CECI Errata Sheet 4 February 2020

No. 1

ER 25-345-1
Military Publications Systems Manual

31 January 2019

The Engineer Regulation (ER) title is incorrect: ER 25-345-1 Military Publications Systems Manual title on page one needs to be corrected.

Changes are as listed below:

FROM:

DEPARTMENT OF THE ARMY
U. S. Army Corps of Engineer
CECW-EC Washington, D.C. 20314-1000

*ER 25-345-1

Regulation
No. 25-345-1 31 January 2019

Military Publications
SYSTEMS MANUAL

TO:

DEPARTMENT OF THE ARMY
U. S. Army Corps of Engineer
CECW-EC Washington, D.C. 20314-1000

*ER 25-345-1

Regulation
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Commissioning
SYSTEMS MANUAL

DEPARTMENT OF THE ARMY
U. S. Army Corps of Engineers
Washington, D.C. 20314-1000

*ER 25-345-1

CECW-EC

Regulation
No. 25-345-1

31 January 2019

Commissioning
SYSTEMS MANUAL

1. Purpose. This regulation provides policy and guidance for developing a Systems Manual (SM) for each facility designed, constructed, or rehabilitated by the US Army Corps of Engineers (USACE). The SM is required by the Unified Facilities Guide Specification (UFGS) 01 91 00.15 for Total Building Commissioning, and is defined in ER 1110-345-723, Total Building Commissioning Procedures.

2. Applicability. This regulation applies to any project that is required to be commissioned using procedures defined in ER 1110 345-723, regardless of the complexity of the project.

3. Distribution Statement. Approved for public release, distribution is unlimited.

4. References.

a. AR 25-30, Army Publishing Program
https://armypubs.army.mil/epubs/DR_pubs/DR_a/pdf/web/r25_30_FINAL.pdf

b. ER 1110-345-723, Total Building Commissioning Procedures
https://www.publications.usace.army.mil/Portals/76/Publications/EngineerRegulations/ER_1110-345-723.pdf?ver=2017-03-29-145811-607

c. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) Guideline 0 – 2013, The Commissioning Process, Annex O, Systems Manual

d. ASHRAE Guideline 1.4 – 2014, Procedures for Preparing Facility Systems Manuals

e. UFGS 01 91 00.15 Total Building Commissioning
http://www.wbdg.org/FFC/DOD/UFGS/UFGS%2001%2091%2000.15.pdf

5. General. All buildings must have a SM that describes how the building operating systems (as defined by the Commissioning (Cx) Plan) are intended to be operated and maintained. Simple designs warrant simple descriptions. As the designs become more complex, the SM must also contain more descriptive narratives, additional detail about system configurations, and more descriptive information on system operation. Irrespective of the simplicity or complexity of a building system, the operators of that building will benefit from a clear and concise description

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*This Engineering Regulation (ER) supersedes ER 25-345-1, Systems Operation and Maintenance Documentation, dated 31 Jan 1991.

of the system's intended operation and actual performance at the time commissioning is completed.

The SM will be assembled by operating system, describing the design, operation, and tested performance of each system installed in facilities constructed or rehabilitated by USACE for its customers. For renovation projects, develop an SM to the extent necessary to describe operation of systems renovated as well as existing systems that are either affected by or used in the renovated system.

Project development team members must coordinate their efforts to properly define the requirements for the SM in the design and/or construction contracts.

6. Guidance. The Designer of Record (DOR) for the project must incorporate the System Manual requirements as defined in Appendix A of this ER and the requirements as described in the ER 1110-345-723, Total Building Commissioning Procedures into the construction documents via UFGS 01 91 00.15.

The content of the SM must be complete comprehensive and supplementary to the construction submittals. When documentation of information is expected to be so voluminous that will likely cause extensive reproduction, the requisite information may be, at a minimum, referenced to a repository (electronic or physical location; as defined by Contracting Officer's Representative (COR) where the end-user can obtain the requisite information. A brief narrative defining the operating systems salient information must be provided when referencing a repository.

7. Systems Manual (SM). The SM is an organization of project documentation by separate and distinct building systems. For each system provided under the construction contract, the SM will describe in detail the operation of each system, its equipment and subsystems, and its interrelationship with other systems. The Construction Contractor is required to submit the SM at completion of Functional Performance and Integrated Systems testing. The Government's Commissioning Specialist, the Designer of Record and O&M staff representative must review and acknowledge or provide comments on the SM prior to final acceptance.

a. SM Organization and Content. Appendix A presents the requirements for SM organization and content and must be followed in order to make the deliverable conform to the requirements of this ER. Additional references include ASHRAE Guideline 0, Annex O of that guideline, and ASHRAE Guideline 1-4. In the event of conflict, Appendix A of this ER takes precedence.

b. Construction Contractor's Lead Commissioning Specialist (CxC) Responsibilities. The CxC must review the SM for clarity, completeness and accuracy. The CxC must certify to the Government that the SM is complete, clear and accurate. The CxC must ensure that the SM is organized by building operating system.

