APPENDIX C

VIABILITY SURVEY PROCEDURES FOR UMCS

1. PURPOSE AND SCOPE.

a. Introduction. A Utility Monitoring and Control System (UMCS) is an energy management system which employs hardware and software to effect energy as well as manpower and equipment savings. Energy savings may be accomplished by monitoring and providing control and/or control overrides for heating, ventilation, and air conditioning (HVAC) systems as well as for lighting and central plant equipment. Manpower savings may be accomplished by remotely monitoring equipment, meters or systems which would otherwise require periodic visual observation. Equipment savings can be accomplished by early detection of equipment failure or reductions in equipment performance levels. The UMCS may also be used to assist in building and maintenance management.

b. Purpose. The purpose of this document is to provide guidelines to prepare documents for obtaining funds for a UMCS. The viability survey is the first opportunity to collect engineering data to quantitatively evaluate the feasibility of a UMCS as well as to support future project activities. It is a necessary prerequisite for funding authorization for further study, design and construction. After a decision has been made to pursue a new or expanded UMCS, the proper programming documents must be prepared in order to receive ultimate authorization for the expenditure of funds. This programming document is the DD form 1391 for Military Construction-Army (MCA) projects over $500,000 and Operations and Maintenance (O&M) projects. Other criteria or funding documents may be required to authorize expenditures from other funding sources. Prior to completion of the programming documents, the installation must have a scope of work for the project, a budgetary construction cost estimate and the appropriate economic analyses justifying the need for the UMCS project.

c. Scope of the UMCS Survey. The major purpose of the UMCS survey is to obtain site specific data which can then be used to justify and support future project related efforts. For example, the survey will identify the approximate number and types of required monitoring and control points as well as the type and extent of the data transmission system (DTS). These data can be used to estimate the installed cost of the new or expanded system. The survey will also identify potential energy saving opportunities (ESOs) as well as potential manpower or equipment saving opportunities. These cost and savings data allow the estimation of an economic payback figure for the project. This payback figure can then be evaluated in accordance with guidance provided by the Department of the Army (DA) or the installation's major command (MACOM). The site specific data obtained during the survey can also be used in the preparation of scopes of work for future project activities. Finally, the system cost estimates can be used in the preparation of the government cost estimate. After these steps are successfully accomplished, the proper programming documents can be completed. To support these ultimate goals, the primary data to be collected during the survey include:

(1) A list of candidate facilities and/or other energy, equipment or manpower saving opportunities which are to be included in the project.

(2) A description of the required site preparation to prepare the Central Station and to network the remote UMCS equipment to the Central Station.

(3) A preliminary list of the number and type of points to be monitored or controlled. These data may be used to develop a project cost estimate. Methods for system cost estimating and energy savings calculations are available from the UMCS Mandatory Center of Expertise (MCX).

(4) Data for use in estimating potential energy savings.

(5) Descriptions of any modifications or repairs to existing equipment or controls which are required for an UMCS system to function effectively.

(6) Operating schedules of the various facilities included in the project in order to estimate potential energy savings.

(7) A descriptive list of existing UMCS components, (i.e. existing sensors or control devices) to be utilized with the new or expanded system.

(8) A list of utility records for the Post and candidate facilities in order to quantify the economic impact of the potential energy savings.

d. General. This document is directed solely to providing procedural guidelines for UMCS surveys. Other activities which occur in the course of a UMCS project beginning with the DD form 1391 preparation and ending with the acceptance of the system, are covered in other references. Section 1.4, *References*, provides further documentation and guidance on UMCS projects.

e. UMCS-MCX Responsibilities. The U.S. Army Corps of Engineers UMCS-MCX is responsible for all phases of UMCS projects as detailed in ER-1110-3-109, *Centers of Expertise*. When requested, the UMCS-MCX will provide survey support and services on a reimbursable basis.

f. References.

(1) U.S. Army Engineering and Support Center, Huntsville , Corps of Engineers, *Energy Savings Analysis for UMCS.*

(2) U.S. Army Engineering and Support Center, Huntsville , Corps of Engineers, *UMCS Viability Cost Estimator*, 21 Nov 96.

(3) U.S. Army Engineering and Support Center, Huntsville , Corps of Engineers, *UMCS Design Cost Estimator*, 21 Nov 96.

(4) Department of the Army, *Cost Estimates-Military Construction,* TM 5-800-2, 12 June 1985.

2. RESPONSIBILITIES.

a. General. The survey for preparation of funding documents can be accomplished using personnel from various sources such as the installation, the MACOM, specialized engineering firms, Corps District offices, and the UMCS-MCX. Installation personnel will be familiar with needs of the installation and characteristics of existing facilities, utilities and other systems. Representatives from the MACOM and UMCS-MCX will be experienced personnel who have been involved with the initiation, design, installation and operation of other UMCS projects. The basic responsibilities for each team member or group are listed below.

b. Participants. The survey team may include representatives from the following principal participants:

(1) UMCS-MCX. The UMCS-MCX is tasked to ensure proper design, installation, testing and acceptance of UMCS projects and to provide engineering support to DoD and other government agencies. To accomplish this, the UMCS-MCX will:

(a) Perform surveys upon request.

(b) Provide team leadership and team members.

(c) Provide technical assistance for UMCS projects.

(d) Develop UMCS guidance for design and construction.

