

CHAPTER A-10

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DRAWINGS

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CHAPTER A-10

DRAWINGS

10.1 GENERAL.

10.1.1 Purpose and Scope. This chapter sets forth criteria and standards to enable designers and drafters to prepare a clear, uniform set of design drawings and illustrations. Unless specifically noted in the A-E's scope of work, the standards for drawing presentation contained in this chapter shall be used in the preparation of all drawings required in a contract. Drawings shall be prepared with the expectation that the construction will be able to construct the facility without any additional assistance and/or without the necessity for modifications to correct design deficiencies. Drawing submittals shall also be detailed to the extent that an accurate cost estimate can be prepared and shop drawings can be checked. Special consideration has also been given to the reproduction processes, and plotting equipment. If Building Information Modeling (BIM) is required, Chapter A-16, Building Information Modeling sets forth criteria and standards for preparation of a complete and functional BIM model.

10.2 **APPLICABLE PUBLICATIONS.** The publications listed below, hereinafter referred to by basic designation only, shall be used when preparing drawings. In each case, the most current edition existing at the beginning of the design shall be used.

A/E/C CAD Standard Release 6.1 dated August 2019 and Graphics Standard Release 2.1 dated August 2019 available on Internet at

<https://cadbimcenter.erdcdren.mil/default.aspx?p=a&t=1&i=2>

NOTE: The A/E/C Work Structure at the above website is a common environment that can be used across agencies and engineering applications. This environment contains folder structures, tools, and resource files that implement the A/E/C CAD Standard and the A/E/C Graphics Standard documents. By utilizing one environment across agencies and applications it will give greater consistency when delivering A/E/C Standards-compliant deliverables.

ER 1110-1-8152 Engineering and Design Professional Registration and Signature on design documents dated 24 January 2012

10.3 COMPUTER AIDED DESIGN (CAD).

10.3.1 CAD Requirements. The following CAD file requirements will apply:

- a. The design drawing files shall be created using guidance provided herein. The CAD Details Library provided by the CAD/GIS Technology Center should be used as much as practicable. The A/E/C CAD Standard Release 6.1 is provided by the CAD/BIM Center to set forth standards that will provide a consistent and compatible platform for CAD system use Corps-wide. The establishment of a uniform CAD platform will provide a means for rapid, accurate transfer and integration of virtually all project-related information throughout the life cycle of any building project or facility master plan. Savannah District has chosen to make Autodesk Revit the

- system of record for vertical design and Bentley MicroStation the system of record for horizontal design and all other projects. All translations from other systems to assure compatibility must be the task of the A-E firm and not of Savannah District personnel.
- b. As a **minimum** each drawing in a design shall have an electronic file copy. Only **one** drawing should occupy an electronic file. With very few exceptions, all drawings will be plotted black and white.
 - c. A key plan should be displayed on each plotted drawing that depicts topographic information or plans that are broken due to size and scale.
 - d. The **electronic files** should be saved with the composite drawing (drawing as it is to be plotted) in View 1.
 - e. All referenced files are to be attached without drive or directories (**no paths**). All reference files must be in the same directory as the sheet file in electronic deliverables. The electronic file naming convention begins with 3-digits provided by the Data Management Section referred to as the Project Code. This Project Code is provided within the Specific Instructions provided at the beginning of any design effort for Savannah District. The Data Management Section is the proponent of this action.
 - f. The files making up the Electronic Bid Set (EBS) are PDF files. Each electronic file is named for SHEET ID of the drawing. (Example G-001.pdf, VF101.pdf, T-101.pdf). For projects with multiple buildings, the BUILDING ID shall be added to the file name to differentiate between drawings with the same SHEET ID. (Example A-101TEMF.pdf, SB101HQ.pdf, etc.) In addition, files for multiple buildings shall be organized into folders. No two files for a project shall have the same name. Furnish spreadsheet or text file containing list of all PDF files by PDF filename, SHEET ID & drawing titles. File shall also illustrate folder organization for projects with multiple buildings.
 - g. The **electronic file name** should be displayed on each drawing, and on the Index in the space labeled "filename".
 - h. Civil site and TOPO drawing CAD files:
 1. Civil site and TOPO drawing CAD files shall use the seed files available from the Savannah District Engineering Criteria web site - <http://www.sas.usace.army.mil/About/DivisionsandOffices/EngineeringDivision/EngineeringDesignCriteria.aspx>
 2. All drawing elements shall reside on appropriately named levels/layer, in accordance with the 6.1 A/E/C/ CAD standard.
 3. All polygons shall be cleaned and free of duplicate vertexes and self-intersections.
 4. On the civil site plans, label all existing structures with a building number, even when they are scheduled for demolition.
 5. On the civil site plans, all streets shall be labeled with the street name.
 6. All site plans are to be displayed with North to the top of the sheet. Due North on the map will be as viewed from the bottom of the map.
 7. All site drawings will have exactly the same match lines.
 8. Pertinent survey information must be present on the existing topography; datum, date, survey method, and surveyor name.
 9. The **site layout plan** needs to clearly identify the construction limits of the project. The resulting CAD file will be a singular file depicting the **project site layout** with a closed polygon depicting the construction limits. The construction limits polygon will reside on an individual layer named **C-PROP-CONS** per the 6.1 A/E/C CAD standard AIA format with the Level/Layer

