PaperSpace / Model Space

Develop all drawings in model space including all drawing text, and dimensions. One exception is for a drawing developed in full scale (one-to-one), for example: PFD, P&ID and plotted drawing used as templates in fabrication. Place the following data in the PaperSpace layout area, as appropriate:

- Title block,
- General Notes
- Parts List/Bill of Materials
- View Port Layer
- Drawing status information, for example
  - Approved for Design stamp
  - Approved for Construction stamp
  - Electronic PE stamps

4.15 Metadata

Excluding AutoCAD attribute data (refer to AutoCAD attribute functions in AutoCAD documentation); it is acceptable to place drawing metadata considered beneficial to future CAD users on a separate layer titled "MEDADATA." Set the layer to the non-plot setting in the layer control box to prevent this information from plotting.

5.0 DRAWING CATEGORIES

5.1 New Project Drawing Types

This direction covers drawings that document baseline information of structures, systems, and components. These include several different drawing types, such as the following:

- Altered-Item
- Architectural Floor Plan
- Arrangement/Installation
- Assembly
- Block Flow Diagram
- Civil Plans
- Connection Diagram
- Drawing Tree
- Electrical One-Line Diagram
- Envelope
- Loop Sheet
- Modification
- Piping and Instrumentation Diagram (P&ID) see ADDENDUM -D- Development of Piping and Instrumentation Diagrams (P&IDs).
- Plot Plan
- Process Flow Diagram (PFD). See ADDENDUM -C- Preparation of Process Flow Diagrams (PFDs).
- Schematic Diagram
- Sections and Details

Note! This is a sampling of drawing types and ***not*** intended to be all-inclusive. Use other/additional drawing types as necessary.

An H-Series Drawing has a unique Hanford H-Series drawing number, See 7.2, Drawing number. See the project POC for H-Series drawing numbers. These drawings are 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.

Fabrication and construction drawings are ***not*** normally included as engineering drawings, for example, piping spool piece and installation drawings; rebar bending and installation drawings; concrete lift and block-out drawings and weld map drawings are project record drawings that may be required as submittals, but ***not*** normally as engineering documentation for retention in the Hanford Document Control System. Develop these drawings using the contractor's drawing standards, unless otherwise specified in the Statement of Work.

5.2 Modification Drawings

A Modification Drawing is developed for changing an existing facility's drawings impacted by vendor engineering designs and shall have the changes identified and interfaced with the project engineering point of contact.

5.3 Altered Item Drawing

An Altered-Item Drawing documents modifications to commercially available vendor-supplied items (off-the-shelf) that require modification to support a design. The Altered-Item drawing establishes a new part number and configuration control of the modified vendor item. Develop an altered item drawing to control a new configuration using the original vendor item. See Section 8.10.9, Altered Item.

5.4 Process Flow Diagrams (PFDs)

The Process Flow Diagram (PFD) is a simplified graphic description of the basic process flow showing equipment, piping, and controls necessary to clarify the process, heat, and material balance conditions and control concept. The PFD includes and integral or attached material balance depicting operating conditions. See ADDENDUM -C- Preparation of Process Flow Diagrams (PFDs).

5.5 Piping and Instrumentation Diagram (P&ID)

The Piping and Instrumentation Diagram (P&ID) is a detailed graphical representation of a system used to develop system design and provide documentation for configuration control of a System, Structure or Component. The P&ID shows equipment, instrumentation, piping, and any other miscellaneous items required for the mechanical design of the system. System interfaces are also included on the P&ID. Use standard symbology based on a Legend drawing. See ADDENDUM -D- Development of Piping and Instrumentation Diagrams (P&IDs).

6.0 DRAWING SIZES AND MATERIAL

6.1 Sizes

6.1.1 General Drawing Standards

Drawings sizes are in accordance with American National Standards Institute (ANSI) Y14.1-1995 (R2002), *Drawing Sheet Size and Format*, or ANSI Y14.1M-1995, *Metric Drawing Sheet Size and Format*, as applicable.

6.1.2 Preferred Drawing Sizes

For inch-pound system drawings, the ANSI "F" (28" x 40") and "D" (22" x 34") size are the preferred inch size Drawings.

For Metric dimensioned drawings, the ISO "A1" size drawing (594 mm x 841 mm) is the preferred metric size. The following applies to the use of drawing sizes:

The following applies to either imperial or metric drawings:

- All drawing sheets of a multiple sheet drawing are to be the same size.
- Avoid mixing metric system and inch-pound system on drawing sheets on the same set of drawings (multiple disciplines) for the same project.

6.1.3 Unacceptable Drawing Sizes

Do not use ANSI "E" size, ISO "A0" size, and roll or elongated size drawings.

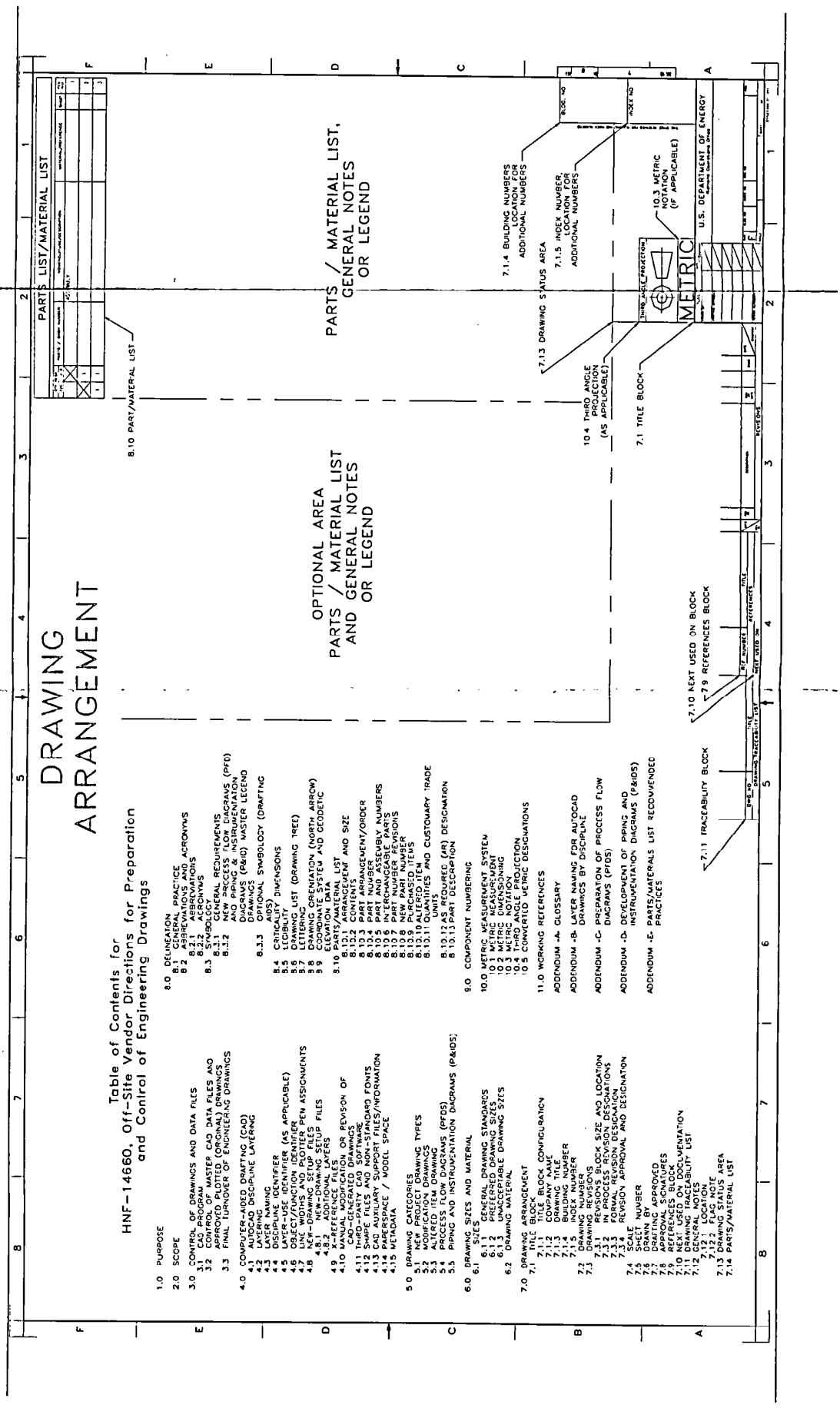
6.2 Drawing Material

Plot drawings intended for final turnover on a minimum 20 lb opaque bond 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 as shown in Figure 5 – Drawing Arrangement and as defined in this instruction.

Figure 5 - Drawing Arrangement



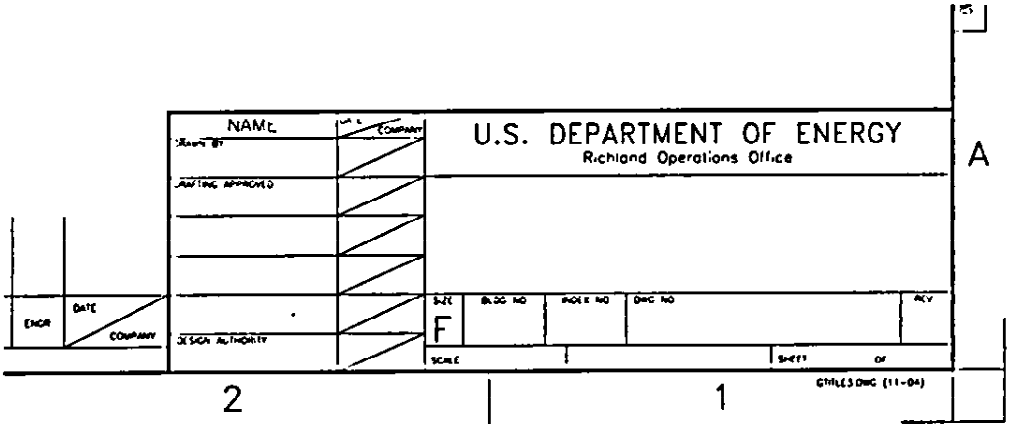
7.1 Title Block

A specially attributed drawing title block is required for all H-Series Drawings. Each Discipline has specific attributes and specially developed AutoCAD start models are available (AutoCAD .dwt file). See Section 4.13, CAD Auxiliary Support Files/Information for additional information on accessing the required .dwt files.

7.1.1 Title Block Configuration

The Title Block conforms to ANSI Y14.1- 1995 or ANSI Y14.1M-1992, except as modified by this standard where additional spaces in the Title Block identify unique. Hanford data used to file and retrieve engineering drawings. A complete Title Block is placed on each drawing sheet (i.e., the second sheet drawing format per ANSI Y14.1-1995 is not used). See Figure 6. Only one title block is to exist in any data file. Also, see section 4.14, Paper Space / Model Space.

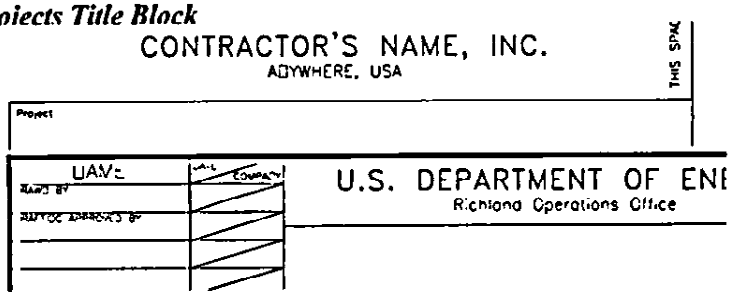
Figure 6 - Typical Title Block



7.1.2 Company Name

For A/E contract drawings, place the name of the firm centered above the title block. In the approval section of the title block, place the acronym of the company (for example FH for Fluor Hanford) for each identified name next to the date. See Figure 7 – Capitol Projects Title Block.

Figure 7 - Capitol Projects Title Block



7.1.3 Drawing Title

- Clearly identify the subject matter
- ***Do not*** include capitol project numbers or building numbers (for example, W-120), see 7.1.4, Building Number
- Use of Hanford area numbers are acceptable for area-wide presentations, see 7.1.4, Building Number
- Limit the total number of characters and spaces to sixty (60) or less
- The minimum height of the lettering in the title is 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.
- Arrange titles 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. Identify the drawing type on the second line of a two line drawing title, or the third line of a three line drawing title.
- For capital projects, enter the project number and project title in a supplemental block above the Title Block. See Figure 7 - Capitol Projects Title Block.

7.1.4 Building Number

- Enter the building or area number in the corresponding block located within the Title Block. The FH POC will provide the Hanford Site building numbers for the project. See Figure 5, Drawing Arrangement and Figure 6 Typical Title Block.
- For a drawing with 3 to 12 building numbers, the title block template will automatically place all the Building Numbers in the supplemental block, which is located directly above the title block and along the right border of the drawing. The template automatically places the words "SEE ABOVE" in the building number block within the title block. For the location of the supplemental block, see Figure 5 – Drawing Arrangement.
- If more than 12 buildings are affected, assign an area number followed by the letter G, for example: 200G, 400G.

7.1.5 Index Number

- The FH POC will provide the Hanford Site index numbers during an early review of the drawings. An index number must be assigned and affixed to the drawing prior to approval by FH.
- Each drawing sheet is limited to a maximum of twelve index numbers. When assigned Index numbers exceed two, the title block template automatically places the Index Numbers in the supplemental block directly above the title block (see Figure 5 – Drawing Arrangement). The supplemental block is located along the right border of the drawing and the title block template is designed to automatically place the words "SEE ABOVE" in the index number block within the title block when more that two Index Numbers are entered. For the location of the supplemental block, see Figure 6 – Typical Title Block,

7.2 Drawing Number

Obtain drawing numbers through the FH project POC. There are two locations for the drawing number, in the title block and outside the right border of the drawing in zone "B." See Figure 5, Drawing Arrangement. Place the drawing number in the title block using 6 mm to 8 mm (.24" to .35") high lettering. See Figure 6 - Typical Title Block.

7.3 Drawing Revisions

7.3.1 Revisions Block Size and Location

Each drawing has revision number recorded in three places on the drawing, see Figure 9 Revision Number Locations. The size of the revision block is according to ASME Y14.1-1995 (R2002), and configured as shown in Figure 8 – Typical Revision Block. For the location of the revision block, see Figure 5 – Drawing Arrangement.

Figure 8 – Typical Revision Block

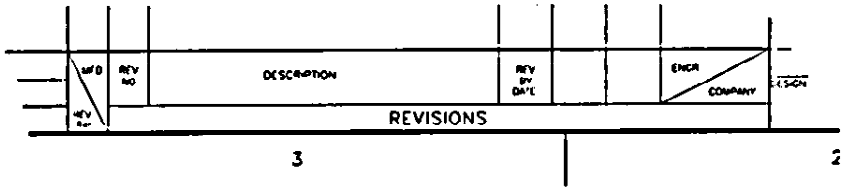
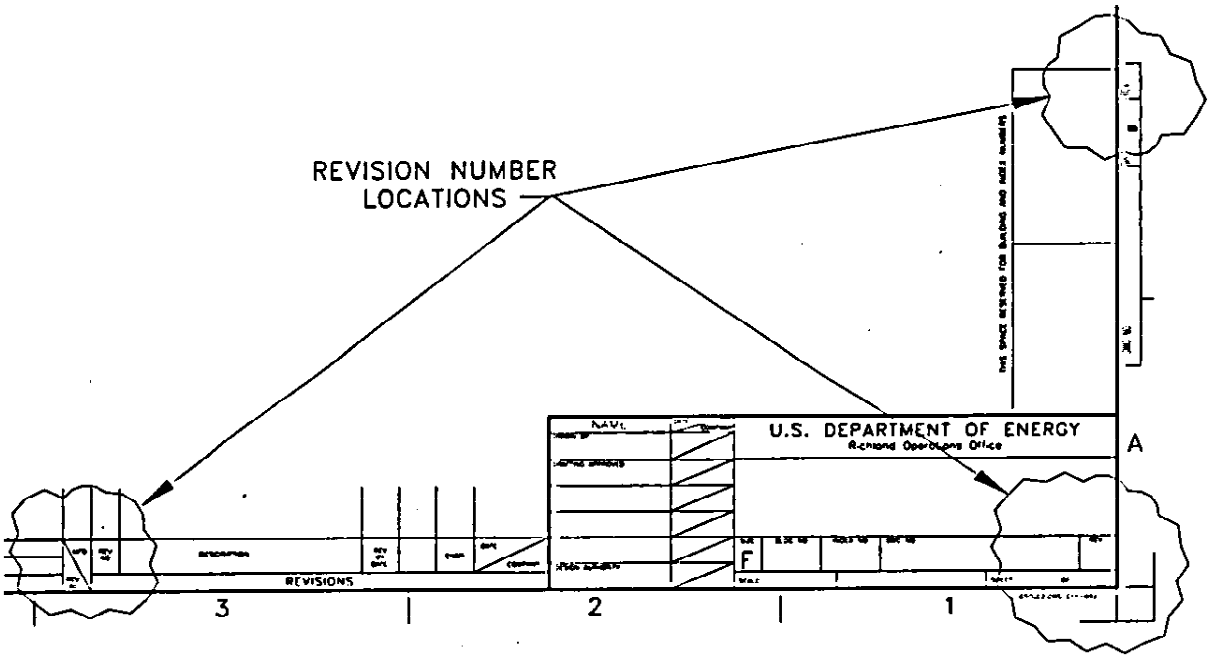


Figure 9 - Revision Number Locations



7.3.2 In Process Revision Designations

All drawings under initial development (prior to FH design approval) use Alpha revisions, for example, A, B, C. Alpha revisions are used for in process control and may be identified with the review cycle of the drawing, for example, A=30%; B=60%; C=90%. For FH drawings placed into "project status" the alpha designator is placed behind the formal revision number, for example, 3A, 4B, etc. ***Do not*** use the next sequential revision designation (numeric) until the drawing is ready for approval, which requires the FH Facility Modification Package Process (FMP) as authorization. For clarification, contact the FH POC.