(e) Ensure compliance with UMCS design standards.

(f) Develop procedures and techniques for installation and checkout.

(g) Define levels of responsibility for UMCS inspection, testing and acceptance.

(h) dentify UMCS consulting sources, both commercial vendors and design services, for end users.

(i) Define UMCS inspection requirements.

(2) Corps District Office Representative. The local Corps District office may be involved in administering either the UMCS design or construction contract, or both. Therefore, their participation in the survey will familiarize them with all project parameters from the outset.

(3) MACOM Energy Office Representative. The MACOM establishes procedures for review and approval of requests for UMCS installations. The MACOM is then responsible for forwarding survey requests to the UMCS-MCX and providing support and funding for the survey activities.

(4) Directorate of Public Works Representative. The primary source of information concerning the candidate facilities, utilities and energy consumption will be the DPW. This information is necessary in order to develop a system concept and to support the needed economic analyses.

(5) Communications Office. The communications office should assist in the conceptual planning of the communication network from the field equipment back to the central equipment in the Central Station. This individual should have all necessary data on any existing communications network and be involved in the design of any new network.

(6) UMCS Manager. The UMCS manager is the on-site manager of any existing UMCS and is responsible for its operation and maintenance. An UMCS manager may not yet be identified if the installation does not have a existing system.

(7) Other Installation Personnel. Other installation personnel such as shop foremen, plant operators, HVAC mechanics and UMCS operators who can provide significant guidance to the survey should be available.

c. The Survey Team. The survey team is responsible for the actual building-to-building survey and the resulting economic analysis. The number of survey team members and their individual specialties will vary according to the size and complexity of the proposed system and the time available to accomplish the survey. As a minimum, the survey team should include an electrical engineer, a mechanical engineer and a technician. Larger teams will include multiples of the above positions with some of the members specializing in a specific aspect of UMCS application. The people on the team should possess the skills necessary to identify areas of UMCS application with the potential for economic savings. Qualifications and responsibilities of each team member are discussed below.

(1) Team Chief. The team chief should typically be either a mechanical or controls engineer with experience in both fields. The team chief will be experienced in the selection, design, installation, operation and maintenance of UMCS systems. The team chief will direct all survey activities and coordinate with Post personnel as required to accomplish the survey. The responsibilities of the team chief include:

(a) Coordinating the survey activities in advance with the installation including sending the survey notice.

(b) Assembling the team.

(c) Organizing and scheduling the survey.

(d) Handling the survey team logistics.

(e) Conducting briefings.

(2) Mechanical Engineer. An engineer with experience in the design and analysis of all types of mechanical systems including central plants and other utility systems such as water and wastewater treatment systems. This person should have experience in inspecting HVAC systems and components including controls. If a controls engineer is not available, one of the engineers on the survey team should be well versed in instrumentation and controls.

(3) Electrical Engineer. An engineer with experience in the design and checkout of various types of local control systems (i.e. pneumatic, electric, etc.) as well as the hardware and software requirements of an UMCS system. Additional experience in design and analysis of electrical power distribution systems for both building power distribution systems as well as installation-wide power distribution systems is desirable.

(4) Technician. The technician's primary task is to work with and assist the engineers listed above in both data gathering and analysis. They should be experienced in the field in which they are to be working.

3. SURVEY REQUIREMENTS.

a. Initiation. A survey is initiated when an installation has established the need to install or add to an UMCS. Survey support can be requested from the UMCS MCX while site specific data should be requested from the installation. A survey team chief will be chosen to prepare a survey plan, assemble the survey team and perform the survey. Responsibilities of survey team members are outlined in Section 2.

b. Survey Notice. The assistance of site personnel is crucial to the success of a survey. The assistance required ranges from arranging for Post and facility access to provision of site engineering data. It is essential that the installation be notified of the pending survey and required support as much in advance as possible so that survey needs can be met without significantly impacting the normal workload. This notification is provided through the survey notice letter. The survey team chief will provide the survey notice letter to the Post commander and closely coordinate with his designated point of contact, usually the DPW. The survey notice will cover, as a minimum, the following subjects:

(1) Proposed survey schedule.

(2) Survey team members (including clearances where necessary).

(3) Facility access requirements.

(4) Safety, fire and security regulations.

(5) Necessary site specific data, such as:

(a) As-built drawings (i.e., Architectural, Mechanical, Electrical, Existing UMCS, Communications, etc.).

(b) Candidate UMCS applications.

(c) Utility Records (e.g., Fuel consumption, Electrical consumption, Utility rate contracts, Central plant data).

(d) Real Property Records

(e) Building occupancy schedules.

(f) Major equipment operating schedules.

(g) Buildings scheduled for demolition.

(h) Major equipment scheduled for shutdown or removal.

(6) Desired design and construction schedule.

c. Security Clearances. Applicable security restrictions will be carefully observed during all survey activities including information gathering. Any classified data gathered or developed as part of the site survey will be safeguarded appropriately. All team members will possess the necessary clearance levels required by the installation prior to the start of the on-site portions of the survey.