8. Supplementation to this ER is permitted but not required. If supplements are issued, USACE Commanders will provide a copy of their supplement to HQUSACE CECW-EC, Washington, DC 20314-1000, through the chain of command channels.

FOR THE COMMANDER:

KIRK E. GIBBS
Colonel, EN
Chief of Staff

1 Appendix
Appendix A Systems Manual
Organization and Content

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Appendix A
Systems Manual Organization and Content

1. General. A Systems Manual (SM) will be developed for each construction or renovation project. The SM is intended to provide all of the information necessary to understand, operate, and maintain each individual system installed in the facility. The SM must be developed under the intent of ASHRAE Guideline 0, Annex O and ASHRAE Guideline 1.4, as modified by ER 1110-345-723, and to meet the requirements of ER 25-345-1.

Very small or non-complex projects may not require commissioning to the extent called for in UFGS 09 91 00.15. Coordinate with the Government COR and Cx specialist(s) to determine the level of details to meet SM requirements consistent with appropriate level of commissioning.

a. The SM is an assembly of design, operation, and maintenance documentation created by the design team, contractors, vendors, and Cx team. Collecting, separating, and reassembling this documentation by system, as the content becomes available will make production of the SM easier and will enhance the quality of final product.

b. It is recommended that the SM be created electronically, using a format that complies with the project scope of work, and is searchable. The structure should include a separate file folder for each system to accommodate multiple users simultaneously.

c. The SM arrangement may be as follows:

Part I, Building Summary
- Executive Summary
- Owner's Project Requirements (OPR)
- Basis of Design (BOD)
- As-Built Construction Documents

Part II, Commissioned Systems
- Table of Contents (TOC)
- Name of System (Tabbed and repeated for each system)
- Consolidated Equipment List for each system
- System single-line diagram
- Equipment performance data from approved submittals related to systems commissioned
- As-built sequences of operation and as-built control drawings
- As-built set points for all systems commissioned
- Recommended schedule for re-testing with proposed testing forms
- Recommended schedule for sensor and actuator calibration
- Recommended equipment preventative maintenance schedules not included in O&M manuals
- Full equipment warranty information
- Confirmation of completed training for the user, O&M personnel, and occupants
- Ongoing system optimization procedures

2. Part I, Building Summary. Part I of the SM is intended to summarize the building design and operational requirements.

a. Executive Summary. The executive summary is a narrative providing a general overview of the building's design, function, and operational requirements. It is intended primarily to help the building operators understand how the Facility Related Control Systems (e.g. Building Control System, Utility Monitoring and Control System, Electronic Security System, Fire Life Safety, etc.) and other Low Voltage systems work together to meet the Owner's Project Requirements. The narrative should describe the operation of the building systems to the extent necessary for journeyman understanding. The narrative may be constructed from writings found in the Design Analysis and Basis of Design; however, the CxC may also write portions of this narrative to achieve the primary intent.

b. Owner's Project Requirements (OPR). Include the most recent OPR document in the SM.

c. Basis of Design (BOD). Include the most recent BOD in the SM. Include the DOR contact information.

d. As-Built Construction Documents. Include the storage location for the most recent as-built drawings and specifications to assist building operators and maintenance personnel in locating these documents. These documents may be stored in a physical location, on a computer server, or both.

e. Commissioning (Cx) Report. The Cx Report is a separate submittal under UFGS 01 91 00.15 that defines the execution and results of the Cx process. The SM need only make reference to the Cx report.

3. Part II, Commissioned Systems. Part II of the SM is a system specific repository for assembling the relevant project documentation that describes each system. The assembly must include applicable parts of the as-built project documentation that describe the installed equipment and systems, the commissioned operation and set points, and the required effort to maintain each system's function.