Description of **Construction limits/controls, staging area**. Depiction by symbology alone is not acceptable. The construction limits should include all areas of expected disturbance – grading, clearing, erosion control, utilities, etc.

10.3.2 CAD Deliverables. The requirements of the CAD drawing **deliverables** are itemized as follows:

- a. As a minimum each drawing represented in a design should have an electronic file. The acceptable software shall be identified in the specific instructions for each project as determined by the customer's requirements; Currently Bentley MicroStation (.DGN) and Autodesk AutoCAD (.DWG) are the acceptable electronic file formats. Any supporting resource files, pen tables, plot drivers, cell and font libraries must also be furnished to the Savannah District with the electronic files. All work should be completed using default settings with no specialized font or line styles. All resource files furnished by the A/E/C CAD Center are considered default.
- b. Furnish PDF files of all drawings at each submittal stage in addition to binder PDF files of each drawing set or volume, if applicable. Each drawing should occupy one PDF file and should be named by the SHEET ID, G-001.pdf. VF101.pdf, etc. (and BUILDING ID, if applicable.) Each binder PDF drawing set should be named to include the PN, submittal stage, and volume, if applicable. (Example PN12345_60%_VOL1.pdf).
- c. A text file or spreadsheet listing each electronic PDF file name, SHEET ID, and drawing title should be included with the electronic drawing. The electronic media used for delivery should be CD or DVD created with a drive adhering to **ISO 9660**.

10.3.3 CAD Standards. The A-E shall comply with the 6.1 A/E/C CAD Standard from The CAD/BIM Center. The web site for the standard is <https://cadbimcenter.erd.c.dren.mil/default.aspx?p=a&t=1&i=2> .

10.4. **SUBMITTAL REQUIREMENTS.** The arrangement by drawing discipline is given in Exhibit A-10-9 of this manual. Specific technical requirements for these submittals may be found in the individual chapters of the respective technical disciplines. Electronic files should be submitted for technical adequacy review at each submittal stage. Submit all the CAD drawing files with a hard copy submittal to the Project Manager. CAD drawing files must be submitted in MicroStation DGN or AutoCad DWG based on contract requirements, and PDF format. Only one set of the CAD files is required. Each electronic drawing submittal package must display a label with:

Base name
Project name
CAD # _____
Design submittal phase
Firm Name

10.5 **FINAL (100%) DESIGN SUBMITTAL REQUIREMENTS.** The drawing guidance given in this chapter is applicable to the Final (100 Percent) Design submittal. Additionally, it should be noted that all title block information (titles, SHEET ID, category code, solicitation no, etc.) must be complete in the Final (100%) Design submittal. Specific technical requirements for this submittal may be found in the individual chapters of the respective technical disciplines. This submittal shall include **all** electronic files necessary to display every drawing for the design. CAD drawing files must be submitted in MicroStation DGN or AutoCad DWG based on contract

requirements, and PDF format. A hard copy plot of each drawing must also be submitted to the Project Manager. Only one set of the CAD files is required. Each electronic drawing submittal package must display a label with:

Base name

Project name

CAD # _____

Design submittal phase

Firm Name

10.6 CORRECTED FINAL DESIGN SUBMITTAL REQUIREMENTS.

10.6.1 Notice. In the Corrected Final Design Submittal, the designer of record finalizes the construction documents. This includes the incorporation of approved comments from the previous design submittal reviews. The Corrected Final Design Submittal requirements shall be the same as the Final Design Submittal requirements. Unless indicated otherwise in the project Specific Instructions, this submittal will not be another review in ProjNet and is only for final backcheck of all comments.