4. THE SURVEY.

a. Beginning the Survey. An entrance briefing will be conducted with the survey team and the responsible installation personnel. An installation DPW representative will brief the survey team on the proposed scope of the project and the economic analysis guidelines to be used. The DPW representative is responsible for providing site specific information such as contact persons for as-built drawings, facility access, utility information, secure areas, and other areas of general installation coordination. DPW personnel will also provide information on any existing UMCS and other associated control systems.

b. Candidate Facilities and Systems. The survey teams will work with the DPW and other installation and facility personnel to develop a preliminary list of candidate facilities and other system applications. Prime candidates for inclusion on the site survey list are facilities and/or systems which have large energy consumption or equipment ratings. Buildings which are occupied less than sixteen hours per day or less than seven days per week are generally good candidates as are central chiller and boiler plants. Other candidates should include utility or other system meters, especially remote meters which must be manually logged frequently. Site specific circumstances may also result in other candidate UMCS applications.

c. Tasks. There are three primary tasks of the UMCS survey. The first is to obtain information that was requested but not obtained prior to arrival on site. This could potentially include any of the items discussed previously in Section 3. The second is to verify the site specific information received including the as-built drawings, major equipment and building operating and occupancy schedules, buildings scheduled for demolition and major equipment scheduled for shutdown. The third is to obtain information not readily available from existing documentation. This would include:

(1) Identify any major equipment not documented.

(2) Identify any potential savings opportunities not documented.

(3) Identify communications system requirements.

(4) Determine the routing of any new or extensions to the existing communications system in order to serve all potential UMCS points.

(5) Determine the extent of any existing UMCS and the condition and suitability of the installed equipment.

(6) Prepare initial sketches of any readily identifiable changes which must be made to the existing mechanical or electrical systems.

(7) Determine the source and type of heating and cooling for each building.

(8) Verify data gathered to calculate heat loss and the cooling load of each building.

(9) Verify the existence and condition of economizer capabilities for each major air system.

(10) Identify local loop controls or devices which are in need of repair or replacement.

(11) Develop an input/output (I/O) point estimate. This is a function of the degree of control required, types of systems to be monitored, and the selected application programs. The I/O point count will have a direct impact on the system cost.

(12) Develop a preliminary list of required application programs. Commonly used programs include:

(a) Scheduled start/stop.

(b) Steam boiler selection.

(c) Optimum start/stop.

(d) Hot water boiler selection.

(e) Hot water outside air reset.

(f) Lighting control.

(g) Demand limiting.

(h) Chiller selection.

(i) Day/night setback.

(j) Chilled water reset.

(k) Economizer.

(l) Condenser water reset.

(m) Chiller demand limit.

(n) Ventilation/recirculation.

(o) Hot/cold deck reset.

(p) Remote boiler monitoring control.

(q) Reheat coil reset.

Specific requirements for the design survey are covered in Appendix D, DESIGN SURVEY PROCEDURES. Included in Appendices C and D are survey data forms. These forms are intended for use during the survey to record data for use in the subsequent analyses.

5. SURVEY REPORT.

a. Survey Report. The end product of the survey is a compilation of the data used to complete the DD form 1391 or other funding documents as well as to support future project related activities. Preparation of the survey report consists of compiling information gained during the survey in a concise and organized manner. The report will present the information obtained on each building individually. The report will also tabulate all information required to perform the project cost estimate and the project economic analysis.

b. Project Cost Estimate. The project cost estimate will be prepared using information obtained during the survey. Spreadsheet-based UMCS cost estimators with comprehensive lists of devices and systems are available from the UMCS-MCX. One version is intended to determine the viability of UMCS at a specific site and the other applies to the final design. See Section 1.4, References.

c. Project Economic Analysis. The project economic analyses are prepared using information obtained from the viability survey and cost estimate. A methodology to determine energy savings for the economic analyses may be found in the Energy Savings Analysis (ESA) manual and computer program for UMCS.

d. Preparing the DD form 1391 or other funding documents. As appropriate, data obtained in the site survey, the cost estimate, and the economic analysis will be summarized in DD form 1391. Instructions for completing DD form 1391 are found in appropriate programming guides.

6. SURVEY PROCEDURES.

a. Introduction. Much of the survey effort will involve identifying and documenting the equipment to be controlled. This includes verifying equipment, piping and electrical circuits, and tracing out local control loops. The purpose of the survey is to obtain adequate information to evaluate the economic feasibility of a proposed UMCS and support future project activities. Once candidate buildings have been selected and all available records have been obtained on each building, the detailed building survey may be started. During the detailed building survey it is important to:

(1) Verify major energy using equipment.

(2) Verify present and required operating conditions.

(3) Make preliminary selection of application programs.

(4) Note any major required equipment modifications.

(5) Note existing building occupancy schedules.

b. Verify and Identify Energy Using Equipment. During the survey, locate and identify all major systems which could be monitored or controlled by the UMCS. Note discrepancies between actual field conditions and as-built drawings or equipment lists. Survey observation sheets for the different system types are located at the end of this Appendix. The necessary survey data differs depending on the types of systems found in each building. The information to be collected for each system type is summarized below.

(1) Air Handling Units. The broad category of air handling units (AHU) comprises many types of systems: single zone, multizone, reheat, variable air volume, fan coils, heating and ventilating, and unit heaters. All these systems provide heating and/or air-conditioning by forced air movement. The items of importance while surveying AHUs are:

(a) The type of AHU.

(b) The building area served by the AHU.

(c) Type of temperature control system.

(d) Types of coils (hot water, steam, electric, chilled water, etc.).

(e) Types of damper controls (fixed, modulating, economizers, etc.).