7.3.3 Formal Revision Designation

At the point FH reviews are complete and FH is ready to approve an engineering drawing, all in process 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, (1, 2, 3, etc).

7.3.4 Revision Approval and Designation

For new a drawing, place revision 0 (zero) approval signatures in the approval block within the title block, see Figure 6 - Typical Title Block, No signatures are placed in the revision block of a drawing being approved at Revision 0. Place Revision 0 (zero) in the three locations as identified in Figure 9 Revision Number Locations

For revision to an FH approved drawing, place approvals (revision 1 and higher) within revision block, see Figure 8 – Typical Revision Block and advance the revision number in the three locations as identified in Figure 9 Revision Number Locations.

7.4 Scale

Enter predominant scale of the drawing or enter "NONE" when no scale is used. See Figure 6 - Typical Title Block.

Enter "SHOWN" if the predominant scale of the drawing ***cannot*** be determined; place a scale under each graphic presentation, as applicable.

The use of a standard Architectural, Engineering/Civil or Mechanical scale is preferred, for example: 1/4"=1'-0", 3'=1'-0", 1=10,1=100, 1/2, 2/1. The use of non-standard scales such as 1/3, 1.315=1 are discouraged.

7.5 Sheet Number

On the first sheet, enter sheet 1 and the total number of sheets to the drawing set. Number all sheets in sequential order without the total number of sheets except on sheet 1. Each subsequent sheet after sheet 1, only shows the next sequential sheet number without total number of drawing sheets. See Figure 6 - Typical Title Block.

7.6 Drawn By

Print the initials and surname of the drawing originator. See Figure 6 - Typical Title Block.

7.7 Drafting Approved

Check all drawings for compliance to this direction, which includes checking the electronic data file to assure that the data file also complies with this direction.

Preferably, the Checker is someone other than an individual(s) involved in the creation of the design or drawing, but ***never*** the person who developed the drawing (Drawn By and Drafting Approved are ***not*** to be the same individual).

Print the initials and surname with the signature placed next or below the printed name. See Figure 6 – Typical Title Block.

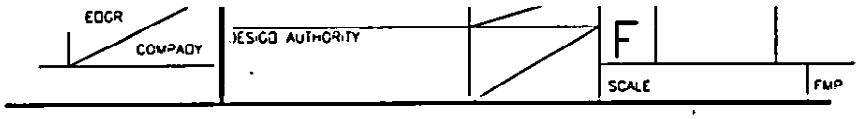
7.8 Approval Signatures

Approvals are in accordance with individual company procedures. Print the initials and surname with the signature placed next to or above the printed names. See Figure 6 - Typical Title Block.

The FH Design Authority/System Engineer (FH DA/SE) signs and dates the Title Block in the bottom approval space. See Figure 10 – Design Authority. The FH Design Authority/System Engineer's approval signifies that all necessary FH reviews are completed and that the design is accepted. Place the company designator identify (for example FH for Fluor Hanford) in the block provided next to the approver's signature and date.

When required,AE/PE stamps are placed above the title block, see 7.13, Drawing Status Area.

Figure 10 - Design Authority

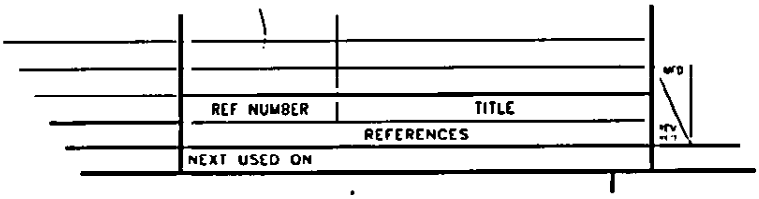


7.9 References Block

List the reference documents that interface with existing design for construction contractors. See Figure 11 – Typical Reference Block. It is acceptable to abbreviate Titles to save space. ***Do not*** list national consensus standards.

Do not list new drawings depicting new construction in the Reference Block. Show the new and definitive design references in the body of the drawing, as necessary.

Figure 11 - Typical Reference Block



7.10 Next Used On Documentation

Enter the drawing number of the next drawing that the drawing supports. This links the drawing to the next higher-level drawing, such as in a drawing tree.

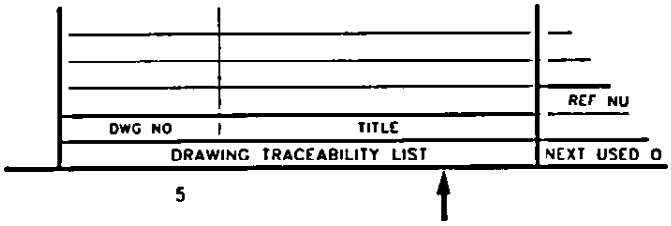
The NEXT USED ON block documents drawing links for easy traceability of the engineering design, for example, a subassembly drawing lists the drawing number of the assembly or the installation drawing. For the location of the block, see Figure 11 – Typical Reference Block.

Enter the words "END ITEM" if the drawing is the top drawing.

7.11 Drawing Traceability List

List all existing drawings affected by the new design and all new Vendor Information File numbers for two-way traceability. For the location of the block, see Figure 12 – Drawing Traceability List.

Figure 12 - Drawing Traceability List



7.12 General Notes

7.12.1 Location

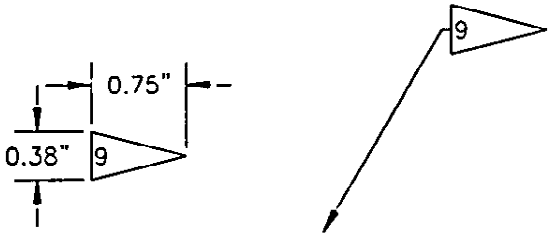
The preferred location of the general notes is directly above the Title Block along the right side of the drawing. An alternate location is to the left as shown in Figure 5 – Drawing Arrangement. On multiple-sheet drawings, general notes start on sheet 1, but may continue on subsequent sheets, as necessary.

7.12.2 Flag Note

When there is a definite advantage to add a specific note to the General Notes the specific note is "flagged" by placing the number of the note in a pennant flag symbol, see Figure 13 – Flag Note Size and Configuration. This notifies the drawing user that a flagged General Note applies to a specific location(s) on the drawing and there will be a corresponding flag in the body of the drawing as a reference to the General Notes. Alternately, a notation (for example, "SEE GENERAL NOTE 5") is acceptable in place of the flag note.

Place the reference to the General Note (flag or notation) near the affected area. Use leader lines from the flag note or notation for clarification of the reference, as needed.

Figure 13 - Flag Note Size and Configuration



7.13 Drawing Status Area

Reserve a space approximately 75 mm (3") high above the Title Block for recording additional Title Block information and for the application of A/E and PE stamps according to individual contractor procedures. See Figure 5, - Drawing Arrangement.

7.14 Parts/Material List

If required, a Parts/Material List is located, or started, in the upper right-hand corner on the first sheet of the drawing. To determine if a Parts/Material List is required, see Section 8.10, Parts/Material List, and Figure 15 - Material and Parts - Drawing Types and Classifications.

8.0 DELINEATION

8.1 General Practice

Drafting is according to applicable ASME/ANSI Y14 series standards as well as nationally accepted discipline codes, standards and practices. Where national practice differs from the direction of this document, this document prevails as the priority direction.

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.
- Fully use Industry-accepted abbreviations, such as DIA for diameter, SCH for schedule, and REF for reference. All other abbreviations 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.
- Punctuation marks, except the slant (/) and the hyphen (-), are ***not*** used. Add a period (.) an abbreviation only if its context does ***not*** obviously represent an abbreviation (for example, ADD indicates addition or addendum).
- Exercise care before using abbreviations to assure proper interpretation by the end users of the drawing.

8.2.2 Acronyms

- Always use acronyms for industrial and professional societies (for example, ASME, ANSI, AWS [American Welding Society], and IEEE [Institute of Electrical and Electronic Engineers]).
- Avoid non-industry-accepted Acronyms. However, if repeated use of a word in text (for example, general notes) makes the use of an acronym an obvious advantage, the acronym may be created. Clearly define the Hanford site-specific acronyms 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. The LEGEND is located either on the drawing or on a separate legend drawing maintained for the system or facility.

For revision to an existing drawing, utilize the existing drawing legend with new additions as required.

Do not identify or reference metric system symbols (for example, mm, Pa) in the drawing LEGEND.

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 FH Design Authority/System Engineer. See Section 4.13, CAD Auxiliary Support Files/Information. Also, see ADDENDUM –C– Preparation of Process Flow Diagrams (PDFs) and ADDENDUM –D– Development of Piping and Instrumentation Diagrams (P&IDs).

H-9-006010 Sheets 1 thru 6, Master PFD and P&ID Legend,
H-9-006015 Sheet 1, Master Abbreviations,
H-9-006020 Sheets 1 and 2, Master Electrical Elementary and One-Line Legend,
H-9-006021 Sheet 1, Master Electrical Plan Legend.

DO *NOT* reference these drawings as the 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 used to develop or revise legends of individual project. Each symbol on a PFD or P&ID shall be traceable to a legend. Unless otherwise directed by the FH Design Authority/System Engineer (FH DA/SE) all drawing shall have a legend on the drawing or reference to a legend drawing developed using these criteria and prepared by the contractor.

Should a symbol be needed that is ***not*** covered by the PDF/P&ID Master Symbology, consult the appropriate national consensus standards for the correct symbology; if no symbology is available, it is permissible to develop the needed symbology by adding it to the PFD/P&ID legend.

8.3.3 Optional Symbology (Drafting Aids)

The symbology specified by the following drawings is optional and provided as a drafting aid to increase efficiency in producing/revising drawings, For new PFD or P&ID drawing legends see section 8.3.2, New Process Flow Diagrams (PFD) and Piping & Instrumentation Diagrams (P&ID) Master Legend Drawings and Section 4.13, CAD Auxiliary Support Files/Information.

Take care when using the following drawings. There are a number of old legacy symbols in these drawings for use when revising existing drawings and ***not*** used in new design unless directed by the FH Design Authority/System Engineer.

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

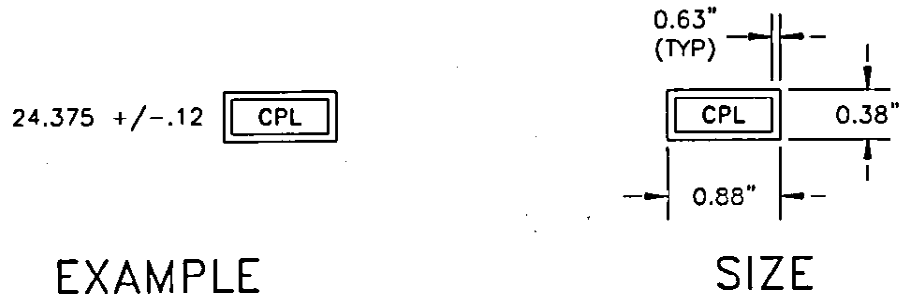
8.4 Criticality Dimensions

Under the direction of the FH Design Authority/System Engineer (FH DA/SE), identify Criticality Prevention Limit (CPL) dimensions on the face of a drawing as illustrated in the Figure 14, CPL Symbol. A Criticality Engineer is responsible for critical dimensioning and determines the need for the placement of the criticality symbol on a drawing. The critically symbol on a drawing also requires a note defining the symbol.

- Placement
  Place the CPL symbol immediately after the designed dimension. Each CPL dimension needs its own tolerance, for example, 3' -7" + 1/8" or 7" + 1/16".
- Size and shape
  Draw the CPL symbol as a double-lined rectangle (1/16" line separation) with the letters "CPL" centered inside the symbol box, as shown.
- Local or Flag Note
  The following note defines the CPL symbol on a drawing:

  "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 CONTROL INSPECTION."

Figure 14 - CPL Symbol



8.5 Legibility

Drawings shall be prepared so prints are legible when reduced. As an example, parallel lines have at least 1.5 mm (.06") spacing on the plotted drawing to maintain distinction. The final released drawing has to be capable of passing a fifth-generation copy test.

8.6 Drawing List (Drawing Tree)

Place a drawing list (Drawing Tree) on the first drawing if the project set of is 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:

- Drawings
  - Number
  - Sheet number
  - Index number
  - Building numbers (if more than one building is involved in the project)
  - Title of each drawing
- Vendor information (VI)
  - FH assigned VI file retrieval number
  - Title
- Specifications
  - FH assigned HNF retrieval number
  - Title

8.7 Lettering

- Lettering is all upper case Gothic as defined in ANSI Y14.2M, *Line Conventions and Lettering*. Use only fonts supplied with the AutoCAD program, see Section 4.12, Shape Files and Non-Standard Fonts
- AutoCAD's supplied fonts ROMANS and ROMAND comply with ANSI Y14.2M.
- Letter height is a minimum of 3 mm (.12"), except for lower case letters or metric symbols (for example, mm, and g). Lower case letters and symbols are to be proportional to the upper case lettering
- In cases where smaller letter height is needed and the drawing ***cannot*** be expanded, for example, a map, a minimum height of 2.5 mm (.1") is allowable

8.8 Drawing Orientation (North Arrow)

North is oriented to the top or left side of the sheet. Exceptions where modifications are being made to existing facilities where the orientation of the existing drawings is different or where industry practices dictate, for example, 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. Place a north arrow 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

Use a Parts/Material List on fabrication and assembly drawings, but ***not*** on project construction drawings where a separate specification controls materials. See Figure 15 - Material and Parts - Drawing Types and Classifications. For additional guidance on developing a Parts/Material List, see, ADDENDUM –E – PARTS/MATERIAL LIST RECOMMENDED PRACTICES. For additional clarification, contact the CAD and Drawing Technical Authority through the FH project POC.