10.6.2 General. The drawing guidance given in this chapter is applicable to the Corrected Final Design submittal. This submittal shall include **all** electronic files necessary to display every drawing for the design. CAD drawing files must be submitted in MicroStation DGN or AutoCad DWG based on contract requirements, **and** PDF format. A hard copy plot of each drawing must also be submitted to the Project Manager. Only one set of the CAD files is required. Each electronic drawing submittal package must display a label with:

Base name

Project name

FY, Line Item

CAD # _____

Design submittal phase

Firm Name

10.7 MATERIALS.

10.7.1 Drawing Media. Drawings shall be plotted on bond paper, English Inch Pound Unit Projects drawing size ANSI D (22" x 34" overall) or Metric Unit project drawing size A1 (841 x 594). Savannah District Data Management Section provides these borders, title blocks, and zoning to A-E's. A new border sheet file should be obtained each time a new project is begun due to changes in border requirements.

10.7.2 Other Media. There are various electronic files available from Savannah District, Data Management Section. The A-E should request CD with files through the Project Manager, or ask for the current Web page where they can be found. Files are available for use with Bentley MicroStation and Autodesk Revit. Formats available on CD are the following:

- a. Border Sheets
- b. Cover Sheet
- c. Combination Cover/Index Sheet (for jobs with 50 or less drawings)
- d. Index of Drawings (for use with Cover Sheet)

- e. Location Plans (not all Installations have electronic files)

10.7.3 General Requirements.

- 10.7.3.1 All drawings will be prepared electronically with software compatible and approved by Savannah District, unless a special waiver has been obtained from Project Management. Color plotting is not acceptable for contract drawings.
- 10.7.3.2 Excessive patterning should be avoided. Associative patterning or hatching should be used for area patterns and line styles should be used in lieu of linear patterns. The use of multiple line placements to depict line width is not advised. Shading should be used sparingly. Any characteristic that is dependent on plotting software should be avoided. The drawings become the property of the users and each have different plot configurations.

10.8 DRAWING PREPARATION.

- 10.8.1 Drafting Standards. All line work, text, symbolizing, and other aspects of drafting shall be accomplished in accordance with standard drafting practices. Consistency is essential throughout the drawing set; from one discipline to the next the drawing appearance (text size, font, case, line weight consistency, etc) should be constant. Complete legends of symbols and lists of abbreviations shall be included on the drawings for all submittals so that their meanings are clear. Key plans and match lines should also be used.
- 10.8.2 Half-size Reduction. Particular care shall be exercised to insure that all work is prepared for half-size printing. Congested areas should be enlarged to a suitable scale. For any sheet or part of a sheet not meeting this standard, the designer will be required to promptly re-scale and resubmit, at no additional expense to the Government, a new drawing which is completely readable when reduced half size.
- 10.8.3 Drawings Incorporating Photographs. Certain project drawings (e.g., operations and maintenance work, rehab projects, etc.) may be best portrayed by use of digital or scanned photographic images of the actual buildings or aerial photographic site plans. This method may be used only if the text and line work is placed on a separate level from the basic photograph. (The border and title block should be a reference file to the photograph.) Also, those portions of the photograph, which lie beneath the text and/or line work, must be removed in order to ensure clarity and readability of the composite drawing.
- 10.8.4 Line Weights. Line weights are illustrated in the 6.1 A/E/C CAD Standards. Additionally, special care should be taken to distinguish between new and existing work. Line weights for new work shall be heavier than for existing work where they both occur on the same drawing. Only the line weight variations can effectively distinguish between new and existing work on the full-size prints. Scale and space permitting, a separation of three line weights will be used to distinguish new from existing.
- 10.8.5 Text. The NCS recommends that the minimum text height for plotted CAD files is 3/32 in. (2.4 mm). However, to maintain legibility in half-size drawings, most sites go no lower than 1/8 in. (3 mm) in text height for dimensions, notes, callouts, table/schedule text, and general text on full size drawings. Subtitles and titles shall be plotted equivalent to 3/16 in. (5 mm) and 1/4 in. (6 mm) lettering size, respectively. The text height and text

width shall be assigned equal number values. Line spacing shall be equal to one half of the text height. Refer to Table 5-1, 2.0 Graphics Standard for comparison of font types to be used.

10.9 DRAWING FORMATS.

10.9.1 General. All projects shall have a cover and an index sheet or a combination thereof. If Savannah District is providing the soil borings, reserve some space on the index plates for the soil boring sheets. Refer to table EXHIBIT A-10-9 for discipline organization per discipline designator.