(f) Starter and motor type and size.

(g) Start up and operational items associated with the system.

(h) Summer/winter operational data.

(i) Equipment constraints.

(j) Valves.

Survey Sheet 1, Air Handling Unit Survey Observations, lists the noteworthy items.

(2) Perimeter Radiation Systems. Perimeter radiation systems are heating units normally found in exterior zones of buildings and are typically sized to match the heat losses from walls, windows, and doorways. The main items of importance while surveying perimeter radiation systems include:

(a) The type of perimeter radiation system (steam, hot water, electric, etc.).

(b) The building area served by the perimeter radiation system.

(c) The type of temperature control system.

(d) Start up and operational items associated with the system.

(e) Kilowatt (kW) rating of the equipment.

Survey Sheet 2, Perimeter Radiation Survey Observations, lists noteworthy items.

(3) Boiler and Converter Systems. When central boiler systems provide heating to buildings via steam to hot water or hot water to steam converters, the converter capacities (including any storage and associated pump sizes) should be noted. On such systems, the UMCS will normally interface with the existing control loop to regulate the temperature or pressure output of the unit. It is necessary to inspect the control system to see what local control loops exist and if additional control valves will be required. On most hot water systems, an important energy saver is outside air reset. The existing control systems should be inspected to see if local reset controls already exist. On hot water systems, pumps should be noted as candidates for UMCS controlled equipment. Survey Sheet 3, Boiler and Converter Survey Observations, lists noteworthy items.

(4) Chillers and Compressors. When surveying chiller and compressor units it is important to identify which unit serves which air handling units. This is necessary to know whether an air conditioning compressor system is serving AHUs which can be shut down during unoccupied hours or AHUs which condition critical areas where the chiller needs to provide cooling 24 hours a day (i.e., computer areas, hospitals, mission critical facilities, etc.). The following information must be obtained:

(a) The type of chiller or compressor system.

(b) Rated capacity of the system.

(c) The compressor and auxiliaries motor data.

(d) The type of controls used on the systems.

(e) Method of condenser temperature control.

(f) Chiller alarms and interlocks (if any exist) for future monitoring by the UMCS.

Survey Sheet 4, Refrigeration Equipment Survey Observations, lists noteworthy data.

(5) Domestic Hot Water. Domestic water heaters may be either direct fired using fossil fuels, electric resistance, or receive heat from a central plant. Note the tank capacity, setpoint, heating input and peak use periods. Survey Sheet 5, Domestic Hot Water Survey Observations, lists noteworthy items.

(6) Lighting. To accomplish lighting control through the UMCS, the power distribution system configuration for the lighting circuits must be known. Identify the branch circuits in a building and note local switching arrangements. Determine the lighting wattage for the building. Field verify the electrical plans to make sure the lighting layout has not changed. Note whether delamping (which will reduce the overall light wattage and potential UMCS savings) has been implemented. Survey Sheet 6, Lighting Survey Observations, lists noteworthy data.

(7) Miscellaneous Equipment. There are a few systems which may be analyzed during the survey which were not included in the above system descriptions. These systems include: (1) exhaust fans, (2) water pumping systems, and (3) miscellaneous loads which could be cycled on predetermined time schedules. Survey data required for exhaust fans include: (1) fan use (i.e. laboratory, toilet, etc.), (2) horsepower, (3) capacity in cubic feet per minute (cfm), and (4) present and required operating schedule. Other miscellaneous electrical or thermal equipment may not be routinely identified, but could offer the potential for energy savings through UMCS control. For such equipment note the capacity and present and required schedule of operation. There may be savings by shutting the equipment off during hours when it is not required.

c. Verify Present and Required Operating Schedules. After inspecting the energy using equipment, the most critical data to retrieve are operating schedules of the equipment. Most of the savings estimated depend heavily on this information. Building and operational and maintenance personnel should be interviewed to determine how the systems are currently operated. Are the fan systems deenergized during unoccupied hours? Are the thermostats setback at night? Are there any existing timeclock devices, and if so, do they work? Next, interview the building manager to determine the actual required hours of operation for each system. If, for example, an AHU is only providing conditioning to spaces for occupant comfort, then the system could be shut off during unoccupied hours. However, if the AHU is providing ventilation for special equipment (i.e., laboratory, computer, or special process area) or providing make-up air for exhaust systems, the AHU may need to operate 24 hours a day. See Survey Sheet 7, Building Data Survey Observations, for a list of what data should be recorded for operating schedules.

d. Identification of Equipment Modifications. If the implementation of the UMCS requires modification of a piece of mechanical or electrical equipment, adequate information must be obtained during the survey to develop a budgetary estimate of the cost for the modification. Areas where mechanical and/or electrical modifications may be necessary include things such as:

(1) Duct work additions or changes.

(2) Piping additions or changes.

(3) Additional fans or pumps.

(4) Control circuit components.

(5) Disconnect switches.

