ORDER

SW 1052.3

ENERGY MANAGEMENT PROGRAM

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DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

SOUTHWEST REGION

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FOREWORD

1. PURPOSE. This order implements Southwest Region Airway Facilities policy, assigns responsibilities, and prescribes standards and procedures for energy management within the organization for Government-owned or leased space and vehicles.

2. DISTRIBUTION. This order is distributed to the section level in the Airway Facilities Division and limited distribution to all Airway Facilities field offices.

3. BACKGROUND.

a. Conservation of Energy Program. For some time, the FAA has been concerned with various programs oriented toward the conservation of energy. Recognizing that short-term energy and fuel shortages will occur at various times, emergency actions for immediate relief were designated during those periods. Under one program, vehicle speeds were reduced to 55 miles per hour; under another, thermostats were set for a wider range of temperatures. Although these and other conservation programs initially helped reduce consumption, they are stop-gap solutions to short-term problems. A new approach is necessary to effectively handle the long-term aspects of the energy situation that will be with us in the foreseeable future.

b. Energy Management. The new approach will be termed Energy Management. The distinction is that instead of being motivated to conserve energy for unselfish reasons, energy management will be based on the economic principal: Save money. As all energy costs rise, especially electrical energy, that portion of the manager's resource budget devoted to energy will increase to a greater percent. The fact of life is that energy costs are rising much more rapidly than the overall inflation rate. Since the FAA has traditionally turned to technology for solutions to its problems, it seems only natural to apply this method again. Sound management of energy resources can be considered an extremely effective example of cost avoidance through applied technology. This directive brings together much of the available information on current methods to conserve energy with appropriate procedures to establish the awareness such an effort demands.

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CHAPTER 1. GENERAL

1. COVERAGE. This directive outlines methods of managing the energy resources controlled, consumed, and paid for by any segment of the Airway Facilities Division in the Southwest Region.

2. OBJECTIVES. This directive provides guidance to reduce the consumption of fuel and energy in Airway Facilities operations and facilities consistent with safety, efficiency, and the overall FAA mission.

3. RESPONSIBILITIES. All regional headquarters Airway Facilities branch and staff chiefs, sector managers, and field office chiefs are responsible for initiating action within their jurisdiction to implement this directive. In addition, overall energy management requirements are contained in the latest edition of Order SW 1052.1, Energy Conservation - Program Responsibilities Reporting Requirements.

4. COST ANALYSIS. Each alteration (both to existing facilities and design features incorporated into new facilities) should be accompanied by a thorough analysis to insure that the engineering design minimizes energy consumption. Where alterations to existing facilities are being considered, a break-even period of 5 years or less should be achieved.

5. FUNDING. Where savings can be immediately realized, projects should be instituted as soon as possible within existing authority and resources. For those items not falling within existing funding capability, normal budgetary procedures should be followed, such as Special Maintenance Project (SMP) or Facilities and Equipment (F&E) budget items.

6. EVALUATION. All management reviews and technical evaluation programs will include an assessment of compliance with existing energy conservation program policies and procedures. In addition to reporting on areas where improvement should be made, significant or unusual achievements are also to be cited.

7-8. RESERVED.

CHAPTER 2. PROGRAM COORDINATION

9. ENERGY MANAGEMENT TASK FORCE. A task force will be established to oversee the requirements of this order.

a. Responsibility. The Energy Management Task Force is responsible for:

(1) Reviewing proposed energy management programs.

(2) Identifying and directing conservation opportunities with universal application.

(3) Monitoring field activities to avoid crisis situations which would impact our operations.

(4) Implementing field reporting systems to monitor the energy management program.

b. Membership. The task force membership will necessarily fluctuate, but will typically consist of an Airway Facilities Branch Chief as chairman with members from appropriate Airway Facilities Branches, NAS Sectors, and ARTCC Sectors.

c. Meetings. Meetings will be at the direction of the chairman, with minutes kept of all proposals and actions from these meetings. Task force activities will be coordinated through the regional Energy Conservation Coordinator, ASW-50.