The information below describes the end products required for each system in the building.

a. Consolidated Equipment List. Provide a list of equipment related to each commissioned system. List must include equipment designation, application, building location, manufacturer, model number, and SM page number or tab for performance data.

b. System Single-Line Diagram. Provide a single-line diagram depicting the system. This diagram can be a flow diagram, riser diagram, control schematic, control logic diagram (CLD), etc. obtained from the as-built drawings, provided as a submittal, or drawn by authority of the CxC. The diagram will include all equipment in the system connected by single-lines representing piping, ductwork, or wiring. Include symbols and a legend to clearly show information such as direction of flow and the location of automatic control valves, actuated dampers, and all sensors, gauges, devices, and appurtenances. Show isolation valves, manual dampers, switches, safety disconnects, and circuit breakers to the extent necessary to illustrate a

discussion of equipment shut-down or zone isolation for required maintenance or emergency situations.

c. Equipment Performance Data. Equipment performance data must come from approved submittals related to systems commissioned. Information applicable to the particular piece of equipment installed must be clearly indicated on the data sheets included in this section. Where performance curves are the industry standard for displaying potential performance, these curves must be included in this section. Indicate the particular operating curve where applicable. Mark the following on the performance curves: design operating point with X and Y-axis values and units of measure, commissioned operating point with X and Y-axis values, approximated system curve at the commissioned state, minimum operating curve or surge line, etc.

d. As-Built Sequences of Operation (SOO) and CLD. Provide the most up to date as-built SOO and CLD for each system to include all changes that were made during the Cx Process. Deviations from the controls design may be pointed out and explained in a narrative format showing how the change was necessary to meet the OPR. Deviations do not include instances where the DOR has indicated an adjustable set point or information to be determined by test.

e. As-Built Set Points. Include the as-built set points for all sensors that perform a control or alarm function for the system. The as-built set points are those set points determined during system commissioning or ongoing optimization. Where the DOR left a set point to be determine by test, provide a written test procedure or narrative to explain the system configuration and equipment operational state during the test that determined the set point.

f. Recommended Schedule for Re-Testing with Proposed Testing Forms. Develop a schedule showing the length of time before equipment and systems should be re-tested. Indicate the Functional Test Procedures (FTP), Integrated Test Procedures (IST) and checklists that apply to the equipment or system tests. These procedures must be those used during the Cx process including all changes made to properly configure and test the equipment and systems. Include blank test forms.

g Recommended Schedule for Sensor and Actuator Calibration. Include the recommended length of time between calibrations of sensors and actuators. This schedule must comply with the manufacturer's recommendations and the recommendations of the controls vendor, whichever time-frame is the shortest. Include a written procedure for testing and calibrating each sensor and actuator.

h. The facility O&M manuals submitted by UFGS 01 78 23 and accepted by the government are the repository for all contract operation and maintenance requirements. The SM must reference the O&M manuals. As part of the Cx process when it is determined that recommended Equipment Preventative Maintenance Schedules were Not Included in O&M Manuals and/or where the manufacturer's O&M Manuals do not include sufficient information for the maintenance of components, equipment, or systems, include as supplemental O&M information the required operation and maintenance instructions in the SM. ASHRAE Standard 180 checklists or other Industry Standards for system specific PM items and observations may be used. Provide schedules indicating time-frames or number of equipment operating hours for

initiating operator maintenance. Ensure adequate illustrative material is provided to identify and locate operating controls, indicating devices and locations of areas or items requiring maintenance. Indicate any special tools, materials and test equipment that may be required. Any and all supplemental O&M information provided in the SM must be forwarded to the government to be issued to the Owner as an addendum to the respective O&M manual(s).

i. Full Equipment Warranty Information. Include all warranty information including, dates, contractor and manufacturer warranties with names and points of contacts. When the Warranty Plan and subsequent information is extensive, identify the repository where this information can be obtained. Include the process for making warranty claims. Specifically note warranties provided by manufacturers that are beyond the warranty for construction.

j. Confirmation of Completed Training for the User, O&M Personnel, and Occupants. Include the sign-in sheets from the individual training activities to maintain record of training.

k. Ongoing System Optimization Procedures. Provide procedures within the SM for performing and documenting Ongoing Commissioning (OCx) and performance optimization including recommendations for optimizing energy efficiency, comfort and control and maintenance during the Occupancy and Operations Phase of the project. Procedures must include keeping the record documents current as changes are made, updating maintenance procedures and schedules, recording actions taken to optimize building systems, and benchmarking results. Include techniques for periodic benchmarking of system operational data such as controls set-points and measurable equipment performance parameters. Describe data trends that were set up during the initial Cx process and how that trend data can be used to ensure continued system optimization. Provide procedures for the O&M personnel to document modifications and adjustments to the facility systems and changes to building functions, system configuration, start-up and operating procedures, controls programing, system operating set points, etc. This documentation must also provide a way for the operator to record the reason for the change and the results of that change. The O&M staff must be trained, as required by ER 1110-345-723, to use these procedures for maintaining the SM current.