(6) Electrical service changes.

e. Identify Input/Output (I/O) Point Selection. Identify the application programs which relate to the particular systems identified in each building. The selected application programs will largely determine the I/O points required for each system and impact the potential economic savings.

f. System Deficiency Survey Report. After a visual inspection and interviews with operations personnel, note the existing control devices that must be repaired or replaced in order for the system to be in good working order.

g. Local Controls Interface. In general, existing local control loops will need to be modified to include the interface required for UMCS supervisory control. During the survey, verify how each control loop is presently connected and operated and identify the required failure mode for each control loop and piece of equipment.

h. Electrical Power. At each building, new electrical power will be required for field equipment panels and other control devices, such as equipment transformers, control actuators, etc. During the survey, identify where the contractor will obtain power for UMCS devices. Generally, the power source should be 120/208 volt, 3 phase, 4 wire system. If this power type is not available, make a note in the survey report so that an estimate of the cost to provide suitable power can be included in the project budgetary cost estimate.

i. Device Mounting Locations. During the survey, ensure adequate space is available to mount UMCS components such as field equipment panels, programmable logic controllers (PLCs), data terminal cabinets (DTCs) and various sensors. If circumstances arise where special space or mounting considerations will significantly alter the budgetary cost estimate, document this in the survey report.

j. Building Wiring. Note all interior and exterior wall and ceiling construction throughout the building where wiring will be run. If wiring cannot be installed concealed, note how and where new conduit shall be installed (for example, install conduit exposed across ceiling of shop area). Also note all ceiling heights where wiring will be run.

k. Central Station/Island Stations. The recent and continuous advancements in computer technology have minimized space and power requirements with respect to the Central/Island Stations and remote workstations. Desktop personal computers are now available with abundant speed and memory to serve any function in the system. Determine the probable location of the Central Station and note the availability of communication lines. When fiber optic DTS is specified, locating the Central Station in buildings with existing fiber optic capacity is highly recommended.

l. Energy Metering. Energy meters should be located at the public utility service point and additional energy meters may be installed at the building level. The survey requirements for these two areas are described below.

(1) Main Site Utility Distribution Metering. The electrical meters at the point of service by the utility company must also be metered by the UMCS if electrical demand limiting is implemented. Determine the location of all the electrical meters used for billing the facility by the power company. The UMCS will need to monitor all of the same points. In most cases, this will involve only one main point where the utility company substation or transformer banks are located. The utility company generally will provide a meter output from their meter at the request of the customer. This can be verified through the utility company representative who can also provide an estimate of the cost. If gas or other main utility metering is being considered, the same approach is recommended for existing meter locations. In many cases a pulse contact may be added to the existing meter head for the UMCS to monitor.

(2) Building Submetering. For building submetering, there are a number of different energy and flow measurements available. For gas or liquids, determine the fluid to be measured (gas, water, steam,

etc.), and its maximum flow rate. For electrical service metering, determine the secondary voltage to the building and the maximum amp service. With this data, cost estimates can be developed for installing building and equipment submetering.

m. Data Transmission System. There are three methods available for DTS: (1) fiber optics (FO), (2) wirelines, and (3) radio frequency (RF). Each DTS type has its economic and technical benefits. The preferred DTS is fiber optics or wirelines. The selection will be based on economics and the particular site requirements. Any new communications systems at a facility will have to be coordinated with the local communications office for approval. For DTS to be installed on existing aerial poles, meet with the communications personnel at the installation and go over the proposed DTS routing on site plans showing existing telephone and electrical power poles. The local communications office should identify all rights-of-way for adding cables on these poles. In addition, if the facility has specific design criteria for installation of overhead wires, the communications office should provide these guidelines. For underground direct buried DTS, the communications office should locate on site plans special obstructions or right-of-way problems. On some facilities where communications wiring is run underground, there may be spare conduits available for special applications, such as UMCS or fire/security. Communications office approval is normally required to use these conduits. The use of radio frequency equipment requires approved frequencies to transmit data signals to receivers on the facility. Again, the communications office should identify any problem areas to reach with RF signals (for example, “shadows” behind obstructions or other RF noise interference).

(1) Fiber Optics and Wireline DTS Application. Each facility will have its own design criteria for installation of communication cables. In some instances the DTS will be aerial, and in some cases it will be underground. After identifying the routing of the DTS from building-to-building, locate the DTS entrance to the building floor plan where the contractor will mount the cable terminations and junction boxes. Also note the exterior wall construction, which is needed for wall penetration details and cost estimating. Once the basic method of installation of the cabling has been determined through coordination with the communications office, conduct a visual survey with the facility site plans to verify pole locations, direct buried cable obstructions and other factors which might significantly impact the budgetary cost estimate.

(2) Radio Frequency DTS. The use of radio frequency (RF) DTS involves the installation of radio receivers and transmitters for data communications. Coordinate the possible use of RF with the communications office to avoid problems with the availability of radio frequencies for data transmission. On some facilities, all available frequencies are used and RF will not be an option. To survey a facility for RF DTS, look at the local geography. Make note of large hills and valleys which may obstruct the communications of the RF. Also, determine where the main transmitter antenna should be located. Many times a tall building will provide a suitable location for elevating the antenna system. If there is no available tall building, identify an alternative location for a new antenna tower. The transmitter for the RF must be located in close proximity to the antenna. If the antenna is located on top of a building, the transmitter could be located in the building. If a new antenna tower is built, a new enclosure may be necessary to house the transmitter. Since the RF DTS is only used for communication between the UMCS central equipment and the SFPs, the designer must choose an alternate DTS for SFP to field equipment panel communication.

n. Energy Savings Estimation. Collect all essential data to estimate potential energy savings and system cost. Survey Sheet 8, Energy Estimating Survey Observations, is a list of information required for this purpose.

o. Documentation of Results. After completing the survey, compiling and organizing the data will help in determining whether the data is complete. All survey notes and sketches should be dated and initialed by the engineer in charge of the survey. In many cases, changes will occur during and after the UMCS design. If there is any question as to the conditions at the time the notes were made, it is important to have the date and person responsible for the survey data. During this period, it is also

important to write a short memorandum to summarize the results of the survey. This memo should include:

(1) A list of people involved in the survey.