10. ENERGY COORDINATORS. The Chief, Maintenance Operations Branch and Airway Facilities Sector Managers, or their designees, will serve as energy coordinators. Specific individuals will be designated and a list of these will be maintained by the Chief, Maintenance Operations Branch. As energy coordinators they will:

a. Develop expertise in energy conservation measures and activities for appropriate facilities and equipment under their control.

b. Obtain and disseminate posters, pamphlets, literature, and other energy related publications. Sources of such items are organizations like the Federal Energy Administration (FEA), General Services Administration (GSA), Department of Energy (DOE), state agencies, local companies, etc.

c. Conduct annual energy management surveys for all facilities within their jurisdiction to insure that the energy being consumed is at a minimum level. Surveys shall be documented and contain cost/benefit analyses for recommended improvements. It is recommended that these surveys be conducted at the time of the technical inspection of the facility.

d. Report specific accomplishments and general recommendations for reducing energy to the Chairman, Energy Management Task Force, as required by paragraph 50.

11. TRAINING. Requests for energy related training are to be included as part of the AF training program. Reference documents on energy management will usually

stress the need for training to achieve the best results. In many cases, this specialized training is available locally through utility companies, junior colleges, or technical societies; and each sector is encouraged to show initiative in educating its personnel with local resources. Where this type of training is not available or may not suit the Federal Aviation Administration's (FAA) specific purposes, additional training will be developed by the regional office to the extent permitted by fiscal conditions. Sectors should plan for a minimum of two persons in each sector to be trained.

12. EQUIPMENT/INSTRUMENTATION. Just as special training is required for energy management, certain instruments are necessary to diagnose and analyze the various facilities and equipment. Most of these instruments are generally not available within the FAA, but required items will be acquired as the program develops and funding is available. The more commonly used and less costly instruments are to be procured by the sectors out of their own resources, while the less frequently needed, more expensive instruments will be made available by request from a regional pool. Examples of the two categories of energy management instrumentation follow:

a. Sector.

Anemometers

Velometers

Thermometers

Ammeters

Pressure gauges

Tachometers

Light Meters

b. Region.

Digital/recording thermometers

Power consumption meters

Strobotachs

Infrared detectors

Heat-loss meters

Water flow meters

Air flow meters

13. RESERVED.

CHAPTER 3. ENERGY AUDIT

14. ENERGY AUDIT. An energy audit is fundamental to the successful development and implementation of a total energy management program. The more comprehensive the audit is, the more valuable insights into conservation opportunities and cost savings it will provide.

a. Performance of Energy Audit. It is essential that the energy audit be made by persons who are thoroughly knowledgeable of the energy management program, know what to look for, and can present findings in an unbiased manner. Those performing the audit must be expert enough to recognize a possible source of wasted energy and how to correct it. For complex facilities, the audit is performed best by a team, usually consisting of the energy coordinator, environmental personnel, and a representative of management. The following section provides information on what to look for when making an audit. Much of this information can be recorded in the suggested format shown in Appendix 1 or as adapted to individual facility needs.

b. Objective. The intent of the energy audit is to identify areas of waste and inefficiency and to discover energy conservation opportunities. The audit generally begins with a review of a building's energy consumption over a specified prior period, usually the previous year, using an Automated Data Processing (ADP) printout to be provided for this purpose. Two types of information should be recorded: That pertaining to the design of the system (nameplate data) and that pertaining to the condition of the system.

c. Basic Procedures. The following discussion highlights some of the basic procedures usually involved in conducting an audit. Information from all sources should be reviewed and correlated. The most obvious correlation is that between energy consumption data and climatic conditions. Are certain trends evident? Are there major changes in consumption data which cannot be explained by the weather? If so, do logs reveal a possible cause? Do logs indicate that certain procedures have been changed? If so, do energy consumption data, correlated with climatic data, indicate a difference? What about electrical demand? Do "peaks" and "valleys" occur in a somewhat uniform pattern, or are there unexplained phenomena which bear investigation?

d. Observations. Observations of equipment operation should center on how people operate their equipment, lighting, appliances, drapes and blinds, etc. It also is extremely important to observe:

(1) Normal personnel activities (arrival, lunch, departure, etc.);

(2) How many persons usually remain in the building, and for how long, after normal hours; and

(3) The equipment used after hours, and central systems (heating, cooling, lighting) required for support.

e. Recorded Information. When equipment is inspected, basic design information should be recorded to identify the specific type installed, its manufacturer, model number, nameplate ratings, current condition and other factors as appropriate. This information helps determine optimal start and stop times; whether lighting can be stepped-down or turned off altogether during lunch hours; possible installation of control systems to reduce energy consumption for those working after hours, etc. It can also help identify the equipment which could be connected into energy management and control systems performing such functions as demand control, duty cycling, and optimized start/stop. The audit should result in a thorough report detailing each and every energy-wasting condition in the building's energized systems, nonenergized systems, and human systems. The report also should contain:

(1) Modification items which can be implemented to remedy each area, with due consideration for its effects on other building systems.

