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Engineering Technical Letter (ETL) WR 86-16: Direct Digital Control (DDC) of
Heating, Ventilation, and Air Conditioning (HVAC) Systems

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USPFO for Oregon

WESTNAVFACENGCOM (Code 09A2C.76)
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1. PURPOSE: The attached ETL supersedes criteria previously provided in
AF/LEEEU letter 3 Apr 85, same subject; afesc/dem letter 21 Mar 85, same subject; and joint Air Force/Army Corps of Engineers ETL 1110-3-354, 7 Dec 84,
same subject.

2. implementation: The guidance in this ETL is mandatory and applies to all
projects currently under design and to all future projects. It should be
noted that this ETL does not change previous policy, only clarifies it.

/s/
A. R. MARTINS, Chief
MAC, AFRES, ATC & Special Projs Branch

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AFETL 86-16 dtd 9 Dec 86

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS UNITED STATES AIR FORCE
WASHINGTON, D.C.
20332-5000

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Engineering Technical Letter (ETL) 86-16: Direct Digital Control (DDC) of
Heating, Ventilation, and Air Conditionig (HVAC) Systems

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AFRCE-BMS	AFRCE-SAC	AFIT/DET/DEM	HQ AFCC/DEM
HQ AFRES/DE	AAFES/ENC	ANGSC/DEE	HQ AFESC/DEM
NAVFAC Code 04/05	1100 ABG/DE	DAEN-ECC/ECE/ECE-S	

1. Purpose: This ETL establishes the policy for using and designing DDC systems for Air Force construction projects.

a. Present HVAC Control System Policy: DDC is prohibited in current HVAC control system requirements as stated in ETL 83-1, 16 Feb 83, which allows the use of electric, electronic, or pneumatic control systems. A change to ETL 83-1 will be published in 1987, and will use standardized control drawings, guide specifications, design instructions and standardized control panels with diagnostic troubleshooting capabilities. This control system design uses conventional analog controls with proportional integral (PI) controllers and industrial grade components.

b. Future HVAC Control System Policy: For future HVAC control systems, a Direct Digital Control (DDC) implementation master plan (IMP) is being developed by contract to determine how DDC should be incorporated into Air Force projects as the technology matures.

c. This ETL supersedes AF/LEEEU letter 3 Apr 85, same subject; AFESC/DEM letter 21 May 85, same subject; and joint Air Force and Army Corps of Engineers ETL 1110-3-354, 7 Dec 84, same subject.

2. Effective Date: This ETL is effective immediately.

3. Referenced Publications: This ETL is authorized in accordance with AFR 8-7; Air Force Engineering Technical Letters (ETL) dated 9 January 1986, which is directive in nature and requires compliance with ETL's. Other applicable publications are as follows:

a. ETL 83-1, Design of Control Systems for HVAC, dtd 16 Feb 83.

b. ARF 88-15 (Draft), Criteria and Standards for Air Force Construction.

4. Description/Implementation: detailed description of requirements/ criteria and instructions for MAJCOM, AFRCE, etc. are described in the following paragraphs:

a. DDC may be described as the direct operation of HVAC local loop control devices such as valves or damper actuators by a digital computer using as inputs stored program(s) and real-time sensor measurements. The digital computer and it's associated software replace the local loop pneumatic, electric, or electronic analog controllers.

b. The increased capabilities and rapidly declining costs of microcomputer products have resulted in the development and marketing of DDC systems. These systems hold great potential for conserving energy and lowering initial purchase and subsequent operating costs when applied to government HVAC systems. The versatility of DDC systems requires only programming changes strategies. These include sophisticaed control programs that are either unavailable or very expensive in conventional HVAC system controls. Self-diagnostic programs are provided as part of many DDC systems.

c. The current generation of DDC systems may be troublesome when implemented on military installations. At the present time, no standard communication protocols exist for data transmissionbetween DDC systems of different manufacturers of Energy Management and Control Systems (EMCS). No standard exist for programming languages to make changes in operating setpoints and application programs. Many systems require manufacturer specific troubleshooting equipment and/or are unique in their troubleshooting methodology. Given our present method of competitive procurement of systems and supplies, each base would soon have DDC systems from many manufacturers to compicate operation, maintenance, and logistic support.

d. The Air Force has not, as yet, developed firm criteria to alleviate the above mentioned problems and to define minimum requirements. Therefore, it is in our best interest to control the number of different DDC systems installed at each individual installation, to assure that DDC systems procured will operate with existing equipment, and to gather information that will allow the development of firm criteria in the future.

5. Action to be Taken. The application of DDC systems is prohibited except under special conditions as pilot projects. Military Construction Program (MCP) and O&M DDC pilot projects may be developed and implemented using the rules described below:

a. MCP pilot projects may be nominated by installations and will have the full written commitment of the MAJCOM/DEE to comply with the design,

construction, operation, maintenance and special documentation requirements described below. The projects should be restricted to non-critical projects which will impose only limited measurable on the operations and maintenance resources of the installation. Request for approval of DDC pilot projects will be provided through the appropriate AFRCE to AF/LEEEU, and with information. Requests for approval of DDC pilot projects will be provided through the appropriate AFRCE to AF/LEEEU, and with information copies provided to AFESC/DEM.