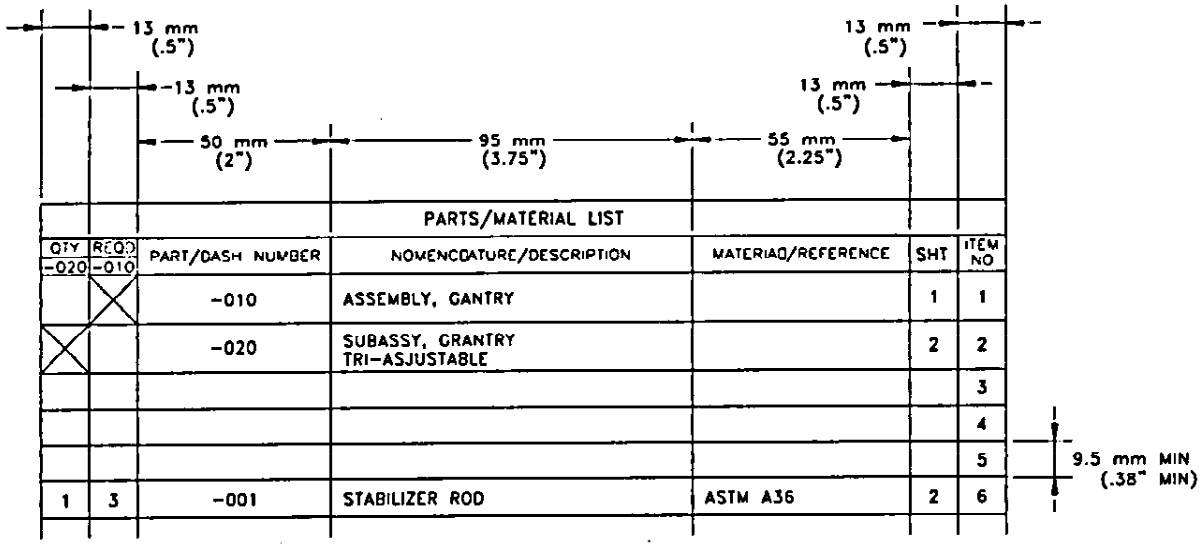
Figure 15 - Material and Parts - Drawing Types and Classifications

Engineering Drawing Type	Parts/Material List *Not* Used	Formal Parts/Material 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
Altered Item		1	5
Specification Control			All
Non-Fabrication/Construction Drawings (maps, conceptual layouts, cell arrangements, diagrams, schematics, wire run list, and drawings made for operational use).	All		

Code Key for Figure 15

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 16 - Parts/Material List



PARTS/MATERIAL LIST

QTY -020	QTY REQD -010	PART/DASH NUMBER	NOMENCOATURE/DESCRIPTION	MATERIAL/REFERENCE	SHT	ITEM NO
	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

8.10.1 Arrangement and Size

The minimum width of the Parts/Material List block having one quantity column is 240 mm (9.5"). See Figure 16 – Parts/Material List. Add quantity columns 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. ***Do not*** number individual pieces of weldments or other inseparable assemblies.

8.10.3 Part Arrangement/Order

Initially, arrange the parts/material list in a hierarchy (assemblies, subassemblies, detail parts, catalog items). It is ***NOT*** necessary to rearrange the parts/material list merely to add later entries.

8.10.4 Part Number

For engineered items, assign a unique part number to identify a designed item. The part number is a unique, non-duplicated number assigned to control a design configuration to maintain and controlled using an H-Series Drawing, for example, an assembly, subassembly and/or individual component. Identify non-interchangeable items with separate and unique part numbers. For items specifically engineered, designed and fabricated of use on the Hanford site, the official part number is the drawing number and an assigned dash number. When referencing a Hanford part number both drawing number and the dash number is used.

8.10.5 Parts and Assembly Numbers

Assign each assembly, subassembly, and detailed part a separate and unique part (dash) number. Assign the primary assembly -010 dash number. Additional assemblies and subassemblies are assigned every tenth number consecutively (for example, -020, -030, -040, etc). Assigned the first detailed part -001 dash number then 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. If needed for clarity, explain the interchangeability in the general notes.

8.10.7 Part Number Revisions

When a revision is necessary to the parts/materials list including material deletions the following methods apply for changing the parts/material list:

- Place a line through the text of the part or material item description, or
- Erase the part or material item description and add the word "Deleted," and
- Place a line through deleted part number.

8.10.8 New Part Number

Assign new part numbers, including applicable altered item part numbers when the design of a part, fabricated assembly, or procured item is changed, see Section 8.10.4. Assign a new part number if any of the following conditions apply:

- Performance or durability is affected to the extent superseded items have to be discarded for reasons of safety, failure, or malfunction.
- Interchangeable with respect to installation and/or specified performance is altered in existing designed parts, assemblies, or subassemblies such that the new designs are ***not*** directly and completely interchangeable
- Replaced /redesigned parts are limited to use in specific applications and the newly designed items are ***not*** so limited.
- Alteration of an existing Hanford item, or vendors' purchased item, for an application.
- Rework of existing items ***cannot*** be directly and completely interchangeable with the new design.

NOTE: Add new/replacement parts at the end of the parts/materials list using sequential part numbers. Do ***not*** use existing Part numbers to identify new or different parts/material—assign new part numbers.

8.10.9 Purchased Items

Identify purchased items in the parts/materials list with the manufacturer's part number or vendor information (VI) number as applicable. Control of the design is by the vendor, unless modified for a design application (Altered Item).

8.10.10 Altered Item

Develop a new Altered Item Drawing for a vendor-supplied item that requires alteration after purchase for a Hanford Site application as specified in a new engineering design. The following applies:

- The words "ALTERED ITEM" are the first two words of the drawing title.
- Place the words "ALTERED FROM (manufacturer's part number and part name or existing Hanford part number and part name)" in the description column of the parts list.
- Assign a new Hanford part number to the altered item and place the part number column.
- Detail the alteration using visible lines in accordance with ASME Y14.2M-1992, Line Conventions, and Lettering.
- Use phantom lines identified in ASME Y14.2M for reference features. Limit reference features (features ***not*** needing alteration) to orientation for alterations.

8.10.11 Quantities and Customary Trade Units

Enter quantities (counted accurately) in customary trade units.

8.10.12 As Required (AR) Designation

Enter AR (as required) if the quantity is unknown or where the quantity could vary.

8.10.13 Part Description

Enter a generic description, except for where it is necessary for a specific commercial item purchased as a sole source. List the name of the item first with supplemental descriptive words following. The description of an item must be complete and provide specifications sufficient to procure the item.

Use standard industry language to define the item. If the item described in the parts/materials list text is complete without the aid of detailed graphics, a detailed graphic is ***not*** placed on the drawing.

9.0 COMPONENT NUMBERING

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

10.0 METRIC MEASUREMENT SYSTEM

Use the following direction as applicable for drawings where the metric system is used.

- Metric designations, for example, mm, Pa, L m^2, cm^2, etc, are symbols within the metric system and used to the fullest extent possible for clarity on engineering drawings.
- Use (SI) symbology, as identified in the latest edition of ANSI/IEEE Standard 268, *American National Standard for Metric Practice.*
- ASME Y14.38, does ***not*** address the metric symbols and is ***not*** applicable for metric designations.
- Modifications to drawings containing English units may continue to use the English system unless otherwise specified by the contract.

10.1 Metric Measurement versus Inch-Pound Measurement in Design

In designs specifying metric system of measurement, use hard metric measurements. ***Never*** use the inch-pound system to develop a design and then convert the design from inch-pound measurements to metric measurements. See soft metric conversion, and hard metric conversion.

10.2 Metric Dimensioning

- Show all linear dimensions on engineering drawings in millimeters, except on large site plans and civil drawings. Large site plans and civil drawings show linear dimensions in meters with the decimals carried out to one, two, or three places.
- ***Do not*** use commas in metric system numbers. Spaces are used in place of commas to separate digits into groups of three (for example, 500 000 mm) but a comma is ***not*** used in four-digit numbers, (for example, 5000 m). Use a space to separate the numeric value from the measurement unit (for example, mm, m), but ***never*** allow the number and unit to be separated between lines of text.
- Metric dimensions and unit symbols are always in upright type (vertical lettering), even when the surrounding text is in italics.
- Use square meters or sub-multiples to specify areas (for example, m^2, cm^2, and mm^2). Fluid volumes are specified in liters (symbol is upper case L), except large volumes may be expressed in cubic meters (m^3) (for example, 1000 L = 1 m^3).

- Avoid dual dimensioning (both inch-pound and metric shown for the same dimension). In cases where dual dimensioning is determined to be needed, such as an interfacing point with existing items, the following applies:
  - Show metric dimensions first with the inch-pound equivalent shown in parentheses
  - Add a general note to the drawing stating the inch-pound dimensions shown in parentheses are equivalent to the metric dimensions they follow, but are not to be used for fabrication/construction
  - If an interfacing point requires an inch-pound dimension, show the specific tolerance for each dimension at each inch-pound dimension occurrence

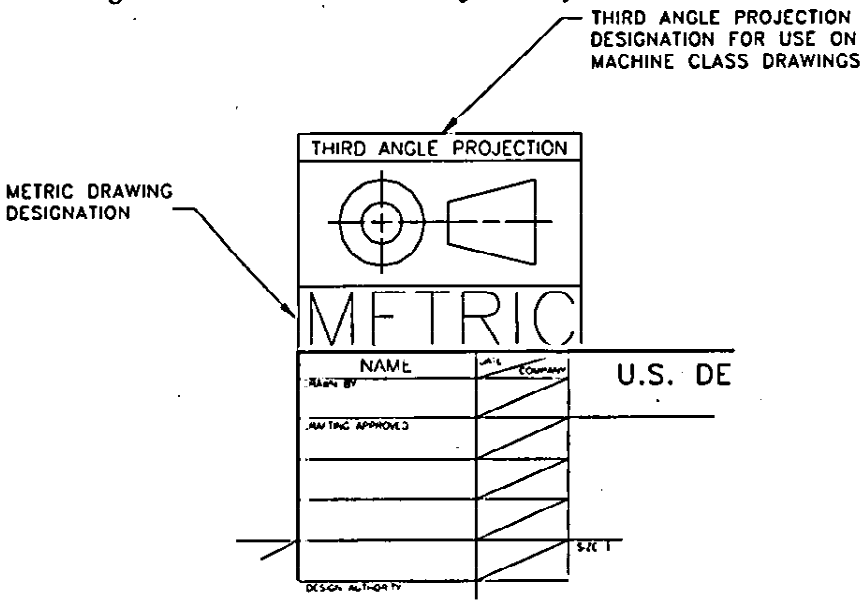
10.3 Metric Notation

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 17 and Figure 5.

10.4 Third Angle Projection

All metric 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. Place the international projection symbol and the words "THIRD ANGLE PROJECTION" directly above the metric notation, see Figure 17 and Figure 5.

Figure 17 – Metric Designation and International Projection Symbol



10.5 Converted Metric Designations for Construction Materials and Parts

Converted metric designations are designations of materials and parts converted from the inch-pound system (for example, 2" pipe converted to DN 50 pipe; 2x4 lumber stud converted to 50 x 100 mm lumber stud). Show these conversions where items have equivalent metric designation.

Many industrial products are available in metric designations and follow the appropriate industry organization standards for designations. In some cases where designations lose their proper meaning, inch or metric equivalents are ***never*** shown (for example, 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 Working References

ASME Y14 Series, *Drafting Practices*
IEEE Standard 268-1992, *American National Standard for Metric Practice*
ASME Y14.1-1995 (R2002), *Drawing Sheet Size and Format*
ASME Y14.1M-1995 (R2002), *Metric Drawing Sheet Size and Format*
ASME Y14.2M-1992, *Line Conventions and Lettering*
ASME Y14.3-2003, *Multi and Sectional View Drawings*
ASME Y14.38-1994, *Abbreviations and Acronyms*

H-9-006010, Sheets 1 thru 6, Master PFD and P&ID Legend
H-9-006015, Sheet 1, Master Abbreviations
H-9-006020, Sheets 1 and 2, Master Electrical Elementary and One-Line Legend
H-9-006021, Sheet 1, Master Electrical Plan Legend

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

Washington Coordinate System of 1983, south zone (1991) (WCS83S[1991])
The North American Vertical Datum of 1988 (NAVD88)

ADDENDUM -A-, Glossary

altered-item drawing: An engineering drawing used to depict an alteration to a commercial item and to place the altered item under configuration control through assigning a new part number. An altered-item drawing reflects only the change and ***not*** intended to show complete fabrication detail.

applied material: Material ***not*** normally shown on the graphic presentation of a drawing (for example, glues, adhesive, paint, cleaner). It may or may ***not*** have a manufacturer's identification number. Identify special instruction on applied material in the General Notes. Weld rod is ***not*** included in this definition.

architectural floor plan: A floor plan is a horizontal section through a structure showing floors, exterior walls, and interior partitions, with appropriate symbols for materials used.

arrangement/Installation drawing: The top-level drawing where multiple related details, assemblies, subassemblies, and certain connecting parts and/or instructions depict the relationship of the drawing with one another. Arrangement/installation drawings are prepared to show particular equipment locations. This helps in identifying the desired location and identifies where potential interferences are likely.

as required (AR): Used for notation where exact quantities are ***not*** known or ***cannot*** be determined. 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 have the same meaning and used interchangeably.

assembly drawing: An assembly drawing is the top-level drawing showing the engineering instructions for assembly of the depicted design. It identifies the subassemblies, components, and assembly methods. It provides traceability to the engineering drawings that detail the end-product engineering design.

assemblies: Every tenth number is reserved for assemblies (for example, -010, -020, -030, -040) and the Parts are identified starting with -001 for the first part and consecutively for all others, reserving every tenth number for assemblies (for example, -001 through 009; -011 through -019; etc.).

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

baseline documentation: For the purpose of this instruction, engineering design documents that detail the design criteria and used to construct, fabricate and maintain a system, structure or component are baseline documents and under configuration control for the useful life of the depicted design.

block flow diagram: A precursor to the development of the Process Flow diagram and P&ID drawing is the understanding of the expected end process. The block flow diagram shows the major elements used in the process.

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

civil plan drawing: Civil Drawings are Graphic and symbolic representations of existing and/or planned surface features of a region showing the necessary construction required for develop of a site. These drawings show natural and manmade features or objects (such as hills, valleys, streams, swamps, buildings and structures, power transmission lines, railroads, etc.), indicating their geometric configuration and physical relationship to other structures and boundary lines.

component number: A component number consists of letters and/or numbers that initially serve to 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 file: The CAD data file is the computer data file used to produce a hard copy drawing. Also, see definition of Master CAD File.

connection diagram: A connection diagram shows the connections of devices contained within a console/cabinet or panel. It is used a guide for installation of wires or cable.

configuration control: Managing engineering drawings by processing the drawing and maintaining the history of the latest revision to the drawing. Additionally, any changes to the drawing require a process to assure incorporation of the changes into the affected drawing.

construction drawing: Construction drawings depict information necessary to build and or assemble a structure or system and come in a variety of different disciplines. These drawings normally depicted in orthographic projection with each view containing the necessary dimensions to support making or assembling the depicted structure/system.

customary trade units: Refers to identifying items in accepted units for purchasing specific items, fabrication materials and construction consumables through identifying accepted unit of weight or measurement. One of the important variables is whether the design is in metric or the inch-pound system as the quantities for the design can be dependent on which system is used. For example, inches, millimeters, pairs, pounds, ounces, liters, etc. Each industry has its customary units for either metric or inch-pound and identifying the correct unit is necessary to assure purchase of the proper quantity.

dash number: A dash number is a unique numerical identification assigned to an item for configuration design control. When suffixed to the drawing number, the dash number provides a unique part number for that item. Assigned dash numbers identify two or more items or an assembly depicted on a drawing and used for unique identification and configuration control of the item. The dash number consists of a three-digit number following the drawing number, as follows:

EXAMPLE: *H-3-60670-010*
-010 is the Dash Number
H-3-60670 is the Drawing Number

designed item: For the purpose of this instruction, a designed item is an individual fabricated item engineered and designed to meet the requirements of an engineering application/function that requires an assigned part number for configuration control.

detailed item (Piece Parts): 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: For the purpose of this procedure, the function of managing the acceptance, routing, tracking and revision history of engineering documents that demonstrate the fabrication, construction and installation of systems, structures, and components on the Hanford Site.

drawing Tree drawing: A drawing list showing all the drawings that make up a project by showing how the drawings link together (forward and backward traceability). The drawing tree provides an over view of the drawing and is the first drawing of a project drawing set.

drawing original: Is the plotted drawing that is approved by signatures of authorized company personnel that attest to the accuracy and quality of the engineering contents of the drawing (for new drawings) or for the revision to an approved engineering drawing.

electrical one-line diagram: This is a one-line diagram showing the electrical power distribution through single lines and graphic symbols. It shows component devices of an electrical circuit or system of circuits. One-line diagrams are useful in depicting the overall relationship between component devices of circuits and between circuits. A one-line diagram records a maximum amount of significant electrical system information in a minimum amount of space.

engineering document: An approved and released engineering specification, criteria, graphic representation of a facility system, structure, and/or component retained for its lifetime. This can be the original signed document and/or the electronic version of an engineering document. Also see definition for Master CAD Drawing; Engineering drawing and Original Drawing

engineering drawing: For the purpose of this direction, an engineering drawing is an engineer approved drawing, including architectural and civil that depicts by means of graphics, pictorial, and textual presentations, the form, fit, and function needs of an engineering approved structure, system or component. Also, see definition of Original Drawing and Vendor Information.

envelope drawing: There are two different definitions covering this drawing type, as follows:

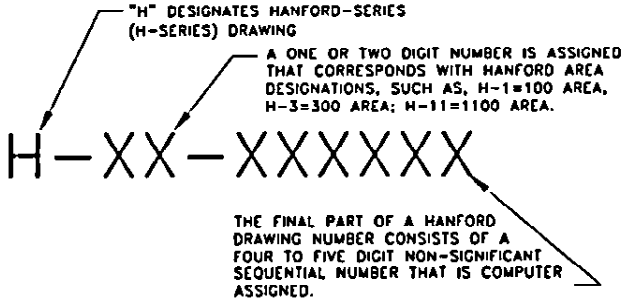
- Customer developed drawing that defines the area that an item is required to fit within, in some cases, the area available for maintenance, is called the envelope of the design, is normally used when, an item is being purchased to ensure that it will fit in the area reserved during the design process.
- Manufacturing Vendor developed drawing that defines the dimensions of an item for the purpose of installation and may include additional space requirements for maintenance.

fifth-generation copy test: For the purposes of this direction, 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); a copy of that copy (third-generation copy), etc., until achieving a fifth-generation copy of the original. The graphics and text of the fifth-generation copy have to be clearly legible without magnification, special lenses, or editing.

final plot: See definition for drawing original.