(2) Modification cost of above modification items, if any.

(3) Type of equipment and controls that should be added to the various systems.

(4) Proposed new procedures such as development of a lighting schedule to reduce energy consumption.

(5) Financial aspects such as total costs involved, projected payback periods, and return on investment for these undertakings. In addition, the report should specify the priorities in light of factors established as criteria.

f. Feasibility Study. Whenever changes require a significant capital outlay or result in closing a portion of the building for a time, the action will be justified by a feasibility study. Such studies will provide adequate information required to reach a decision and should include the following considerations:

(1) Efficiency. Identify where energy inefficiencies and waste now exist. This does not imply modifications to the system, but rather changes in operation which should be taken to bring the system up to the efficiency at which they should function. This in itself can save a considerable amount of energy in most buildings.

(2) Equipment Performance. Determine if a given piece of equipment is operating poorly and why. If poor maintenance seems to be the problem, it would mean that a revised maintenance schedule may be required, that more instruction must be given, or that the person performing the maintenance is not qualified. At all times, consider how any changes--even bringing the system up to full operating efficiency--will affect other elements of the same system or other systems.

(3) Modifications. Determine where systems can be modified in accordance with guidelines provided in the following section to achieve greater energy efficiency. In so doing, consider how the modifications should be made and what the effect will be on other systems related to it directly or indirectly.

(4) Implementation. Determine problems which are likely to occur through implementation of items. It is important to recognize and avoid stumbling blocks of this nature.

(5) Alternatives. Before determining exactly which alternatives to pursue, you must first identify those alternatives applicable to your facility. Since it is unlikely that you will be able to pursue all of them during the first or even second year of your program, it probably will be most effective to determine which group of alternatives will fall within your budget yet yield maximum benefits. Calculation of the cost of each alternative and possible amount of time it will take to implement it from start to finish should be performed.

15-19. RESERVED.

CHAPTER 4. GENERAL CONSIDERATIONS

20. INTERIOR SPACE UTILIZATION. The way in which interior building space is utilized by occupants can have a pronounced effect on energy management as well as on productivity. Some of the potentially beneficial modifications which should be considered include:

a. Equipment and Furnishings. Locate all computer and computer-type equipment requiring close temperature and humidity control in a common space to be served by a common system. Locate wall hangings, displays, and furniture away from supply and return air grilles and registers to prevent obstruction of air flow.

b. Air Grilles and Registers. Adjust air grilles and registers for draft-free operation to avoid use of make-shift baffles and deflectors.

c. Unused Areas. Assure that blinds or shades are drawn, registers are closed, equipment is off, etc.

d. Personnel. Emphasize to employees through an education program the need for everyone's personal commitment to achieve FAA's goal in "energy management."

21. MAINTENANCE PRACTICES. The importance of good maintenance to a program of energy management cannot be overemphasized. Not only will effective maintenance help ensure efficient operation of equipment and systems, but it will also help prolong the usable life of equipment. The maintenance guidelines presented herein should all be performed to bring systems up to their designed efficiency. They also should be continued on a regular schedule based on individual systems and operation. Inspection of many of the items mentioned also will provide some idea of the effectiveness of the maintenance program now in effect and the condition of equipment. Realize that these guidelines are general only. Wherever possible, the manufacturer of the equipment involved should be contacted to obtain pertinent literature describing the maintenance procedures suggested. Proper maintenance of fans, pumps, and motors can greatly improve operational efficiency and so eliminate unnecessary energy consumption. Special attention shall be given to the maintenance procedures associated with the following:

a. Fans.

(1) Check for excessive noise and vibration and correct as necessary.

(2) Clean fan blades.

(3) Inspect and lubricate bearings regularly.

(4) Inspect drive assemblies. Adjust or replace as necessary to ensure proper operation. Proper tensioning of belts is critical.