(1) Designers of pilot projects will prepare a complete and detailed design analysis showing the source of the criteria used, the vendors of products considered acceptable under the proposed design, technical proposal evaluation criteria and weighting, recommended quality assurance levels (meet standard products criteria), and life cycle cost analysis comparing DDC

systems to conventional controls (the design must still comply with ETL 83-1). This information will be provided through the appropriate AFRCE to AF/LEEEU and AFESC/DEM.

b. O&M pilot projects may be nominated by the MAJCOM and submitted to AFESC/DEM for approval.

(1) The request must contain:

(a) A written commitment of the base civil engineer to comply with the requirements described in this letter.

(b) A life cycle cost analysis comparing DDC systems to conventional controls.

(c) A brief description of the equipment to be controlled and the control strategy to be implemented.

(d) Documentation supporting the decision to maintain DDC systems by contract (show that the funds have been programmed) or maintained in-house (show the installation already has or will obtain, the necessary tools, equipment, and training).

(2) Designers of approved pilot projects will prepare complete and detailed contract documents and design analysis including:

(a) Drawings and specifications (The design must still comply with ETL 83-1).

(b) The names of vendors of systems considered acceptable under the proposed design.

(c) Recommended quality assurance measures and life cycle cost analysis comparing DDC systems to conventional controls.

c. Reporting for MCP and O&M projects to AF/LEEEU and AFESC/DEM.

(1) MCP Projects. The base will document installation time and problems, software debugging time and other problems, defective delivered components, problems encountered, and cost of maintenance during the first year. This information will be provided through the appropriate AFRCE to AF/LEEEU and AFESC/DEM when requested.

(2) O&M Projects. The base will document installation time, software debugging time and other problems, defective delivered components, and benefits. This informatio is to be submitted to DQ AFESC/DEM at

acceptance of
the system. The format will be furnished with the pilot project approval
letter.

(3) The base will prepare reports, approximately every six months,
documenting failures, part numbers, and time to repair. Format will be
furnished with the pilot project approval letter. Report Control Symbol

AFESC/DEM (AR) EMCS by the same manufacturer. Hence, the units cannot meet the requirements for interfacing with EMCS and the requirement for competitive procurement.

(4) In order to have a complete data base, provide a list of DDC systems that are presently in design, under construction, or installed. Indicate the base, project status, manufacturer, model, and provide a brief narrative commenting on experiences with the system, both good and bad. If the system is installed also include initial system cost, date of installation, and method of maintenance. This report should be compiled by the MAJCOMs with the support of the AFRCEs and should be prepared to reach AFESC/DEM no later than 1 July 87. A copy of this report shall be forwarded to AF/LEEEU.

6. Clarification on the difference between DDC HVAC systems and Solid State Controls located on equipment:

a. Included in the Moratorium: The moratorium on the installation of DDC systems applies to controls which are external to the heating and air condition equipment. Examples of such control components are the control panels, air handlers, control devices (external to boilers) which control the temperature of hot water for heating system, and room temperature control devices. The moratorium includes both DDC equipment for new designs as well as retrofits of existing facilities, central heating plants, and central cooling plants.

b. Not included in the Moratorium: The moratorium does not apply to the control components which are normally furnished integral with the equipment by the manufacturer and are installed at the factory. Examples of such control components are the controls furnished integral with chillers and boilers by the manufacturer.

c. Notes on General Requirements: Even though there is no moratorium on some DDC applications (such as DDC incorporated within a chiller), the general requirement for a minimum of two years of experience with the equipment must still be met. For example, a chiller model which incorporates DDC (microprocessor-based controls) cannot be incorporated in Air Force facilities until the requirement for a minimum of two years experience with that

model
DDC system is met.

d. It is emphasized that there is a requirement for competitive procurement of equipment. Performance specifications must allow open and free
competition for government procurement to the maximum extent possible. Specifications, where require equipment to contain DDC, are prohibited when
there is only one manufacturer which produces that type of equipment.

7. Reasons for the Current Moratorium on DDC Applications by the Air Force:

a. EMCS Interface: Although sales brochures typically claim that DDC
Systems are "easy to interface with EMCS", vendors state clearly that DDC
systems can only be interfaced to certain models of EMCS by the same manufacturer. Hence, the units cannot meet the requirements for interfacing
with EMCS and the requirement for competitive procurement.

b. Training of Operators: DDC vendors openly state the special training of operators is required for successful operation of DDC equipment. Because of this requirement, the equipment fails to meet Air Force criteria for maintainability of control equipment. In particular, the current product line of major DDC manufacturers employ proprietary codes and computer languages. Because of the requirement for competitive procurement, the use of DDC equipment would lead to a variety of different DDC units on a base and the requirement that operators learn a wide variety fo specialized codes and computer languages, which inhibits maintainability.

c. Servicing of Equipment: The current DDC product line from major manufacturers involves high proprietary equipment which would pose sever servicing problems at Air Force Bases. This is because of the following characteristics:

(1) There is little or no interchangeability of the components of different manufacturers. Spare and replacement parts could not be competitively procured.

(2) THe equipment is in a rapid state of development, and the current hardware is expected to become obsolete within a few years,

(3) Servicing the equipment requires extensive training for the particular equipment from each manufacturer.

d. Acceptance Testing: To ensure that controls hardwar meets the requiments of the specifications, it must be subjected to an acceptance test during installation. Currently, there is no acceptance test for such equipment because of the software involved in DDC applications.

FOR THE CHIEF OF STAFF

/s/
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