FH Design Authority/System Engineer (FH DA/SE): For the purpose of this instruction, this FH engineer is assigned overview responsibility for a specific system, structure, or component.

H-Series drawing: Is the official engineering drawings assigned unique, non-duplicated drawing numbers starting with the letter H, followed by a dash and one to two numbers that correspond to area designators, then another dash and a non-significant sequential number. These drawings require development with specific standards for releasing retrieving and maintaining the drawing for the life of the Hanford facilities they represent.



Hanford Document Control System (HDCS): The official database that tracks the current and historical status of all documents deemed important to both current and past operations of Fluor Hanford. For example, all engineering documents (drawings, specifications, supporting data, vendor information data, and environmental data) released into the system and with all changes to the engineering documents identified, released, and tracked against the affected engineering document.

hard copy drawing: See definition for drawing original.

hard metric conversion: The process of changing measurements from inch-pound units into metric units by converting dimensions into SI metric dimensions (base 10 system). This conversion of inch-pound design directly to metric dimensions to achieve duplicate (equivalent) design is called a hard metric conversion. For example, an item measuring 3/4-inch by 5 1/4 inches would result in a hard metric conversion that is approximately 19 mm x 133 mm with the tolerances then specified in metric; neither the dimensions nor tolerance will be equivalent. Hard metric conversion establishes a complete new item design that rarely interchanges with the inch-pound design and usually ***not*** interchangeable. Also, see glossary for soft metric conversion, inch-pound system, and metric system.

inch-pound system: For the purpose of this instruction, Inch-pound system identifies units of measurement (a.k.a. English System or Imperial System). Inches, yards, miles pounds, degrees Fahrenheit, gallons, etc, and are the formally recognized inch-pound units 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 disassembly without destroying the intended function of the item (for example, weldments, or bonded assembly).

item number (find number): A number assigned to every line entry of a Parts/Materials Lists to tabulate items in the list; used to locate an item in the field of the drawing. The find number is ***not*** the part number. The term "Find Number" is interchangeably with the term "Item number".

loop sheet: Instrument Loop drawings normally show each component from field device to final receiver including physical location, initiating device, its terminal number, and junction box with its

terminal number, cable number with pair number/polarity, receiver instrument terminals/cabinet terminals, and system functional blocks of loop in simplified schematic format.

Master CAD data file: For the purpose of this instruction, the Master CAD Data File is the latest formally approved 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 and care to ensure that it is available for subsequent revision of the engineering drawing.

metadata: Embedded data considered important that provides information to future users about the data file (data about the drawing data). Examples include drawing view port XP scales, and block information.

metric system (International System (SI) of Units): Adopted metric measurement system approved by the 11th General Conference on Weights and Measures (CGPM) in 1960, and recognized by the worldwide standard setting organizations such as ISO, ANSI, German Institute of Standards (DIN), Japan Instrument Society (JIS), and Center for Studies of Nuclear Energy (CEN).

modification drawing: A drawing type developed to show modification to an existing system or structure and used during the construction/modification phase. Modification drawings also include drawings showing required demolition to facilitate modifications. Modification drawings provide as-built documentation for updating the primary engineering drawing used for operations and maintenance. When a modification is work complete, and depending on the classification of the affected drawing (for example, essential or support) it may be incorporated into the primary drawings to reflect the As-Built configuration; then the modification drawing is placed into inactive status.

part number: Items specifically engineered for the Hanford site are assigned part numbers that consist of the drawing number (H-Series Drawings) plus an assigned dash number, also see Altered Item drawing. Part numbers for purchased items are the manufactures assigned part number part number. A vendor item number from a catalog (for example, Grange or McMaster Carr) is ***not*** a part number and may only be use as a reference.

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

process flow diagram (PFD): A simplified schematic description of a process, including the following elements:

- 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

This is accomplished using specific symbology traceable to a Legend for identifying equipment, piping, instrumentation, and process lines.

piping and instrumentation diagram (P&ID): The principal engineering design document used to define the details of how a process works and how it is controlled. This drawing shows the interconnection of process equipment and the instrumentation used to control the process schematically (without regard to the physical system layout). This is accomplished using specific symbology traceable to a Legend for identifying equipment, piping, instrumentation, and process lines.

plot plan drawing: The plot plan often functions as "top drawing" for a set of civil, architectural, structural, HVAC, piping and instrumentation and electrical drawings, which together comprise the complete design. Plot Plans are permanent records, which depict the basis for design of new facilities. This type of drawing shows the limits of the facility footprint; therefore, its accuracy is of extreme importance.

release: For the purpose of this instruction, the formal FH process of making an engineering drawing the current controlled revision and placing the original approved hard copy drawing in formal drawing storage and concurrent retention of the associated CAD data file in the Hanford Engineering Document Management System.

revision: The formal act of incorporating approved changes to an engineering drawing. The revised drawing replaces the previously approved and released drawing.

schematic diagram: Schematic diagrams facilitate tracing electric circuits and are among the most important engineering drawings. They define functions, without regard to physical size, shape, or location of components, devices, or parts. Graphic symbols and reference designations show connections and junctions of a specific circuit arrangement. Schematic diagrams are useful in circuit analyses and evaluations, as an aid to manufacturing installation testing, quality inspection, engineering changes, operations, and maintenance.

sections and details: Sections cut partially, or entirely, through an area to show construction and treatment of the depicted information (architectural, piping, structural, HVAC). The cutting plane of a section need not be continuous. Sections depict the true position with regard to the cutting plane.

soft Metric conversion: This is 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. Soft metric dimensions result from taking a dimension already designed to inch-pound system dimensions and converting those dimensions to (approximately equivalent) metric dimensions. For example, an item measuring 3/4-inch by 5 1/2 inches could result in a "soft" metric conversion yielding 19 mm by 140 mm (which includes rounding off the numbers). Soft metric conversion can create a situation where tolerances will ***not*** work when using the metric dimensions, therefore a general note stating this fact is highly recommended. Also, see glossary Hard metric conversion, inch-pound system, and Metric System (International System (SI) of Units).

stock/material item: Material used in an inseparable assembly whose final configuration is contained within the configuration of that assembly (for example, a weldment). Also, see Inseparable Assembly definition.

subassembly: An assembled unit designed for incorporation with other units. See definition of Assembly.

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

vendor information (VI) drawing: A drawing prepared by a vendor according to the manufactures individual company requirements that may provide information on interface envelop

configuration, installation, maintenance, and/or operation of a procured item that is commercially available for sale in the open market. Also, See Engineering drawing.

third-party software: For the purpose of this direction, Third-Party Software is any add-on software, including Autodesk owned, used in conjunction with AutoCAD to develop a CAD data file. There is a wide array of these programs available, some of which require the third-party program to be loaded with AutoCAD to work on the CAD data file.

vendor (supplier) item: an item procured from an off-site manufacturer to a vendor's specification that has specific functional, physical features needed a depicted design, for example, valves, pumps, and condensers. The item has a specific part number identification assigned by the manufacturer.

(engineering) vendor information (VI) data: Any type of vendor supplied technical documentation / information that has been determined by the responsible engineer to be necessary for the operation and/or maintenance of items in a system or structure. The types of documents typically procured and maintained as VI include the following:

- Certified Test Data
- Data Sheets
- Equipment Weight
- Illustrative Cuts
- Instructions
- Installation Drawings
- Installation Instructions
- Maintenance Manual
- Operations Manual
- Power Requirements
- Schematics and Control Diagrams
- Spare Parts List
- Specifications

x-reference: 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 bound into the master (main) data file.

ADDENDUM -B-, Layer Naming for AutoCAD Drawings by Discipline

Table B1, General Layering for all Disciplines

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	Line Weight	Plotter Pen Number
	AutoCAD Program				
0	AutoCAD generated. Not for project drawings; used for symbol creation	White	Continuous	3.5 mm 0.014"	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	3.5 mm 0.014"	Pen No. 2
	General Layers				
*?O-BRD	Title block , associated blocks, and drawing border	132	Continuous	3.5 mm 0.014"	Pen No. 2
*?M-DIM	Dimensioning	253	Continuous	2.5 mm 0.010"	Pen No. 1
*?T-TXT	Text, General associated with a specific layer	White	Continuous	3.5 mm 0.014"	Pen No. 2
*?T-BTXT	Text, Bold	Yellow	Continuous	7 mm 0.028"	Pen No. 4
*?T-REF	Reference items and notes that aid CAD uses during construction of the drawing	213	Continuous	2.5 mm 0.010"	Pen No. 1
*?T-CHK	Checker's marks (informal only)	11	Continuous	5 mm 0.020"	Pen No. 3
*?O-VPT	Paper space Viewport border	White	Continuous	3.5 mm 0.014"	Pen No. 2
*?O-CLD	Clouded areas for Hold, FMP/ECN, and revision	White	Continuous	3.5 mm 0.014"	Pen No. 2
*?E-EXST	Anything existing to remain	8	Phantom	2.5 mm 0.010"	Pen No. 1
*?D-DEMO	Existing items /equipment required to be removed or demolished	Cyan	HiddenX2	5 mm 0.020"	Pen No. 3
*?C-CLINE	Center line	Blue	Center	3.5 mm 0.014"	Pen No. 2
*?X-HATCH	Cross-section lines	Blue	Continuous	3.5 mm 0.014"	Pen No. 2
*?H-HIDL	Hidden lines	Blue	Hidden	3.5 mm 0.014"	Pen No. 2
*?V-MLN	Matchlines	Red	Phantom	9 mm 0.35"	Pen No. 5

Table B2 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	Line Weight	Plotter Pen Number
	General Layers				
AO-BRD	Title block, associated blocks, and drawing border	132	Continuous	3.5 mm 0.014"	Pen No. 2
AM-DIM	Dimensioning	253	Continuous	2.5 mm 0.010"	Pen No. 1
AT-TXT	Text, General associated with a specific layer	White	Continuous	3.5 mm 0.014"	Pen No. 2
AT-BTXT	Text, Bold	Yellow	Continuous	7 mm 0.028"	Pen No. 4
AT-REF	Reference items and notes that aid CAD users during construction of the drawing	213	Continuous	2.5 mm 0.010"	Pen No. 1
AO-VPT	Paper space Viewport border	White	Continuous	3.5 mm 0.014"	Pen No. 2
AO-CLD	Clouded areas for Hold, FMP/ECN, and revision	White	Continuous	3.5 mm 0.014"	Pen No. 2
AE-EXST	Anything existing to remain	8	Phantom	2.5 mm 0.010"	Pen No. 1
AD-DEMO	Existing items /equipment required to be removed or demolished	Cyan	HiddenX2	7 mm 0.028"	Pen No. 3
AX-HATCH	Cross-section lines	Blue	Continuous	3.5 mm 0.014"	Pen No. 2
AV-MLN	Matchlines	Red	Phantom	9 mm 0.35"	Pen No. 5
	Specific Layers				
AO-ACCESSORY	Accessory items - including furniture, HVAC equipment, plumbing fixtures, people, trees, vehicles, etc.	White	Continuous	3.5 mm 0.014"	Pen No. 2
AO-CEILING	Ceiling - SATC, hanger wires, etc.	White	Continuous	3.5 mm 0.014"	Pen No. 2
AC-COLUMN	Building column lines	White	Center	3.5 mm 0.014"	Pen No. 2
AO-DOOR	Interior and exterior	Magenta	Continuous	3.5 mm 0.014"	Pen No. 2
AO-DOORSPEC	Door tag (Architectural Steering Group users only)	White	Continuous	3.5 mm 0.014"	Pen No. 2
AO-FLOOR	Floor plan and background	8	Continuous	3.5 mm 0.014"	Pen No. 2
AO-HEADER	Door header (use with ceiling plan)	White	Continuous	3.5 mm 0.014"	Pen No. 2
AO-SCHEDULE	Room, door, finish, and window	Cyan	Continuous	7 mm 0.028"	Pen No. 3
AO-STAIR	Interior and exterior	White	Continuous	3.5 mm 0.014"	Pen No. 2
AO-TAG	Tags for miscellaneous equipment, windows, etc.	White	Continuous	3.5 mm 0.014"	Pen No. 2
AO-WALLS	Interior and exterior	Cyan	Continuous	7 mm 0.028"	Pen No. 3
AO-WINDOWS	Interior and exterior	White	Continuous	3.5 mm 0.014"	Pen No. 2

Table B3 Civil/Structural/Environmental

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

Layer Name	Description	Line Color	Line Type	Line Weight	Plotter Pen Number
	General Layers				
*?O-BRD	Title block, associated blocks, and drawing border	132	Continuous	3.5 mm 0.014"	Pen No. 2
*?T-TXT	Text, General associated with a specific layer	White	Continuous	3.5 mm 0.014"	Pen No. 2
*?T-REF	Reference items and notes that aid CAD users during construction of the drawing	213	Continuous	2.5 mm 0.010"	Pen No. 1
*?O-VPT	Paper space Viewport border	White	Continuous	3.5 mm 0.014"	Pen No. 2
*?V-MLN	Matchlines	Red	Phantom	9 mm 0.35"	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 4.3					
	Civil Drawing Specific Layers				
CO-GRID	Site Grids, Profile Grids, etc.	253	Continuous	2.5 mm 0.010"	Pen No. 1
CO-SITE	Property lines, boundaries, fences, etc.	60	Continuous	7 mm 0.028"	Pen No. 4
CO-ROAD	Roads, trails, parking, etc.	10	Continuous	7 mm 0.028"	Pen No. 4
CO-STRL	Structural work	210	Continuous	7 mm 0.028"	Pen No. 4
CO-GND	Contours, grade breaks, etc.	Green	Continuous	7 mm 0.028"	Pen No. 4
CO-PIPE	Pipelines and piping	Yellow	Continuous	7 mm 0.028"	Pen No. 4
	Structural Drawing Specific Layers				
SC-GRID	Building column grid	253	Center	2.5 mm 0.010"	Pen No. 1
SO-GND	Grade or earth shown on sections	Green	Continuous	7 mm 0.028"	Pen No. 4
SO-CONC	Concrete	Yellow	Continuous	7 mm 0.028"	Pen No. 4
SO-FRWK	Framework	Cyan	Continuous	5 mm 0.020"	Pen No. 3
SO-RBR	Rebar	130	Continuous	7 mm 0.28"	Pen No. 4
SO-MECH	Piping or other mechanical	11	Continuous	5 mm 0.020"	Pen No. 3
SO-EMBED	Embedments	131	Continuous	5 mm 0.020"	Pen No. 3
SO-STL	Steel	130	Continuous	7 mm 0.028"	Pen No. 4

Table B4 Electrical Drawings

Layer Name	Description	Line Color	Line Type	Line Weight	Plotter Pen Number
		General Layers			
*EO-BRD	Title block, associated blocks, and drawing border	132	Continuous	3.5 mm 0.014"	Pen No. 2
EM-DIM	Dimensioning	253	Continuous	2.5 mm 0.010"	Pen No. 1
ET-TXT	Text, General associated with a specific layer	White	Continuous	3.5 mm 0.014"	Pen No. 2
ET-BTXT	Text, Bold text	Yellow	Continuous	7 mm 0.028"	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	2.5 mm 0.010"	Pen No. 1
EO-BLD	Building	171	Continuous	0.50 mm 0.020"	Pen No. 3
EO-CND	Conduit, cable, raceway, boxes, ductbanks	51	Continuous	5 mm 0.020"	Pen No. 3
EO-CPT	Cathodic protection	11	Continuous	5 mm 0.020"	Pen No. 3
EO-EQP	Equipment	211	Continuous	5 mm 0.020"	Pen No. 3
EO-LTG	Lighting	Cyan	Continuous	5 mm 0.020"	Pen No. 3
EO-MS1	Electric miscellaneous 1	32	Continuous	3.5 mm 0.014"	Pen No. 2
EO-MS2	Electric miscellaneous 2	51	Continuous	5 mm 0.020"	Pen No. 3
EO-OHD	Overhead lines	11	Continuous	5 mm 0.020"	Pen No. 3
EO-RCP	Receptacles, (120, 208, 480V)	Cyan	Continuous	5 mm 0.020"	Pen No. 3
EO-SGD	Signaling devices	211	Continuous	5 mm 0.020"	Pen No. 3
EO-UGD	Underground lines (hidden)	13	Hidden	2.5 mm 0.010"	Pen No. 1
		Diagram/Schedule Drawing Specific Layers			
EO-DIA	Diagrams, one-line, elementary, etc.	91	Continuous	5 mm 0.020"	Pen No. 3
EO-MS1	Electric miscellaneous 1	32	Continuous	3.5 mm 0.014"	Pen No. 2
EO-MS2	Electric miscellaneous 2	51	Continuous	5 mm 0.020"	Pen No. 3