10.9.2 Title Blocks. Exhibits A-10-1 through A-10-3, filled-in title blocks as indicated below:

Exhibit A-10-1	A-E Title Block- Sheet Identification and Project Information Block
Exhibit A-10-2	A-E Title Block- Management Block
Exhibit A-10-3	Sample Revision Block

10.9.3 Numbering System. The explanations given below refer to numbering required in title blocks.

10.9.3.1 The Solicitation Number is a unique, alpha-numeric number set which denotes the specific construction bid solicitation. Due to Government contracting requirements, this number is not available until final or corrected final design submittal. Plan to add this number to all drawings under SOLICITATION NO. in the title block prior to your last submittal. The Solicitation Number should also be placed on the Cover Sheet.

10.9.3.2 The Category Code Number, reflecting Army and Air Force criteria, defines facility classification category code, and the sequence for that type facility. This unique seven-digit number set should be added to the border sheet where indicated. This number will be furnished within the Specific Instructions for CAD.

10.9.3.3 The SHEET ID assigned to each drawing is defined in the A/E/C CAD Standard.

10.10 **DRAWING REVISIONS.** In general, the designer/drafter may be involved in revisions to drawings during solicitation and during construction. Revisions during solicitations are referred to as **amendments or revisions**. Revisions during construction are referred to as **contract modifications or modifications**. The methods and procedures for reflecting these changes on drawings are described below and the notation is illustrated in Exhibit A-10-3.

10.10.1 Amendment/Revision Drawings for Solicitations. **All amendment revisions to drawings are made by issuing revised drawing(s).** Use the very bottom space in the revision block and identify it as Revision 1, or the next sequentially higher number for that drawing. Thus, the revision numbers for a given amendment/revision may vary from drawing to drawing and will not necessarily match the amendment/revision number itself. All revised drawings will be annotated by symbol (triangle) on the drawing at the point of revision and will carry a revision number, which will be shown in the column headed "Mark" in the revision block of the drawing. A brief description "**REVISED IN ACCORDANCE WITH AMENDMENT 000#**" will be entered under "Description" in the drawing revision block. Revisions to drawings for Task Orders will be as explained for Solicitations with the exception in the Description. The description will read "**REVISED IN ACCORDANCE WITH RFP LETTER_R#**".

10.10.2 Added Drawings. For sheets to be added by amendment, the revision block will be annotated "**SHEET ADDED BY AMENDMENT 000#**" at the "Description", no number should be placed in the symbol area. Added sheet titles and other information will be a revision to the Index of Drawings sheet. For sheets to be added by revision for Task Orders will be as explained for Solicitations with the exception in the Description. The description will read "**SHEET ADDED BY RFP LETTER_R#**".

10.10.3 Deleted Drawings. For sheets to be deleted by amendment or revision, the drawing will be deleted from the set. Sheets deleted by amendment or revision will be shown as "Deleted" on the Index of Drawings sheet and noted as a revision to the Index of Drawings.

10.10.4 Modification Drawings. Modifications to construction contracts are high priority items and shall be acted upon without delay. Timely preparation of contract documents to accompany the modification package will prevent undue delay in construction schedules. Upon receipt of design requirements for a proposed modification, the A-E will proceed with preparation of the necessary changes or additions. Construction Division will forward the completed package to the Project Manager for finalization and subsequent implementation. Modifications to the construction contract may be accomplished by application of one or more methods available to the A-E. Formulating a clear, concise, and accurate modification package cannot be overemphasized. A method of modifying the contract documents is to revise an existing drawing. Care should be taken to conform to the existing drafting style already present on the drawing files. Acceptable terminology which should appear in the revision block "**REVISED IN ACCORDANCE WITH MCB ##-##-**". Each modification should be properly numbered, described, dated, and initialed by the A-E firm. Occasionally a modification requires preparation of one or more new sheets because of the magnitude of the change. For sheets to be added by modification, the revision block will **not** include the revision number, and the words "**SHEET ADDED BY MODIFICATION #**" will be entered under "Description". Care should be exercised in assigning Sheet IDs to new drawings. For example, if a new sheet is to be inserted between existing Sheets A-501 & A-502, the proper identification would be Sheet A-501A. All drawings added by modification should be noted on the Index of Drawings.

10.11 **SPECIFIC INSTRUCTIONS.** Exceptions to these guidelines or additional guidance relative to a specific job may be provided in the Specific Instructions to A-E for that job.