(5) Inspect inlet and discharge louvers, screens, and filters. They should be kept free of dirt and debris at all times.

(6) Inspect fans for normal operation.

b. Pumps.

(1) Check for packing wear which can cause excessive leakage. Repack and adjust to avoid both excessive water waste and shaft erosion.

(2) Inspect bearings and drive belts for wear and binding. Adjust, repair, or replace as necessary.

c. Motors.

(1) Check alignment of motor to equipment. Align and tighten as necessary.

(2) Check for loose connections and bad contacts on a regular basis.

(3) Keep motors clean.

(4) Eliminate excessive vibrations.

(5) Lubricate motor and drive bearings on a regular basis. This will help reduce friction which can result in overheating and power losses.

(6) Check for overheating. It could be an indication of a functional problem or lack of adequate ventilation.

(7) Balance three-phase power sources to motors. An inbalance can create inefficient motor operation resulting in use of more energy.

(8) Check for overvoltage or low voltage condition on motors.

d. Air Handling Equipment. Proper maintenance of air handling equipment can significantly improve the efficiency. Proper maintenance guidelines include:

(1) Inspect ductwork for air leakage. Seal all leaks by taping or caulking. Inspect ductwork insulation.

(2) Utilize ductwork access openings to check for any obstructions such as loose hanging insulation (in lined ducts), loose turning vanes and accessories, and closed fire dampers.

(3) Inspect damper blades and linkages. Clean, oil, and adjust them on a regular basis.

(4) Inspect mixing dampers for proper operation.

(5) Clean or replace air filters on a regular basis. Inspect air heating, cooling, and dehumidification coils for cleanliness. Coils can be kept clean by using a mixture of detergent and water or other commercial coil-cleaning solutions in a pressurized spray tank.

(6) Inspect for leakage around coils or fan casing.

(7) Inspect all room air outlets and inlets (diffusers, registers and grilles). They should be kept clean and free of all dirt and obstructions.

(8) If electronic air cleaners are installed, check them regularly for excessive accumulations on the ionizing and grounding plate section. Replace filter media if necessary. Follow manufacturer's written instructions whenever adjustment or maintenance is required.

(9) Inspect humidifier/dehumidifier air dampers, fan parts, spray chamber, diffuser, controls, strainer, and eliminator. All must be kept free of dirt, lint, and other foreign particles.

22. ELECTRICAL. Numerous elements of building systems which utilize electricity will be discussed in further detail. Additional guidelines for reduction of electric energy consumption and losses are as follows:

a. Unused Equipment. Through letters, memoranda, signs, personal contact, and other means, encourage all building personnel to turn off all electric equipment not in use, including portable fans, typewriters, calculators, coffee pots, etc. Turn off equipment which will be unused for a period of time; for example, vending machines (in which spoilage would not be a problem) and drinking fountains which could be turned off during the weekend. (You may wish to consider time controls to do the job for you. It would be feasible, then, to also turn off such devices during the evening hours.)

b. Unnecessary Equipment. Disconnect all unnecessary equipment. Ventilation fans in elevators where smoking is not permitted are examples.

c. Redundant Equipment. Reevaluate the requirements for hot standby and redundant equipment.

23-24. RESERVED.

CHAPTER 5. TECHNICAL RECOMMENDATIONS

25. LIGHTING. The following highlights actions which should be taken to implement an effective program of lighting energy management.

a. Modify Usage Patterns. Significant amounts of energy (and cost) can be conserved in buildings. Lighting schedules should be changed to require reduced lighting for daytime unoccupied space such as Saturdays, Sundays, and holidays, nighttime unoccupied space, and maintenance periods when low lighting levels are appropriate. The following suggestions should be considered part of the overall program:

(1) Utilization. Use letters, memos, signs, and personal contact to encourage occupants to use lighting only when it is needed, to use only the amount of lighting required, and to turn off lights whenever they are not being used. Note: This applies even to fluorescent lights, as recent studies have shown that this practice is cost effective in the long run.

(2) Switch Identification. Near each switch identify which lights are controlled by that switch. This enables the user to be more selective while also reducing trial-and-error which can consume significant amounts of energy as banks of lights are quickly activated and deactivated.

b. Relocate Work Station. If applicable, work stations can be located to take maximum advantage of the lighting system which exists or to supplement or enable changes to other elements of the system. Typical modifications to work station locations are as follows:

(1) Installed Lighting. Place desks and other work surfaces in a position and orientation that will use installed luminaires to their greatest advantage (instead of adding or moving luminaires).