Table B5 Fire Protection Drawings

Layer Name	Description	Line Color	Line Type	Line Weight	Plotter Pen Number
		*General Layers			
FO-BRD	Title block, associated blocks, and drawing border	132	Continuous	3.5 mm 0.014"	Pen No. 2
*FM-DIM	Dimensioning	253	Continuous	2.5 mm 0.010""	Pen No. 1
FT-TXT	Text, General associated with a specific layer	White	Continuous	3.5 mm 0.014"	Pen No. 2
FT-BTXT	Text, Bold	Yellow	Continuous	7 mm 0.028"	Pen No. 4
FE-EXST	Anything existing to remain	8	Phantom	2.5 mm 0.010"	Pen No. 1
FD-DEMO	Existing items /equipment required to be removed or demolished	Cyan	HiddenX2	5 mm 0.020"	Pen No. 3
**FC-CLINE	Center line	Blue	Center	3.5 mm 0.014"	Pen No. 2
FV-MLN	Matchlines	Red	Phantom	9 mm 0.35"	Pen No. 5
		Fire Detection Drawing Specific Layers			
FO-AD	Alarm and detection system	211	Continuous	5 mm 0.020"	Pen No. 3
FO-FW	Fire water underground	211	Hidden	5 mm 0.020"	Pen No. 3
		Sprinkler Drawing Specific Layers			
FO-FW	Fire water underground	211	Hidden	5 mm 0.020"	Pen No. 3
FO-SS	Sprinkler system	211	Continuous	5 mm 0.020"	Pen No. 3
FO-HS-1	Standpipe hose system	211	Continuous	5 mm 0.020"	Pen No. 3

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

** Sprinkler drawing only.

Table B6 HVAC Drawings

Layer Name	Description	Line Color	Line Type	Line Weight	Plotter Pen Number
		*General Layers			
HO-BRD	Title block, associated blocks, and drawing border	132	Continuous	3.5 mm 0.014"	Pen No. 2
HM-DIM	Dimensioning	253	Continuous	2.5 mm 0.010"	Pen No. 1
HT-TXT	Text, General associated with a specific layer	White	Continuous	3.5 mm 0.014"	Pen No. 2
HT-BTXT	Text, Bold	Yellow	Continuous	7 mm 0.028"	Pen No. 4
*HT-REF	Reference items and notes that aid CAD users during construction of the drawing	213	Continuous	2.5 mm 0.010"	Pen No. 1
**HO-VPT	Paper space Viewport border	White	Continuous	3.5 mm 0.014"	Pen No. 2
HV-MLN	Matchlines	Red	Phantom	9 mm 0.35"	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	5 mm 0.020"	Pen No. 3
HO-EXH	HVAC exhaust system	171	Continuous	5 mm 0.020"	Pen No. 3
HO-PIP	Piping and piping fixtures and hardware	51	Continuous	5 mm 0.020"	Pen No. 3
HO-PLM	Plumbing and plumbing fixtures and hardware	201	Continuous	5 mm 0.020"	Pen No. 3
HO-RTN	HVAC return system	Cyan	Continuous	5 mm 0.020"	Pen No. 3
HO-SUP	HVAC supply system	51	Continuous	5 mm 0.020"	Pen No. 3
		HVAC/Instrumentation Drawing Specific Layers			
IO-ELEC	Electrical equipment	71	Continuous	5 mm 0.020"	Pen No. 3
IO-DCS	Distributed control system instruments	Cyan	Continuous	5 mm 0.020"	Pen No. 3
IO-ELINE	Electrical signal lines	42	Hidden	3.5 mm 0.014"	Pen No. 2
IO-ILINE	Instrument lines, such as pneumatic	Magenta	Continuous	3.5 mm 0.014"	Pen No. 2
IO-CVAL	Control valves	Cyan	Continuous	5 mm 0.020"	Pen No. 3
IO-SLINE	Software link line	Magenta	Continuous	5 mm 0.020"	Pen No. 3

Table B7 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	Line Weight	Plotter Pen Number
		*General Layers			
IO-BRD	Title block, associated blocks, and drawing border	132	Continuous	3.5 mm 0.014"	Pen No. 2
**IM-DIM	Dimensioning	253	Continuous	2.5 mm 0.010"	Pen No. 1
IT-TXT	Text, General associated with a specific layer	White	Continuous	3.5 mm 0.014"	Pen No. 2
IT-BTXT	Text, Bold	Yellow	Continuous	7 mm 0.028"	Pen No. 4
IT-REF	Reference items and notes that aid CAD users during construction of the drawing	213	Continuous	2.5 mm 0.010"	Pen No. 1
IT-CHK	Checker's marks (informal only)	11	Continuous	5 mm 0.020"	Pen No. 3
IO-VPT	Paper space Viewport border	White	Continuous	3.5 mm 0.014"	Pen No. 2
IO-CLD	Clouded areas for Hold, FMP/ECN, and revision	White	Continuous	3.5 mm 0.014"	Pen No. 2
IE-EXST	Anything existing to remain	8	Phantom	2.5 mm 0.010"	Pen No. 1
ID-DEMO	Existing items /equipment required to be removed or demolished	Cyan	HiddenX2	5 mm 0.020"	Pen No. 3
IC-CLINE	Center line	Blue	Center	3.5 mm 0.014"	Pen No. 2
IX-HATCH	Cross section lines	Blue	Continuous	3.5 mm 0.014"	Pen No. 2
IH-HIDL	Hidden lines	Blue	Hidden	3.5 mm 0.014"	Pen No. 2
IV-MLN	Matchlines	Red	Phantom	9 mm 0.35"	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	5 mm 0.020"	Pen No. 3
IO-INS	Instruments	211	Continuous	5 mm 0.020"	Pen No. 3
IO-DCS	Distributed control system instruments	Cyan	Continuous	5 mm 0.020"	Pen No. 3
IO-ELINE	Electrical signal lines	42	Hidden	3.5 mm 0.014"	Pen No. 2
IO-ILINE	Instrument lines, such as pneumatic	Magenta	Continuous	3.5 mm 0.014"	Pen No. 2
IO-CVAL	Control valves	Cyan	Continuous	5 mm 0.020"	Pen No. 3
IO-SLINE	Software link line	Magenta	Continuous	5 mm 0.020"	Pen No. 3
IO-EQP	Equipment	141	Continuous	5 mm 0.020"	Pen No. 3
IO-MAJ	Major process lines	Red	Continuous	9 mm 0.35"	Pen No. 5
IO-MIN	Minor process lines	Yellow	Continuous	7 mm 0.028"	Pen No. 4
IO-PROC	Process line	152	Continuous	3.5 mm 0.014"	Pen No. 2
IO-PIP	Piping valves and fittings	121	Continuous	5 mm 0.020"	Pen No. 3
		Plans, Elevations, Details, and Assembly Drawing Specific Layers			

IO-TUBE	Tubing	52	Continuous	3.5 mm 0.014"	Pen No. 2
IO-BGND	Background	8	Continuous	2.5 mm 0.010"	Pen No. 1
IO-PIPE	Piping	12	Continuous	3.5 mm 0.014"	Pen No. 2
IO-BLDG	Building	8	Continuous	2.5 mm 0.010"	Pen No. 1
IO-EQP	Equipment	143	Continuous	2.5 mm 0.010"	Pen No. 1
IO-INS	Instruments	210	Continuous	7 mm 0.028"	Pen No. 4
IO-FRM	Panels, racks, cabinets	32	Continuous	3.5 mm 0.014"	Pen No. 2
IO-WRG	Wiring	92	Continuous	3.5 mm 0.014"	Pen No. 2
IO-CVAL	Control valve	130	Continuous	7 mm 0.028"	Pen No. 4
Wiring/Tubing Diagram Drawing Specific Layers					
IO-WRG	Wiring	Green	Continuous	7 mm 0.028"	Pen No. 4
IO-INS	Instruments	Magenta	Continuous	3.5 mm 0.014"	Pen No. 2
IO-DCS	Distributed control system instruments	132	Continuous	3.5 mm 0.014"	Pen No. 2
IO-TBLK	Terminal blocks	152	Continuous	3.5 mm 0.014"	Pen No. 2
IO-SLINE	Software lines	12	Continuous	3.5 mm 0.014"	Pen No. 2
IO-TUBE	Tubing	Yellow	Continuous	7 mm 0.028"	Pen No. 4
Logic/Block Diagram Drawing Specific Layers					
IO-GATE	Logic gate/memory latch	Green	Continuous	7 mm 0.028"	Pen No. 4
IO-SPATH	Software signal path	12	Continuous	3.5 mm 0.014"	Pen No. 2
IO-HPATH	Hardware signal path	152	Continuous	3.5 mm 0.014"	Pen No. 2
IO-INS	Instruments	211	Continuous	5 mm 0.020"	Pen No. 3
IO-DCS	Distributed control system instruments	Cyan	Continuous	5 mm 0.020"	Pen No. 3

Table B8 Mechanical Drawings

Layer Name	Description	Line Color	Line Type	Line Weight	Plotter Pen Number
		General Layers			
MO-BRD	Title block, associated blocks, and drawing border	132	Continuous	3.5 mm 0.014"	Pen No. 2
MM-DIM	Dimensioning	253	Continuous	2.5 mm 0.010"	Pen No. 1
MT-TXT	Text, General associated with a specific layer	White	Continuous	3.5 mm 0.014"	Pen No. 2
MT-BTXT	Text, Bold	Yellow	Continuous	7 mm 0.028"	Pen No. 4
MT-CHK	Checker's marks (informal only)	11	Continuous	5 mm 0.020"	Pen No. 3
MO-VPT	Paper space Viewport border	White	Continuous	3.5 mm 0.014"	Pen No. 2
MC-CLINE	Center line	Blue	Center	3.5 mm 0.014"	Pen No. 2
MX-HATCH	Cross-section lines	Blue	Continuous	3.5 mm 0.014"	Pen No. 2
MH-HIDL	Hidden lines	Blue	Hidden	3.5 mm 0.014"	Pen No. 2
MV-MLN	Matchlines	Red	Phantom	9 mm 0.35"	Pen No. 5
		Specific Layers			
*MO-1DET	Detail	Yellow	Continuous	7 mm 0.028"	Pen No. 4
MO-2DET	Detail	Green	Continuous	7 mm 0.028"	Pen No. 4
MO-FAST	Fasteners	Cyan	Continuous	5 mm 0.020"	Pen No. 3
MO-VEND	Vendor information	8	Continuous	2.5 mm 0.010"	Pen No. 1
MP-PHANT	Moving parts, alternate positions, simplified drafting techniques, for example, screw threads, springs	8	Phantom	2.5 mm 0.010"	Pen No. 1
MO-LAYOUT	Layout and/or construction lines	Magenta	Continuous	3.5 mm 0.014"	Pen No. 2

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

Table B9 Piping Drawings

Layer Name	Description	Line Color	Line Type	Line Weight	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	3.5 mm 0.014"	Pen No. 2
PM-DIM	Dimensioning	253	Continuous	2.5 mm 0.010"	Pen No. 1
PT-TXT	Text, General associated with a specific layer	White	Continuous	3.5 mm 0.014"	Pen No. 2
PT-BTXT	Text, Bold	Yellow	Continuous	7 mm 0.028"	Pen No. 4
PT-REF	Reference items and notes that aid CAD users during construction of the drawing	213	Continuous	2.5 mm 0.010"	Pen No. 1
PO-VPT	Paper space Viewport border	White	Continuous	3.5 mm 0.014"	Pen No. 2
PO-CLD	Clouded areas for Hold, FMP/ECN, and revision	White	Continuous	3.5 mm 0.014"	Pen No. 2
PE-EXST	Anything existing to remain	8	Phantom	2.5 mm 0.010"	Pen No. 1
PD-DEMO	Existing items /equipment required to be removed or demolished	Cyan	HiddenX2	5 mm 0.020"	Pen No. 3
PC-CLINE	Center line	Blue	Center	3.5 mm 0.014"	Pen No. 2
PX-HATCH	Cross-section lines	Blue	Continuous	3.5 mm 0.014"	Pen No. 2
PH-HIDL	Hidden lines	Blue	Hidden	3.5 mm 0.014"	Pen No. 2
PV-MLN	Matchlines	Red	Phantom	9 mm 0.35"	Pen No. 5
Specific Layers					
PO-PIPINGS	Single-line pipe, valves and fittings	Yellow	Continuous	7 mm 0.028"	Pen No. 4
PO-PIPINGD	Double-line pipe, valves and fitting	52	Continuous	3.5 mm 0.014"	Pen No. 2
PO-EQP	Pumps, vessels, etc.	Magenta	Continuous	3.5 mm 0.014"	Pen No. 2
PO-GND	Grade	8	Continuous	2.5 mm 0.010"	Pen No. 1
PO-CONC	Concrete	8	Continuous	2.5 mm 0.010"	Pen No. 1
PO-STRUCT	New structures	8	Continuous	2.5 mm 0.010"	Pen No. 1
PO-PSUPT	Supports	White	Continuous	3.5 mm 0.014"	Pen No. 2

ADDENDUM -C-, Preparation of Process Flow Diagrams (PFDs)

C.1.0 Purpose

This Addendum provides for the development of all new PFDs produced for Project Hanford Management Contract (PHMC) and Fluor Hanford Inc.,(FH) which is the PHMC prime contractor for the Department of Energy Richland operations.

Standardized PFDs allow personnel to quickly get an overview of the process and understand its operation. The PFD is a simplified schematic description of a process that includes the following data:

- 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.

C.2.0 Scope

This Addendum details the requirements for Process Flow Diagrams and is in agreement with a national standard titled Process Industry Practices (PIP), except where noted. It is used in conjunction with the computer aided design/drafting CAD and drawing standards contained herein (HNF-14660).

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 apply this standard to modifications affecting existing PFDs. The responsible FH engineering point of contact shall document the exclusions to this direction (email is acceptable).

This Addendum comprises the minimum direction for developing PFDs. The PFD is developed to give needed data to design disciplines in the early stages of engineering design as well as to operations after project turnover. The following sections are covered:

C.3.0 Application

These directions apply to any project that requires development of a PFD. The PFD accomplishes, as applicable, 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

C.4.0 Definitions

Process Flow Diagram (PFD) – See ADDENDUM –A– Glossary

C.5.0 Responsibility

At project turnover the FH Design Authority/System Engineer (FH DA/SE) will assume responsibility for the PFD. The FH DA/SE may request assistance from the FH Process and FH Control Systems discipline managers to review and comment on the PFD during the course of a project.

The design vendor and FH Design Authority/System Engineer (FH DA/SE) are responsible for ensuring that the PFD meets technical and graphic standards contained herein. PFDs must be approved by FH before subsequent detail design proceeds.

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

C.6.0 Process

C.6.1 Format and Overall Arrangement

- PFDs are created on standard drawing sizes stipulated in Section 6.0, Drawing Sizes and Material

- The data on the drawing must be legible when reduced to 11 inches by 17 inches, also see Section 8.5, legibility
- The PFD is developed in accordance with CAD and drawing standards (HNF-14660), as applicable
- Process flow on the drawing 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; startup, bypass, and minor lines with unspecified flow rates are ***not*** shown
- PFDs should be presented on only one sheet, if possible. A BFD (Block Flow Diagram) may be appropriate and serve the intended purpose in place of a PFD

C.6.2 Drawing Issuance

Drawings released for approval or review and comment will be annotated with "PRELIMINARY" located in the Revision Description Block, with alphabetic sequential versions (revision) starting with the letter "A." Each subsequent version (Such as 30-60- and 90-percent design reviews) are recorded and tracked with the sequential alpha letter designations. When the design in 100% complete and ready for FH review (prior to starting the engineering design) the FH approval revision designation is converted to a numeric revision, starting with For Approval Rev. O (zero).