**CHAPTER A-10
DRAWINGS
EXHIBITS**

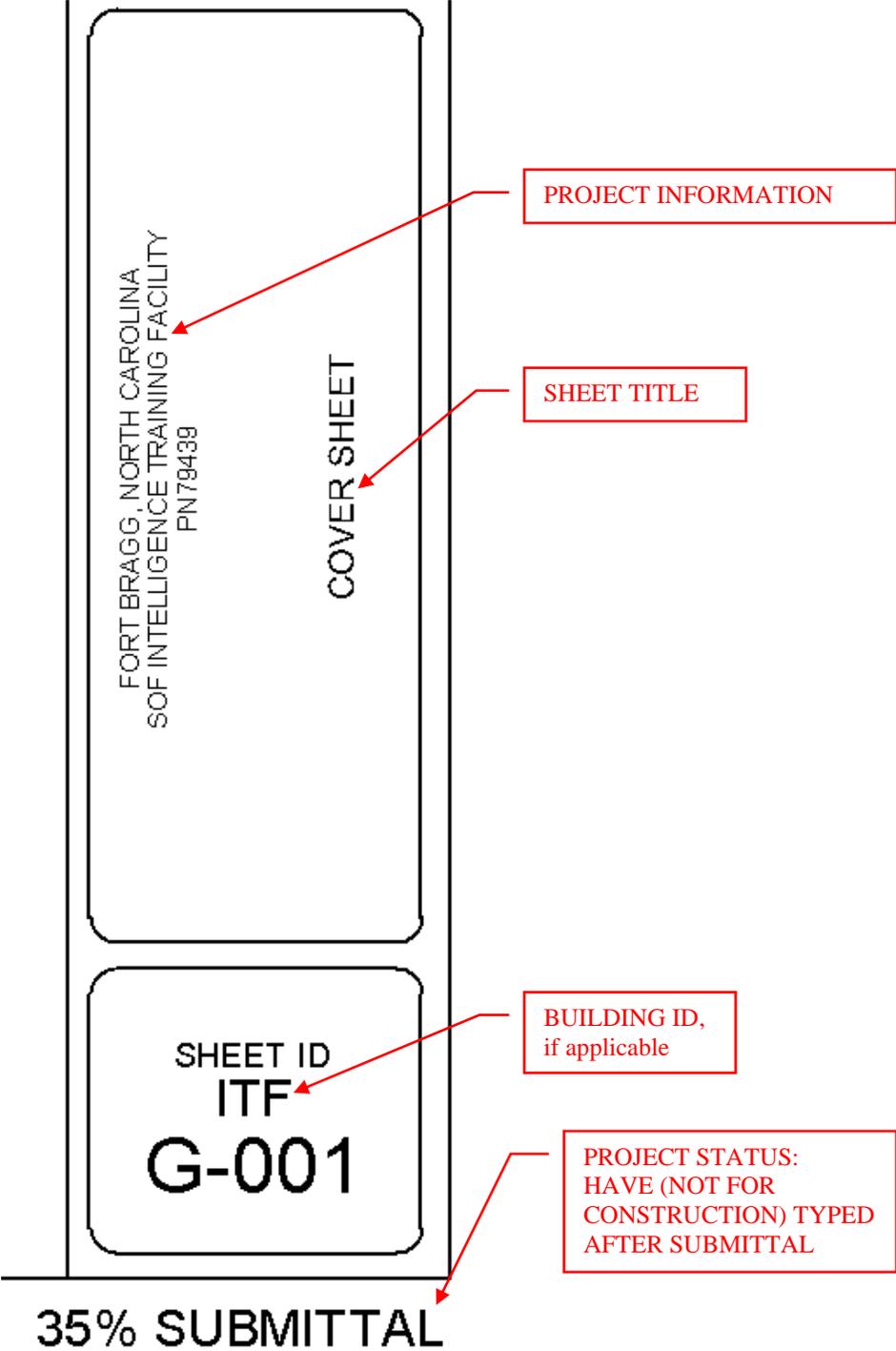


EXHIBIT A-10-1

TITLE BLOCK, SHEET IDENTIFICATION AND PROJECT INFORMATION BLOCK

U.S. ARMY CORPS OF ENGINEERS SAVANNAH DISTRICT 100 W. OGLETHORPE AVE. SAVANNAH, GA 31401		DESIGN BY:	ISSUE DATE:
		J. DESIGNER	MAY 2015
		DRAWN BY:	SOLICITATION NO.:
		J. DRAWER	XXXXX-XX-X-XXXX
		CHECKED BY:	CONTRACT NO.:
		J. CHECKER	XXXXX-XX-X-XXXX
		SUBMITTED BY:	CATEGORY CODE:
		J. SUBMITTER	171-19-04
		SIZE:	FILE NAME:
		ANSI D	FY16PN79439 G-001.dgn