(2) The time and dates of the survey.

(3) The list of names and phone numbers of people contacted at the facility.

(4) Any special problems or comments related to the UMCS design.

(5) General progress made on the survey.

(6) Notes from the entrance and exit interviews with facility personnel.

This information will help as the project matures if questions arise regarding design decisions based on meetings at the facility. Furthermore, the background data and reasons why these choices were made will be documented.

SURVEY SHEET 1

PROJECT: DATE:
LOCATION: PREPARED BY:
PROJECT ENG: CHECKED BY:
BUILDING: FILE:

AIR HANDLING UNIT SURVEY OBSERVATIONS			
	AHU NO.		LOCATION (RM)
	REF. SYS. SERVING AHU		SERVES AREA

UNIT TYPE:									
	SINGLE ZN		2-PIPE FC		4-PIPE FC		UNIT HTR		HEATING & VENTILATING
	MULTIZONE		DOUBLE DT		REHEAT		INDUCTION		VARIABLE AIR VOLUME
	NUMBER OF ZONES				OTHER				
	COMMENT:								

NAMEPLATE:									
					MFG.				MODEL
	SUPPLY FAN HP				MFG.				MODEL
	RET/EXH FAN HP				MFG.				MODEL
	CFM-HTG		CFM-CLG		MIN %OA		MAX %OA		% HTG AREA SERVED
COMMENT:									

COILS:									
	NONE		STM		HW		ELEC		MOD VLV	PREHEAT
	NONE		STM		HW		ELEC		MOD VLV	HEATING
	NONE		STM		HW		ELEC		MOD VLV	REHEAT
	NONE		STM		HW		EVAP MEDIA		MOD VLV	HUMIDIFYING
	NONE		DX		CW				MOD VLV	COOLING

OPERATION:											
HOURS ON:			S	M	T	W	T	F	S	COMMENTS	
PRESENT START TIME										TIMECLOCK?	
PRESENT STOP TIME											
REQUIRED START TIME											
REQUIRED STOP TIME											
MONTHS ON:											
J	F	M	A	M	J	J	A	S	O	N	D

CONTROLS:									
		PNEUMATIC		ELECTRIC		ELEC'NIC		DDC	COMMENTS
THERMOSTAT TYPE:		SINGLE STPT		DUAL SETPNT		SETBACK			
SPACE SETPOINT (IF):		OCC HEAT		UNOCC HEAT		OCC COOL		UNOCC COOL	
OTHER SETPOINTS (IF):		HOT DECK		COLD DECK		MIXED AIR		OTHER	
DAMPER CONTROL:		MIN OA (Y/N)		MAX OA (Y/N)		RA (Y/N)		EA (Y/N)	
		MA CONTROL		ECONO-DB		ECONO-ENT		OTHER	
DEMAND LIMIT:		(Y - YES ; N - NO)							
COMMENTS:									

Survey Form 1

SURVEY SHEET 2

PROJECT: DATE:
LOCATION: PREPARED BY:
PROJECT ENG: CHECKED BY:
BUILDING: FILE:

PERIMETER RADIATION SURVEY OBSERVATIONS			
	PER RAD NO.		LOCATION (RM)
	SOURCE OF HEATING		SERVES AREA

UNIT TYPE:									
	STEAM		HW		ELECTRIC				
	OTHER								
COMMENTS:									

NAMEPLATE:					
	HW PUMP 1 - HP		MFG.		MODEL
	HW PUMP 2 - HP		MFG.		MODEL
	HW PUMP 3 - HP		MFG.		MODEL
	HW PUMP 4 - HP		MFG.		MODEL
COMMENTS:					% AREA HEATING

OPERATION:									
HOURS ON:	S	M	T	W	T	F	S	COMMENT	
PRESENT START TIME								TIMECLOCK?	
PRESENT STOP TIME									
REQUIRED START TIME									
REQUIRED STOP TIME									
MONTHS ON:									
J	F	M	A	M	J	J	A	S	O	N	D

CONTROLS:								
		PNEUMATIC		ELECTRIC		ELEC'NIC		DDC	COMMENTS
RADIATION CONTROL:		NONE		2-WAY VLV		3-WAY VLV		OTHER	
SPACE SETPOINT (F):		OCC HEAT		UNOCC HEAT		OCC COOL		UNOCC COOL	
RESET CONTROL (F):		HW HIGH		HW LOW		OA LOW		OA HIGH	
COMMENTS:									

Survey Form 2

SURVEY SHEET 3

PROJECT: DATE:
LOCATION: PREPARED BY:
PROJECT ENG: CHECKED BY:
BUILDING: FILE:

BOILER & CONVERTER SURVEY OBSERVATIONS			
	BOILER/CONVERTER NO.		LOCATION (RM)
	SOURCE OF HEATING (PLANT)		SERVES AREA

UNIT TYPE:									
	STEAM		PSIG		HW		TEMP.		BOILER TYPE:
	NO.2 OIL		NO.6 OIL		N.GAS		ELEC		FUELS:
	STM/HW		HTHW/HW		HTHW/STM		OTHER		CONVERTER TYPE:
	SPACE HEAT		DHW		OTHER				USE:
COMMENTS:									% HEATING AREA SERVED (BASEBOARD RADIATION ONLY)

NAMEPLATE:						
	MFG.		MODEL		CAPACITY OUTPUT (BTUH)	
					CAPACITY INPUT (BTUH)	
	MFG.		MODEL		CAPACITY OUTPUT (BTUH)	
					CAPACITY INPUT (BTUH)	
	HW PUMP 1 - HP		MFG.			MODEL
	HW PUMP 2 - HP		MFG.			MODEL
	HW PUMP 3 - HP		MFG.			MODEL
COMMENTS:						

OPERATION:									
HOURS ON:	S	M	T	W	T	F	S	COMMENT	
PRESENT START TIME								TIMECLOCK?	
PRESENT STOP TIME									
REQUIRED START TIME									
REQUIRED STOP TIME									
MONTHS ON:									
J	F	M	A	M	J	J	A	S	O	N	D

CONTROLS:									
		PNEUMATIC		ELECTRIC		ELEC'NIC		DDC	COMMENTS
SETPOINTS		PSIG		HW SUPPLY					
RESET CONTROL (oF):		HW HIGH		HW LOW		OA LOW		OA HIGH	
BURNER CONTROLS		O2 TRIM (Y/N)		OTHER					
COMMENTS:									

Survey Form 3

SURVEY SHEET 4

PROJECT: DATE:
LOCATION: PREPARED BY:
PROJECT ENG: CHECKED BY:
BUILDING: FILE:

REFRIGERATION EQUIPMENT SURVEY OBSERVATIONS			
	CHILLER/COMPRESSOR NO.		LOCATION (RM)

UNIT TYPE:							
	CENTRIFUGAL WITH WATER SIDE COOLING TOWER						OTHER
	RECIPROCATING WITH WATER SIDE COOLING TOWER						AHU'S SERVED
	RECIPROCATING WITH AIR COOLED CONDENSING UNIT						
	ABSORBTION WITH WATER SIDE COOLING TOWER						
	AIR COOLED CONDENSING UNIT						
	CHW		DX		OTHER		

NAMEPLATE:									
CHILLER		MFG.				MODEL			SERIAL NO.
	VOLTS		AMPS		PH		HZ	CAPACITY (TONS)	
TOWER		MFG.				MODEL			# OF FANS
	VOLTS		AMPS		PH		HZ	HP each	
CW PUMP		MFG.				MODEL			SERIAL NO.
	VOLTS		AMPS		PH		HZ	HP	
CNW PUMP		MFG.				MODEL			SERIAL NO.
	VOLTS		AMPS		PH		HZ	HP	
COMMENTS:									

OPERATION:								
HOURS ON:	S	M	T	W	T	F	S	COMMENT
PRESENT START TIME								TIMECLOCK?
PRESENT STOP TIME								
REQUIRED START TIME								
REQUIRED STOP TIME								

MONTHS ON:											
J	F	M	A	M	J	J	A	S	O	N	D

CONTROLS:								
		PNEUMATIC		ELECTRIC		ELEC'NIC		DDC	COMMENTS
SETPOINTS		CWS (oF)		CWR (oF)		CNWS (oF)		CNWR (oF)	
PANEL INDICATORS									
- PRESSURE		LITE-HI		LITE-LOW		GAUGES			
- TEMPERATURE		LITE-HI		LITE-LOW		GAUGES			
- OTHER									
COMMENTS:									

Survey Form 4

SURVEY SHEET 5

PROJECT: DATE:
LOCATION: PREPARED BY:
PROJECT ENG: CHECKED BY:
BUILDING: FILE:

DOMESTIC HW SURVEY OBSERVATIONS:			
	BOILER/CONVERTER NO.		LOCATION (RM)
	SOURCE OF HEATING (PLANT)		SERVES AREA

UNIT TYPE:									
	NO.2 OIL		NO.6 OIL		N.GAS		ELEC		FUELS:
	STM/HW		HTHW/HW		HTHW/STM		OTHER		CONVERTER TYPE:
COMMENTS:									

NAMEPLATE:					
MFG.		MODEL:		OUTPUT CAP (BTUH,KW):	
MFG.		MODEL:		OUTPUT CAP (BTUH,KW):	
DOMESTIC HW CIRCULATION PUMP:					
	HW PUMP 1 - HP		MFG.		MODEL
	HW PUMP 2 - HP		MFG.		MODEL
	HW PUMP 3 - HP		MFG.		MODEL
COMMENTS:					

TANK DIMENSIONS:	DIAMETER (INCHS):	HEIGHT OR LENGTH (INCHES):	TANK CAP (GALS):

OPERATION:											
HOURS ON:		S	M	T	W	T	F	S	COMMENTS		
PRESENT START TIME									TIMECLOCK?		
PRESENT STOP TIME											
REQUIRED START TIME											
REQUIRED STOP TIME											
MONTHS ON:											
J	F	M	A	M	J	J	A	S	O	N	D