When the drawing is revised to incorporate comments from FH, it is issued as Rev 1, and annotated in the Revision Description Block with "APPROVED FOR DESIGN" (AFD). The Rev 1, AFD issue by Vendor is placed under drawing 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	
Revision Designator	***Revision Description***
A, B, C, etc	Internal issue and distribution
0	Issued for approval (FA)
1	Issued as Approved for Design (AFD)
2, 3, 4, etc	Subsequent formal revision approvals and issue
2A, 2B, 2C, etc	Issued for internal interim design development between FH formal revision approvals and used only after initial external issue

C.6.3 Equipment Arrangement

- Major process equipment should be shown and arranged on the PFD using the normal sequence of flow. For visual understanding, relative equipment elevations should be used, 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 may 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.
- ***Do not*** crowd the diagram. Limit the number of equipment items on a drawing so that adequate space remains for future revisions.
- If more than one frame is required for the process, equipment, frames 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.
- Equipment 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 may 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.
  - Usually, only one of multiple identical train units and spared equipment should be shown. The equipment number will indicate the other trains or spares.
  - Typical equipment items which should not be shown on the PFD are as follows:
    - utility systems (for example, refrigeration, cooling water, tempered water, and hot oil)
    - Chemical feed systems, which require a 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 may 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.

C.6.4 Material Balance

- The material balance for normal operating conditions or batch operation is shown as a table in the lower left portion of the drawing. If additional space is needed to show the table, it is placed on a continuation sheet of the PFD. The following table provides an example of a Material Balance Format:

Material Balance Format					
Component	Stream Number	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)*					
Square Cubic Feet Per Minute (SCFM)					
Gallons per Minute (GPM), at operating conditions					
Density at operating conditions, (lb/ft^3)					
Viscosity, Centipoise (cP)					
Pressure, pounds per square inch gage (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 one operating case is presented, completely separate PFDs should be used. Where only minor differences exist between two 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 may 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 and descriptions should be maintained on any stream shown on more than one 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, pounds per hour

- Total volumetric flow
  - Gases, Standard cubic feet per minute (scfm)
  - Liquids, gallons per minute (gpm) at operating conditions
- Stream density (substituting specific gravity for liquids is optional)
- Stream viscosity, cP
- Operating pressure, psig or Pounds per square inch absolute (psia)

- 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] in the Operating Temperature, degree F, block).

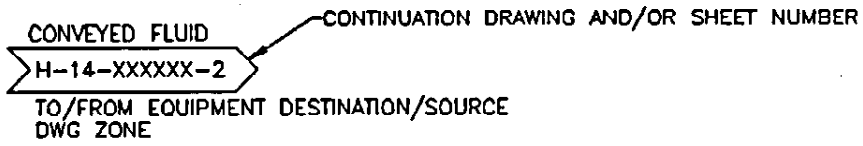
C.6.5 Lines

- Main process streams are shown in heavy (Thick) 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. As a minimum, arrows are located at the end of a line and when the line changes direction.
- The following lines should not be shown:
  - Startup and shutdown
  - Decommissioning
  - Sewers
  - Vents and drains

C.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.

DRAWING CONTINUATION ARROW



- 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.

C.6.7 New Process Flow Diagrams (PFD) and Piping & Instrumentation Diagrams (P&ID) Master Legend Drawings

New PFD, and P&ID drawings generated for use at the Hanford Site shall comply with the symbology specified in Section 8.3.2 New Process Flow Diagrams (PFD) and Piping & Instrumentation Diagrams (P&ID) Master Legend Drawings. Also, see Section 8.3.3 Optional Symbology (Drafting Aids).

These drawings are the master listing of symbols for new PFDs and P&IDs 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. PFD and P&ID drawings must have a legend on the drawing or reference to a legend drawing developed using these criteria and/or as specified by the contract.

Should a symbol be needed that is ***not*** covered by the PDF/P&ID Master Symbology, consult the appropriate national consensus standards for the correct symbology; if no symbology is available, it is permissible to develop the needed symbology by adding it to the PFD/P&ID legend.

C.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 Instrument Society of America (ISA) 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.

C.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.

C.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)

C.9.0 Working References

Instrument Society of America (ISA)

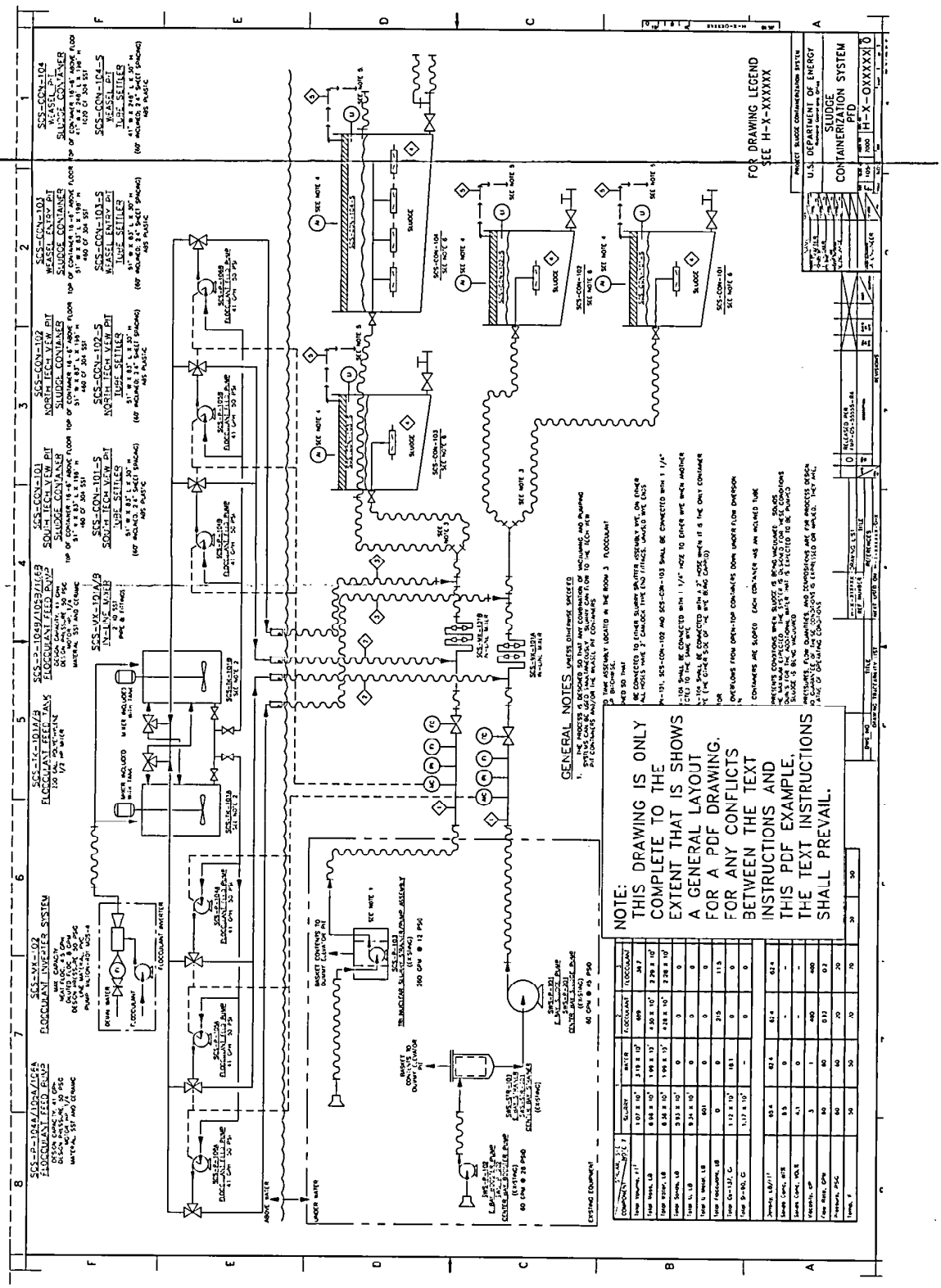
Process Industry Practices (PIP)

Hanford Drawings

H-9-006010 Sheet 1 through 6, Master PFD and P&ID Legend Drawing

H-9-006015 Sheet 1, Master Abbreviations Legend Drawing

Project Hanford Management System
APPENDIX C
Preparation of Process Flow Diagrams
Published: April 2006



HNF-14660, Revision 2
Figure C1, Sample Process Flow Diagram (PFD)

ADDENDUM -D-, Development of Piping and Instrumentation Diagrams (P&IDs)

D.1.0 Purpose

This Addendum provides for the development of all new P&IDs produced for Project Hanford Management Contract (PHMC) and Fluor Hanford Inc.(FH), which is the PHMC prime contractor for the Department of Energy, Richland operations.

Standardized P&IDs allow personnel to quickly get an overview of the system and understand its operation. The directions contained in this instruction are of a general nature and are considered minimum format directions needed to achieve a consistent quality P&ID:

- Flow Diagrams provide the single most important source of information for the project, the client, and the design disciplines in the early stages of engineering design and provide documentation for configuration control. The development should be the result of an established and orderly process.
- Flow diagrams are, by their nature, a document that requires multi-discipline input.

D.2.0 Scope

This Addendum details the requirements for Piping and Instrument Flow Diagrams (P&IDs) and except as noted, this addendum is in agreement with the developing national standard called, Process Industry Practices (PIP). Additionally, use this Addendum in conjunction with the computer-aided design/drafting (CAD) and drawing standards contained herein (HNF-14660).

Modifications to existing P&IDs 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 apply this standard to modifications affecting existing P&IDs. The direction shall be documented by the responsible FH engineering point of contact (email is acceptable).

This Addendum comprises the minimum direction for developing P&IDs that is needed for design disciplines during engineering design as well as for configuration control by engineering and operations after project turnover. The following sections are covered:

D.3.0 Definitions

Piping and Instrumentation Diagram (P&ID) – See ADDENDUM –A– Glossary

D.4.0 Flow Diagram Presentation

The principle objectives in the layout of a flow diagram are to:

- Clearly convey design information in an orderly manner consistent with FH requirements and industry practices
- Minimize rework that may be required by subsequent revisions to the drawing

D.5.0 General Layout Preparation

When initiating the layout of a P&ID, a brief review of the following considerations will greatly enhance the final appearance and quality of the drawing:

- Review and confirm the extent of equipment, piping, and instrumentation to be included on the drawing with the initiator of the Flow Diagram, and consider the possibility of equipment, piping, or instrumentation that may be added later.
- Investigate similar systems on other flow diagrams to ensure consistency among drawings in the same package.
- Identify major process streams.
- Investigate origins and destinations of lines entering and leaving the drawing.
- The following concepts should be observed:
  - The final drawing should have an appearance of uniform density. Components should be arranged in such a manner that an inordinate amount of information is not incorporated into a confined area.

- The process should read from left to right across the page; that is, feed stock should enter on the left and product should exit on the right. There should be continuity of the process stream flow from sheet to sheet.
- Primary process lines should be kept as direct and uninterrupted as possible. Their paths should take priority over secondary process lines (such as bypasses and jump-overs) and utility lines. Piping arrangement should take priority over instrumentation configuration.
- Drawing sheet size is 28" x 40" as indicated in Section 6.0, Drawing Sizes and Materials. This provides a legible 11" x 17" reduced sized copy when specified font sizes are used. Also see Section 8.5, Legibility
- See Section 8.3.2 New Process Flow Diagrams (PFD) and Piping & Instrumentation Diagrams (P&ID) Master Legend Drawings
- See Section 8.2 Abbreviations and Acronyms

- Each project needs to establish the unit of measure—English or metric The Equipment data shown in the following sections English units; each project will specify the by the project.

D.6.0 Piping and Instrument Diagrams (P&IDs)

P&IDs contain the greatest amount of detail of any type of flow diagram. With few exceptions, all equipment, piping, and instrumentation are shown in schematic representation.

D.6.1 P&ID Layout

Due to their nature as an evolutionary document, P&IDs offer the greatest challenge as a layout exercise. The extensive level of detail required on these drawings demands that the designer anticipate special requirements of design information that evolves later in the developmental process. The content of individual P&IDs is generally determined by the Process Engineer.

The following procedure will serve as a basic guide for P&ID layout:

- Review the comments in Section D.5.0, General Layout Preparation
- Read the entire system sketch, and resolve any questions prior to initiating the drafting process
- Locate line continuations for adjacent drawings
- Allocate space in the drawing area for equipment titles, notes, details, and other text type information
- Establish preliminary locations for equipment and preliminary routes for major process streams
- Use this preliminary framework as a skeleton upon which detailed information can be added

Note!!! Develop the entire drawing simultaneously. Do not completely detail one area before starting another. This will prevent unnecessary rework required by subsequent information that requires more space than expected.

After building a preliminary framework, work through the drawing adding detailed information in accordance with D.6.3 Equipment (General Instructions).

D.6.2 New Process Flow Diagrams (PFD) and Piping & Instrumentation Diagrams (P&ID) Master Legend Drawings

New PFD, and P&ID drawings generated for use at the Hanford Site shall comply with the symbology specified in Section 8.3.2 New Process Flow Diagrams (PFD) and Piping & Instrumentation Diagrams (P&ID) Master Legend Drawings. Also, see Section 8.3.3 Optional Symbology (Drafting Aids).

These drawings are the master listing of symbols for use on new PFDs and P&IDs drawings, and are ***not*** to used directly as a project legend for drawings. Each symbol on a PFD or P&ID shall be traceable to a legend. PFD and P&ID drawings must have a legend on the drawing or reference to a legend drawing developed using these criteria and/or as specified by the contract.

Should a symbol be needed that is ***not*** covered by the PDF/P&ID Master Symbology, consult the appropriate national consensus standards for the correct symbology; if no symbology is available, it is permissible to develop the needed symbology by adding it to the PFD/P&ID legend.

D.6.3 Equipment (general Instructions)

This section of the Addendum provides instructions for depicting equipment and associated data on the P&ID;, for example:

- Ensure equipment titles on P&IDs are identical to those on the equipment list.
- Show equipment numbers (underlined) adjacent to the equipment outline.
- Show critical dimensions or elevations between equipment required for process reasons. For example, elevation of vessels required for gravity flow.

D.6.4 Vessels / Columns

- Show the following information at the top of the drawing above the vessel \ column:
  - Vessel \ Column number
  - Title
  - Size (inside diameter (ID) x length tangent to tangent)
  - Design pressure and temperature
  - Number and type of trays; tray spacing
  - Number of packed beds, bed height, type and size of packing
  - Materials of Construction (MOC) for shell/tray/packing
- Show Lines, instrumentation and sample connections
- Show packing, demisters, vortex breakers, and chimney trays.
- Verify tower internals are properly shown including:
  - Catalyst beds
  - Packing (Identify height and size [if required] of packing)
  - Demisters

- Chimney trays,
- Draw-off trays
- Any other internals

- Verify equipment title and number is identical to that shown on the Equipment List and the Process Flow Diagrams.
- Verify that design information, such as dimensions, design pressure, and temperature, insulation requirements are consistent to the Equipment Datasheet.
- Verify that Materials are consistent with the Material Selection Diagram, if applicable, and with the Equipment Datasheet.
- Depict vessels relative size. For example, ***Do not*** show an overhead accumulator larger than the associated tower.
- Show vessel internals in dashed lines to depict dip legs, coils, baffles, tube bundles, vortex breakers, demisters, catalyst beds and supports and internal piping supplied by the equipment vendor.
- Show vessel nozzle sizes and designations inside the vessel, or outside the vessel and beside the nozzle, if needed.
  - Show the nozzle connection type (flange, or special fitting).
  - Show valves located directly on the vessel nozzle are depicted with no pipe between nozzle and valve
  - Show access ways and hand holes
  - Show tangential nozzles in proper orientation
- Show vessels in elevation view only
- Verify tower internals are properly shown including catalyst beds, packing, demisters, chimney trays, draw-off trays, and any other internals with height and size (if required) of packing identified.
- Show height of bottom tangent line of vertical vessels above grade. For horizontal drums, show height of bottom above grade. Verify the height consistent with the pump requirement. Unmarked elevations indicate "Minimum."
- Show agitator, type, speed (revolutions per minute [rpm]), motor horsepower (HP), and MOC, equipped of a vessel and show agitators in a solid line (not a dashed line), along with the agitator equipment number.