MISC
PROJECT
INFORMATION

OWNER
INFORMATION

CONTRACTOR
INFO AREA

EXHIBIT A-10-2
A-E TITLE BLOCK, MANAGEMENT BLOCK

2	REVISED IN ACCORDANCE WITH AMENDMENT 0005	10 APR 2015	
1	REVISED IN ACCORDANCE WITH AMENDMENT 0002	02 APR 2015	
MARK	DESCRIPTION	DATE	

EXHIBIT A-10-3
SAMPLE REVISION BLOCK

CHECKLIST FOR FINAL SUBMITTAL DRAWINGS

The checklist is designed to acquaint firms with printing and storage requirements for preparation of contract documents. It is intended to serve only as a guide and does not replace detailed criteria provided elsewhere.

- __1. All work depicted on drawings should be suitable for reproduction to one-half size.
- __2. A minimum of 1/8" height text should be used within the body of the drawing.
- __3. All **new** work should be shown three weights heavier than existing work when both new and existing appear on the same drawing.
- __4. Plans and model files should be checked for duplications or overprinting of features, notes, plans, sections, details.
- __5. Titles, subtitles, title block and revision block information should be in accordance with Section A-10, Savannah District Design Manual for Military Construction.
- __6. Titles of drawings should agree with the titles listed on the Index of Drawings.
- __7. Signature blocks used to be required on the first set of each discipline, but with electronic bid sets signature blocks are not required.
- __8. Site-adapted drawings must have the appropriate notation in each revision block.
- __9. Amended or modified drawings must have the appropriate notation in each revision block, with triangle on the sheet where the change was made. Triangle is to have the revision number inside.
- __10. Symboling on drawings should be in accordance with A/E/C CAD Standards.
- __11. Coordinate the use of cross-referencing bubbles for locating sections, details and elevations.
- __12. On the Final Design submittal, all title block numbering, (SHEET ID, Category Code, Solicitation No.) should be in place.
- __13. All final contract drawings should have the design file name on the electronic title block.
- __14. Colored ink should not be used for plotting.
- __15. When a plan is cut into multiple sheets to provide a larger scale, provide a key plan showing where the individual plan is in relation to the overall site.
- __16. All drawings should be the same size when plotted at full size. (22" x 34" for English jobs) (594 x 842 mm for Metric jobs)
- __17. No specialized pen table or plot tables should be used to depict line styles or symboling.
- __18. All drawing files must be present on the final CD and the CD should be marked either by label or pen with **Base Name, Project Name, FY, Line Item, CAD#, Submittal Phase and Firm Name.**

- ___19. All PDF files numbered by sheet number shall be submitted. Make sure that all PDF files have SHEED IDs, solicitation numbers, category codes and dates prior to corrected final submittal. Project Manager will provide the solicitation number.
- ___20. Provide an excel spreadsheet or text file with PDF filename, SHEET ID and drawing title with the corrected final submittal.

EXHIBIT A-10-8
CHECKLIST FOR FINAL SUBMITTAL DRAWINGS

TYPICAL DRAWING SET BY DISCIPLINE DESIGNATOR	
DISCIPLINE	DESIGNATOR
GENERAL	G
HAZARDOUS MATERIALS	H
SURVEY/MAPPING	V
GEOTECHNICAL	B
CIVIL	C
LANDSCAPE	L
STRUCTURAL	S
ARCHITECTURAL	A
INTERIORS	I
EQUIPMENT	Q
FIRE PROTECTION	F
PLUMBING	P
PROCESS	D
MECHANICAL	M
ELECTRICAL	E
DISTRIBUTED ENERGY	W
TELECOMMUNICATIONS	T
RESOURCE	R
OTHER DISCIPLINES	X
CONTRACTOR/SHOP DRAWINGS	Z
OPERATIONS	O

NOTE:
**THIS IS GUIDANCE FOR SEQUENCING
OF DRAWINGS FOR LARGE PROJECTS.
IT IS UNDERSTOOD THAT SOME OF
THE CATEGORIES LISTED MAY NOT
BE APPLICABLE TO ALL PROJECTS.**

EXHIBIT A-10-9
TYPICAL DRAWING SET

*** End of Section ***