CONTROLS:									
		PNEUMATIC		ELECTRIC		ELEC'NIC		DDC	COMMENTS
SETPOINTS				HW SUPPLY					
COMMENTS:									

Survey Form 5

SURVEY SHEET 6

LIGHTING SURVEY OBSERVATIONS

FACILITY INFORMATION :

Building Number : _____ Hours of Operation : _____

Building Description : _____ Building Voltage : _____

EXISTING LIGHTING INFORMATION :

Room Name/Type	Lamp Type (**)	Lamps/ Fixture	Watts/ Lamp	No. of Fixtures	Ballast Amp/Mult.	Number of Switches	Number of Circuits	Comments: Controls, Operating Hours, Daylight

GENERAL INFORMATION :

Project Name : _____ Survey Date : _____

Project No. : _____ Survey Team : _____

Notes : _____

* R = Recessed, S = Surface, P = Pendant, ST = Shop Type, W = Wall Mounted & G = Globe

** F = Fluroscent (2F, 4F, 8F), INC = Incandescent, MV = Mercury Vapor, MH = Metal Halide & HPS = High Pressure Sodium

Survey Form 6

SURVEY SHEET 7

PROJECT: DATE:
LOCATION: PREPARED BY:
PROJECT ENG: CHECKED BY:
BUILDING: FILE:

BUILDING DATA SURVEY OBSERVATIONS

BLDG NO: ________ BLDG NAME: ____________________

ZONE NO.		FUNCTION:						
OCCUPANCY HOURS:	M-F		TO		SAT		TO	
	SUN		TO					
PRESENT TEMP	WINTER OCC	Degs F	UNOCC	Degs F				
	SUMMER OCC	Degs F	UNOCC	Degs F				

ZONE NO.		FUNCTION:						
OCCUPANCY HOURS:	M-F		TO		SAT		TO	
	SUN		TO					
PRESENT TEMP	WINTER OCC	Degs F	UNOCC	Degs F				
	SUMMER OCC	Degs F	UNOCC	Degs F				

ZONE NO.		FUNCTION:						
OCCUPANCY HOURS:	M-F		TO		SAT		TO	
	SUN		TO					
PRESENT TEMP	WINTER OCC	Degs F	UNOCC	Degs F				
	SUMMER OCC	Degs F	UNOCC	Degs F				

REMARKS:

Survey Form 7

SURVEY SHEET 8

DATE:
BY:
JOB:
CHK:
FILE:

ENERGY ESTIMATING SURVEY OBSERVATIONS

BLDG NO: _____ BLDG NAME: _____
BLDG FUNCTION: _____
FLOOR AREA: (SQ. FT) _____ # FLOORS _____
SLAB PERIMETER: (FT) _____

I. AREAS: ([ ] FIELD VERIFIED ELEVATION PLANS)

		NORTH	SOUTH	EAST	WEST	TOTAL
WALLS, GROSS	(SQ. FT)					
GLASS	(SQ. FT)					
PERSONNEL DOOR,	(SQ. FT)					
OVERHEAD DOOR,	(SQ. FT)					
WALLS, NET	(SQ. FT)					
ROOF AREA (OR CEILING AREA IF ATTIC IS UNCONDITIONED)					(SQ. FT)	
OVERHEAD DOOR	(SQ. FT)	0	PERSONNEL DOOR		(SQ. FT)	
BASEMENT WALLS	(SQ. FT)					

II. CONSTRUCTION: ([ ] FIELD VERIFIED WALL, ROOF, WINDOW, DOOR TYPES)

WALLS: (SKETCH CROSS SECTION OF WALL)	COMPONENTS	R-VALUE
	1. OUTSIDE AIR FILM	0.17
	2.	
	3.	
	4.	
	5.	
	6.	
	7. INSIDE AIR FILM	0.68
	TOTAL R-WALL =	
	U=1/R	

ROOF: (SKETCH CROSS SECTION OF ROOF)	COMPONENTS	R-VALUE
	1. OUTSIDE AIR FILM	0.17
	2.	
	3.	
	4.	
	5.	
	6.	
	7. INSIDE AIR FILM	0.68
	TOTAL R-ROOF =	
	U=1/R	

GLASS TYPE:	R-GLASS	
SLAB TYPE FLOOR:	SLF	
BASEMENT TYPE:	R-BASEM.	
OVERHEAD DOOR TYPE:	R-ODOOR	
PERSONNEL DOOR TYPE:	R-PDOOR	

UA ODOOR	=	ODOOR AREA	X DOOR "U"	=	
UA PDOOR	=	PDOOR AREA	X DOOR "U"	=	
UA WALL	=	WALL AREA	X WALL "U"	=	
UA ROOF	=	ROOF AREA	X ROOF "U"	=	
UA GLASS	=	GLASS AREA	X GLASS "U"	=	
UA SLAB	=	SLAB PERIM.	X SLF	=	
UA BASEM.	=	B-WALL AREA	X BASE. "U"	=	
INFILTRATION	=	X CFM	X DELTA (T)	=	

INDOOR HEATING SETPOINT. (DEG. F)	
DESIGN OUTDOOR TEMP. (DEG. F)	
DESIGN GROUND TEMP. (DEG. F)	

TOTAL UA (BTU/HR X T)	
DELTA (T)	
+ INFILTRATION (BTU/HR)	
TOT. HEATING LOAD (BTU/HR)	

Survey Form 8