D.6.5 Air Coolers

- Show the following information at the top of the flow diagram above the air cooler outline:
  - Equipment Number (underlined)
  - Equipment Title (underlined)
  - Design Duty: 1000 British Thermal Unites (MM BTU) / hour (Hr); extended surface, ft^2
  - Design Pressure and Temperature / Minimum Temperature

- Material:
- Insulation: (Symbol for type or "None")
- It is permissible to show air coolers with only one bay represented, with a note detailing the actual number of bays required with all instrument tag numbers, shown in a tabulation format in a table.

- Show type of fan pitch control (auto variable / manual).
- Show winterizing details such as louvers, steam heating coils, etc.
- If symmetrical inlet and outlet piping is required for multiple bay air-cooled exchangers, show the actual piping scheme with a note highlighting this requirement.

D.6.6 Shell and Tube Exchanger

- Show the following information at the top of the flow diagram above the exchanger outline:
  - Equipment Number (underlined)
  - Equipment Title (underlined)
  - Design Duty: MM BTU / Hr
  - Shell Design Pressure and Temperature
  - Tube Design Pressure and Temperature
  - Materials:
    - Shell:
    - Tubes:
    - Insulation: (Symbol for type or "None")
- Show correct Tubular Exchanger Manufacturers Association (TEMA) type of exchanger, number of shells or sections, flow arrangement, etc. For TEMA symbology for types of exchangers, see the FH master PFD and P&ID Legend Drawing H-9-006010, Sheet 3, (Section D.6.2).
- Place the equipment number (underlined) adjacent to the exchanger outline
- Note the height of the exchanger above grade if it is elevated for a process reason, other reference points are permissible; for example, overhead condensers.
- On steam-heated reboilers, show pressure level of steam and condensate system.
- Show shell and tube exchangers that are in a stacked configuration in an elevation view. This is necessary to show the true flow scheme through the shell side of the exchangers. This will also allow the illustration of all necessary trim valves, vents, and drains.
- Show single shell and tube exchanger in an elevation view to maintain the pictorial consistency on the P&ID.
- Show double pipe exchangers in an end view. This is necessary to allow the flexibility of showing the correct piping hook-up of multiple units.

D.6.7 Pumps

- Show the following information at the top of the flow diagram above each operating pump:
  - Equipment Number (underlined)
  - Equipment Title (underlined)
  - Design Capacity: Rated Flow (in hot gpm) at Design Differential Pressure (in pounds per square inch [psi])
  - break horsepower (BHP)/Motor HP
  - Material
  - Case
  - Impeller
  - Insulation (symbol for type or "None")
  - Cooling Water, Flushing Oil, Seal Oil, etc. required with type of API plans indicated
- Show correct type of pump and driver. For symbology covering the types of pumps and drives, see the FH master PFD and P&ID Legend Drawing H-9-006010, Sheet 3, (Section D.6.2).
- Show the equipment number (underlined) under each pump symbol with the spares noted.
- Show the size of pump suction and discharge flanges. Show swages to suction or discharge piping.
- For positive displacement pumps, show external relief protection.
- For jacketed pumps, show heating fluid details and piping.

D.6.8 Compressors, Blowers and Fans

- Use the appropriate equipment symbol showing each type of compressor. See D.6.2 New Process Flow Diagrams (PFD) and Piping & Instrumentation Diagrams (P&ID) Master Legend Drawings. If multistage reciprocating, show each stage separately with only one driver.
- The following information is shown at the top of the flow diagram above each compressor outline:
  - Equipment Number (underlined)
  - Equipment Title (underlined)
  - Number of Stages:
  - Design Capacity: Inlet Cubic Feet Per Minute (ICFM)
  - Differential Pressure: psi
  - BHP / Driver HP:
  - Materials:
- Place the equipment number (underlined) under each compressor symbol along with the stage number, which denotes spares.

- Show compressors in process units in proper respect to other process equipment. However, show auxiliary systems such as lube oil and seal oil systems on a separate auxiliary P&ID.
- Show blowers, fans and reciprocating compressor information such as suction / discharge pulsation dampeners, intercoolers.
- Show symbology as specified in the FH master PFD and P&ID Legend Drawing H-9-006010, Sheet 3, (Section D.6.2).

D.6.9 Tanks

- Show the following information at the top of the flow diagram above the tank outline:
  - Equipment Number (underlined)
  - Equipment Title (underlined)
  - Inside Diameter (in feet) and Height (in feet)
  - Net Capacity: Gallons (or Barrels)
  - Design Pressure, psi or inches H_2O
  - Design Temperature, °F
  - Material:
  - Insulation: Type or None
  - For symbology covering the types of tanks, see the FH master PFD and P&ID Legend Drawing H-9-006010, Sheet 3, (Section D.7.2).

D.6.10 Miscellaneous Equipment

- Use the appropriate equipment symbol showing each type of equipment. See D.6.2 New Process Flow Diagrams (PFD) and Piping & Instrumentation Diagrams (P&ID) Master Legend Drawings.
- Show the following information at the top of the flow diagram above the equipment outline:
  - Equipment Number (underlined)
  - Equipment Title (underlined)
  - Design Conditions*
    (*Each type of miscellaneous equipment will have its own type of pertinent design condition information. Choose the most important information needed for operations and add the information to the flow sheet.)
- The information given will depend on the particular type of equipment. The design information could include any of the following items:
- Design Capacity: (GPM or Barrels Per Stream Day (BPSD) or Lbs / Hr)
- Design rating (XX psig at XX °F)
- Differential Pressure (DP): (XX psi)
- Dimensions: (envelope or overall)
- HP: (rating)

- Micron Size
- Package equipment will be enclosed by dashed lines, within the dashed lines enter the words "Provided by Supplier" with the FH assigned Vendor Information number.

D.7.0 Instrumentation

Utilizing knowledge of the process system and the PFD, the process engineer will specify on the P&ID the basic system control scheme or process conditions measured by instrumentation, and the principal piping and valve sequencing and locations necessary to accomplish the intended result. The control systems engineer will be primarily responsible for evaluating this scheme and accurately depicting the details of the instrumentation on the P&ID. In the initial layout of any P&ID, both Process and Control Systems engineers must be alert to allow plenty of drawing space for instrument symbols.

All instrument and control design and symbology corresponds with the appropriate standards of the Instrument Society of America (ISA) and Institute of Electrical and Electronic Engineers (IEEE), except for symbology differences between the national standards and the following drawings, the symbology in the following drawing is used.

- H-9-006010, Sheets 1 through 6, Master PFD and P&ID Legend Drawing
- H-9-006015, Sheet 1 Master Abbreviations Legend Drawing
- H 9-006020, Sheet 1; Master Electrical Elementary and One-Line Legend Drawing
- H-9-006021, Sheet 1, Master Electrical Plan Symbology Legend Drawing.
- Also, see Section D.6.2.

D.7.1 General

- Most, but not all, central control electronics will be a DCS (Distributed Control System) with an auxiliary host computer system. The following are remarks based on DCS.
  - Use a DCS to perform all continuous process control where frequent set point changes or continuous monitoring/alarming is required.
  - Implement local pneumatics for continuous control loops in non-critical service where frequent set point changes are not envisioned,
  - Generally, a DCS is not used for equipment interlocking, remote start or for handling critical alarms.
  - Design separate alarm wiring to a separate annunciator system in a control room.
- Show the proper location for all sampling points, particularly to analyzing instruments. Input from vendor may be required.
- Show all flushing and purge connections for instruments. Detail this design on the right-hand side of the flow diagram (Typically done by Control Systems).
- Show all alarms, solenoid valves, timers
- For simple logic, show all detail logic; for example, Pump Shutdown on low liquid level.
- For complex logic, show a logic table for the location of the equipment, or show it on a separate P&ID, or logic diagram.

- Complex control systems, such as compressor and fired heater shutdown systems, will be provided with "first-out" indication so that the operators can determine what first caused the problem.
- Provide unique identification to all instrumentsshown on the P&ID..

D.7.2 Control Valves

- In general, control valve stations have block valves and a by-pass.
- Show size and action (fail close, open, or last position) of control valves. Also, show by-pass valve size.

D.7.3 Relief Valves

- For Pressure Safety Valve (PSVs), show size of valve with orifice designation, valve number, and set pressure.
- Tag block valves on the P&ID that are locked or car sealed open (a tamper evident safety/security seal). Identify the tagged valves on the P&ID as full port valves.
- Provide a drain valve or a plugged drain between the block and PSV.

D.7.4 Thermal Reliefs

- To prevent overpressure during a blocked-in condition because of heat input, provide lines with a thermal relief if the pressure can build up to 1.5 times the design pressure. Lines included here are liquid filled lines which can be blocked in at both ends.
- Pay particular attention to steam traced lines, cold solvent lines, refrigerant lines, long transfer lines, lines to tankage, and exchangers that have inlet and outlet blocks on the cold side.
- Thermal reliefs in water service will discharge to grade. In liquid hydrocarbon service, they will discharge usually to the nearest safe drain.
- All coolers using water will have a thermal relief valve on the cooling water return line between the cooler and the block valve.

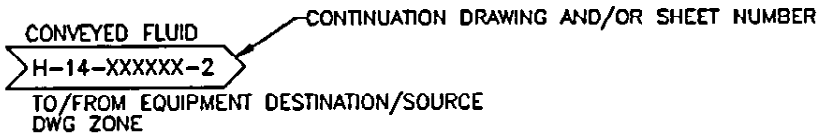
D.8.0 PIPING

D.8.1 General

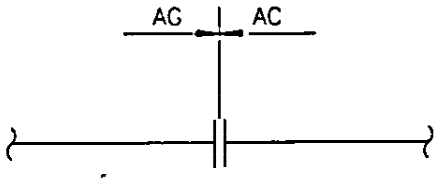
- Section D.6.2, New Process Flow Diagrams (PFD) and Piping & Instrumentation Diagrams (P&ID) Master Legend Drawings, Shows required piping symbols for use on P&IDs.
- Clearly identify all lines entering and leaving the diagram, starting in order as follows:
  - Commodity Name
  - Source / Destination
  - Drawing Number sheet and Zone

- Use the equipment number for the source or destination if the line is routed within the same process unit or system.
- For lines routed outside of the process unit's boundary, use a general name and associated equipment number for a source or destination.

DRAWING CONTINUATION ARROW



- Clearly indicate where a line specification change occurs. This will be cause for a new line number. The example below shows a specification change at a flange where the specifications change.

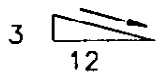


- Identify underground lines with a specification break between AG (aboveground) and UG (underground) piping.
- Clearly indicate where a Limits of Safety Class (SC) Components and Limits of Safety Significant (SS) Components occur; see figure below. This will be cause for a new line number.

D.8.2 Utility and Auxiliary Lines on the P&ID

- Utility lines originate and terminate adjacent to the equipment involved.
  - Only the length of line necessary for valving, instrumentation, and line numbering is shown. Utility line origin and terminus is indicated by descriptive title only. Main utility headers are not shown on the unit P&ID; they are shown on the utility P&ID for that process area. Compressor utility piping is shown only when minor in scope. Otherwise, it is shown on a compressor auxiliary P&ID.

- Line size valves shown on the P&ID need not have their size indicated at the valve. Control and bypass valve sizes will always be shown.
- Reduction in line size is indicated for continuous drawn lines. Reducer symbols are not required for stub-ins.
- Each process line and each utility line is identified by a line number. Line numbers will appear on top of the horizontal line or to the left of the vertical line.
- Corrosion allowances other than the normal allowances indicated in the individual line classes will also be shown.
- Piping components not identified by Instrument or Mechanical Equipment Numbers, etc. and not covered by the Piping Material Specification, are identified by assigning an Item Code Number on the identification symbol. (Refer to the Legend Sheets).
- Packaged equipment or modules (vendor supplied) will be identified on the P&ID by a dashed line or cloud surrounding the package with arrows showing specific junctures of piping between the Contractor and the Supplier in a manner similar to spec break designations.
- Flange breaks will not be shown except for clarification, such as specification changes and at Supplier breaks, as required.
- Equipment, instruments, or piping, which are traced or jacketed, are so indicated.
- All notes will be placed under the horizontal process line or to the right of the vertical process line; for example, SLOPE, NNF (normally no flow), DO NOT POCKET, ETC.
- High point vents and drains are shown only when they connect to a closed system or are required for process and safety reasons.
- All startup and shutdown lines will be shown
- Pipe systems to be cleaned (such as pickled and sand blasted) will be identified (in Pipe specification document)
- Lines to be sloped will be identified with the slope symbol, as shown below:



SLOPED PIPE

D.8.3 Pump Piping

- When using a line size suction valve, the suction valve will be rated for pump discharge conditions when warm up bypasses are provided.
- Temporary pump suction screens may be installed at all centrifugal pumps before start-up and removed after preliminary operations. These screens will be located at the first flanged joint between the pump and the suction block valve with a

spacer or breakout flange for easy removal. If a permanent screen or strainer is required, see to the Master Legend Sheets symbology, see Section D.6.2.

- Provide permanent removable basket type strainers for all rotary pumps.
- Use a line size block and check valve in the discharge line (check valve will be located between block and pump).
- A standard pressure gauge connection will be located in the discharge piping between the pump nozzle and the check valve.
- Provide a casing vent and valve

D.9.0 REFERENCES

ISA (Instrument Society of America) symbology

Hanford Drawings:

H-9-006010 Sheets 1 thru 6, Master PFD and P&ID Legend,
H-9-006015 Sheet 1, Master Abbreviations Legend Drawing,
H 9-006020, Sheet 1, Master Electrical and Elementary and One-Line Legend Drawing
H-9-006021, Sheet 1, Master Electrical Plan Symbology Drawing

Figure D1–PDF and P&ID Legend, Sheet 1 of 2

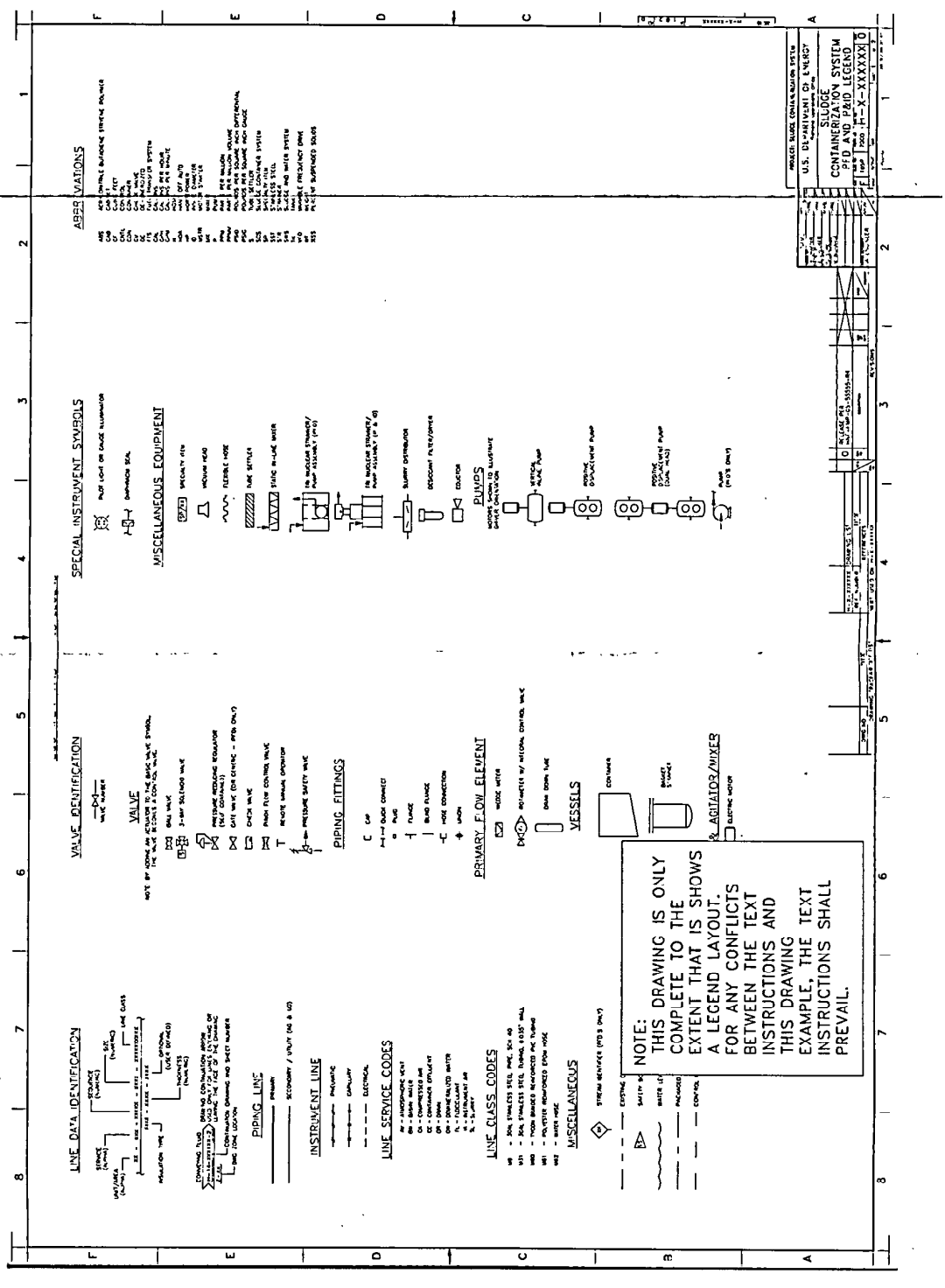


Figure D2-PDF and P&ID Legend, Sheet 2 of 2

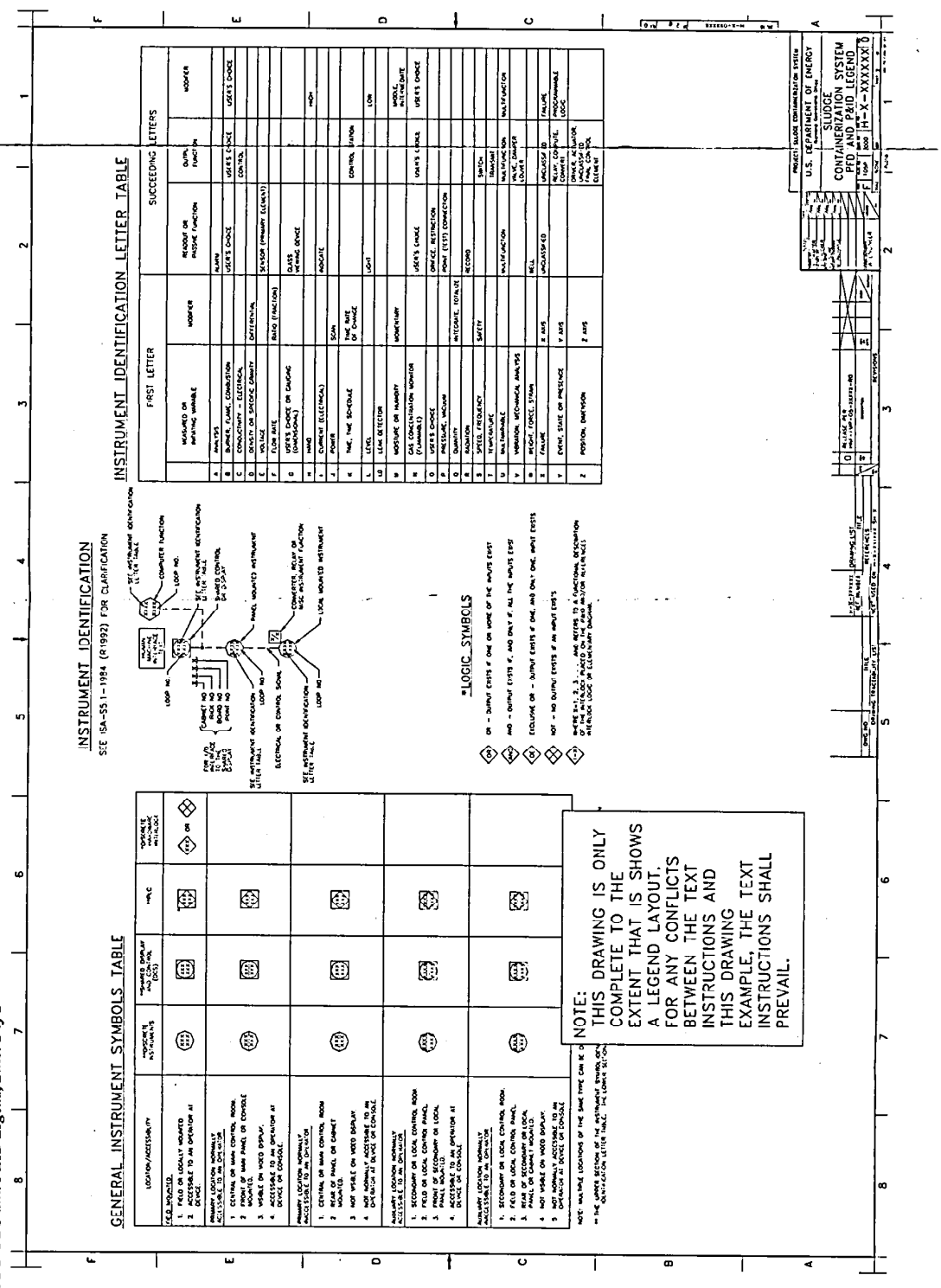


Figure D3–P&ID Example Drawing, Sheet 1 of 4

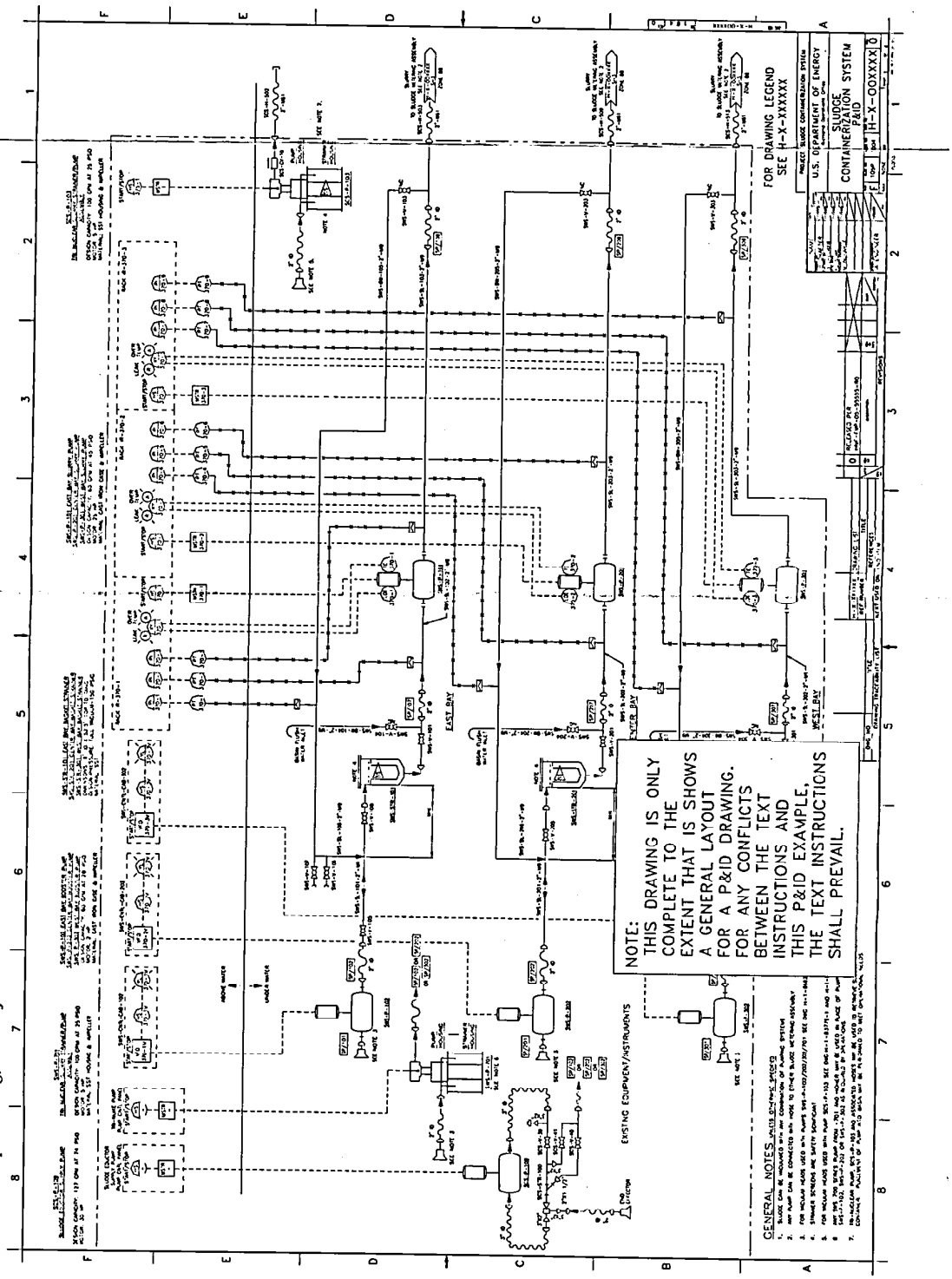


Figure D4--P&ID Example Drawing, Sheet 2 of 4

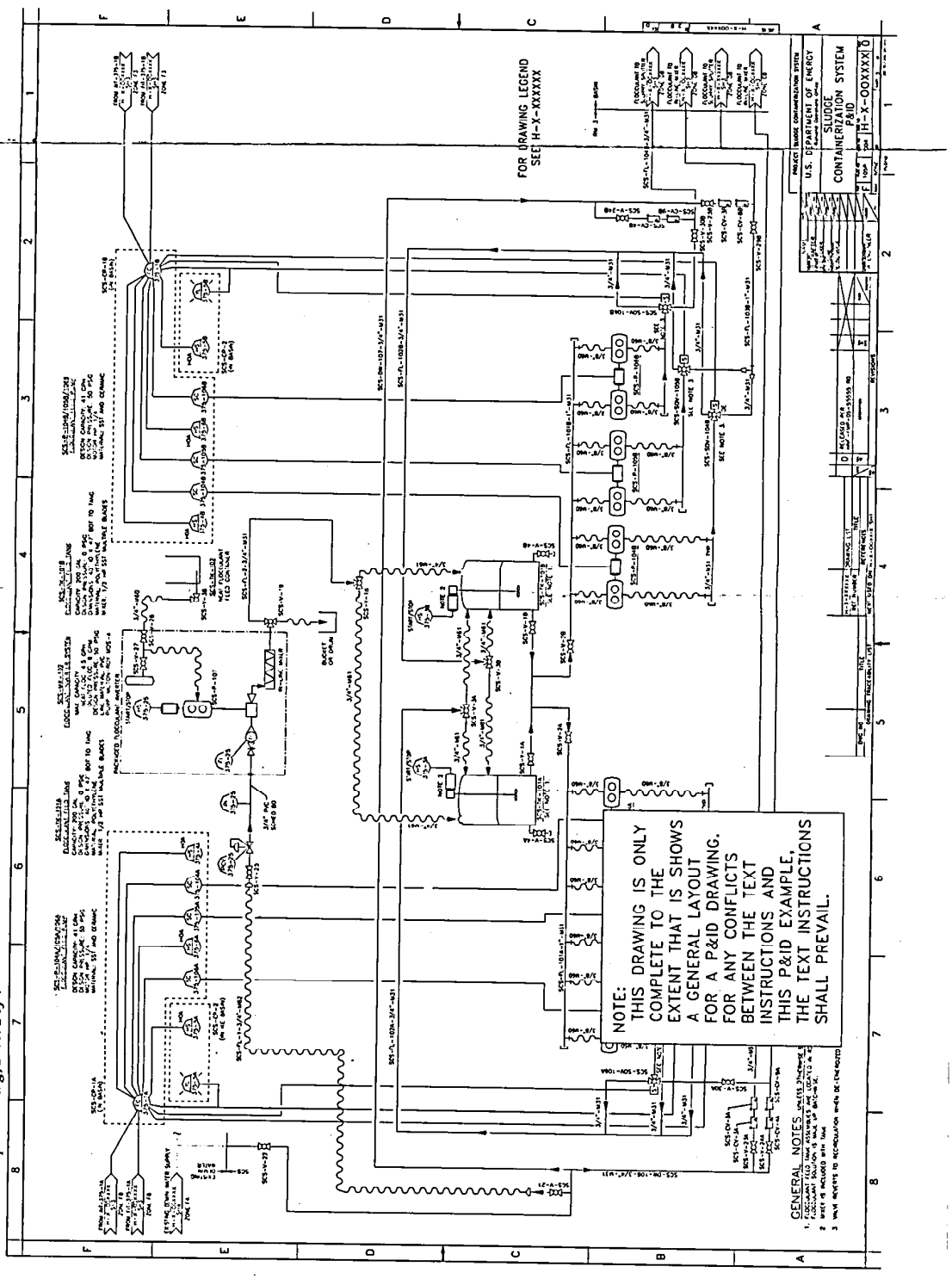


Figure D5–P&ID Example Drawing, Sheet 3 of 4

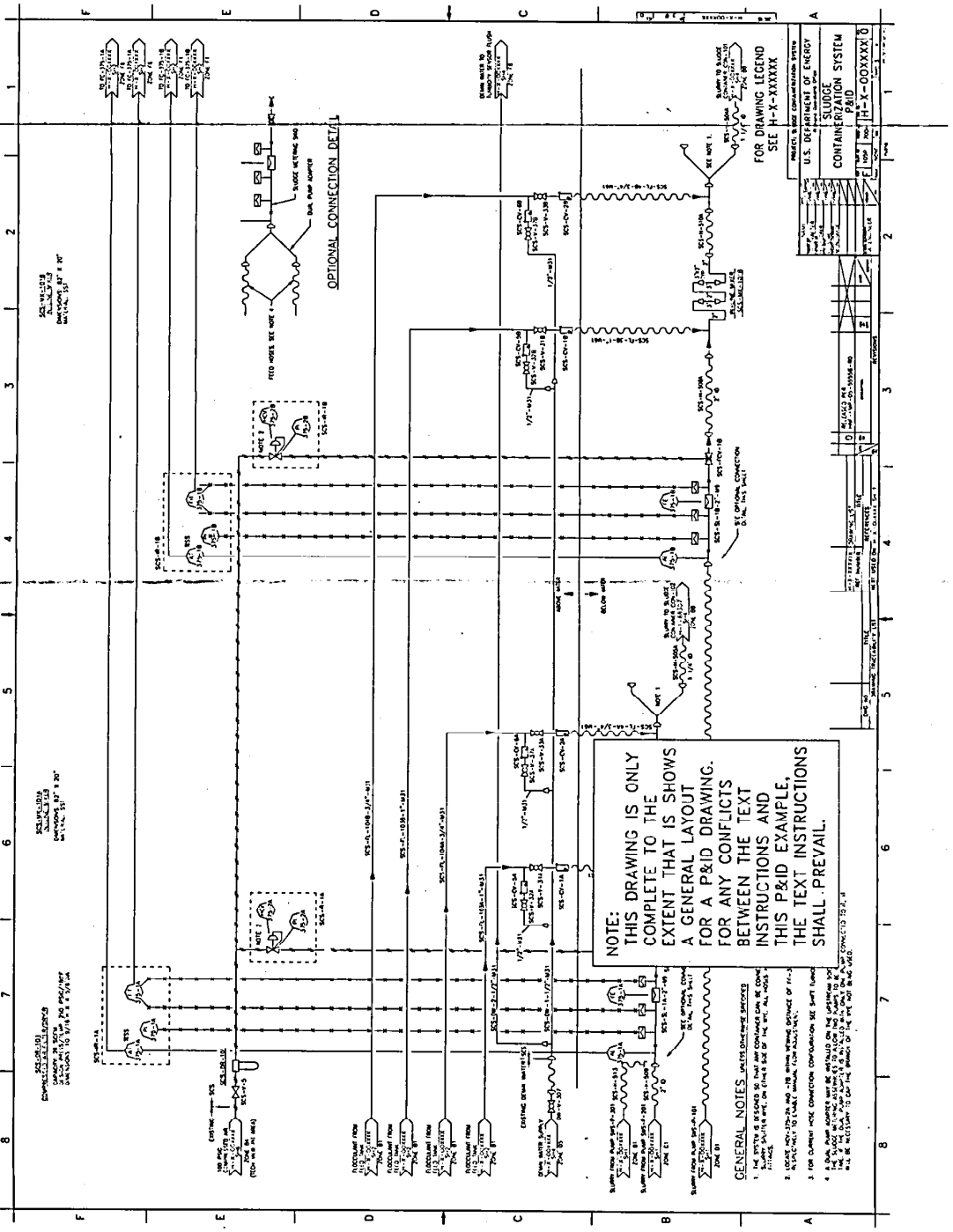


Figure D6--P&ID Example Drawing, Sheet 4 of 4