(2) Illumination levels. The number of areas requiring different illumination levels may provide an opportunity to reduce the total amount of lighting needed by grouping tasks requiring the same levels of illumination.

(3) Daylight. Arrange work surfaces so that sidewall daylighting crosses the task perpendicular to the line of vision.

c. Maintenance. Proper maintenance of lighting system components serves to keep the system running at peak efficiency. This not only conserves energy and energy costs, but also helps maintain quality illumination and extends lamp and luminaire life. The following maintenance considerations should be reviewed:

(1) Efficiency. Lamp efficiency deteriorates over the life of a lamp. Light output should be checked regularly with a calibrated light meter by maintenance personnel. When the light output of a group of lamps has fallen to approximately 70 percent of the original light output, relamp all fixtures in the group at the same time. This is usually required only when lighting levels are important to task performance and the original light levels must be maintained.

Luminary efficiency can be maintained by properly cleaning the reflecting surfaces and shielding media. Replace lens shielding that has yellowed or become hazy with a clean acrylic lens with good nonyellowing properties.

(2) Cleanliness. Lamps should be wiped clean at regular intervals to assure maximum efficiency. Lamps which are exposed to an atmosphere with substantial amounts of dirt, dust, grease, or other contaminants should be cleaned more frequently than lamps in a relatively clean atmosphere.

d. Lamp Modification. Lamp modification can take many forms. In some cases it may involve elimination of lamps; using those of lower wattages; changing the type involved (which would imply in most cases a change of luminaire), etc. Consider the following guidelines:

(1) Replacement. Replace present lamps with those of lower wattage which provide the same amount of illumination or a lower level of illumination. (Lens changes or lowering the luminaire often can help facilitate this option). This method is particularly applicable where current lighting levels are higher than recommended or where uniform lighting is the most practical due to occupant density, as discussed above. This also is a simple way to provide flexibility should higher levels of illumination be required at some future time. (Note: Be certain that new lamps are compatible for use with existing ballasts in fluorescent and high intensity discharge (HID) luminaires.)

(2) Removal. Use the minimum number of lamps to provide the required illumination levels. Unnecessary lamps should be removed. When lamps are removed from a fluorescent luminaire, all lamps controlled by a given ballast should be removed to prevent ballast failure or reduced lamp life. Also, consider disconnecting ballasts which otherwise would continue to consume energy except in the case of instant start lamps or luminaires with circuit-interrupting lamp holders. Unnecessary fluorescent fixtures should be completely disconnected so that the ballast will not continue to consume power.

(3) Selection. Select lamps which are the most efficient (efficiency is measured in lumens per watt) and which are compatible with the essential requirements. Compatibility with the luminaire, of course, also is essential. If some luminaire replacement is to be undertaken, determination of lamp type involved should also be considered. In general, efficiencies of lamp types rank as follows, in descending order:

Lumens Per Watt (Including Ballast)

	Smaller sizes	Middle sizes	Larger sizes
High pressure sodium	84	105	126
Metal halide	67	75	93
Fluorescent	66	74	70
Mercury	44	51	57
Incandescent	17	22	24

This ranking, of course, is for general use only. There is overlapping of efficiencies between lamp types and even within a lamp type for different wattages, life ratings, etc. Also there are limitations on some lamps with regard to their suitability for a specific application. Selection of the most efficient lamp must be evaluated on the basis of the specific application and the performance characteristics of the individual lamps being considered. Changing from incandescent to a more efficient light source can give paybacks in as little as 1 to 2 years depending upon local costs of energy.

e. Control Modifications. In many cases, modification of existing lighting controls, and addition of new ones, can have a considerable effect on energy consumption. Consider the following guidelines:

(1) Natural Light. When natural light is available in a building, consider the use of photocell switching to turn off banks of lighting in areas where the natural light is sufficient for the task.

(2) Photocell or Time Clock. Use photocell and/or time clock controls for outdoor lighting whenever feasible. Parking areas, building exteriors, identification signs, etc., usually require lighting for only a part of the period of darkness. Such lighting should be turned off automatically during late evening and early morning hours except for security and safety lighting.

(3) Time Controls. Use time controls for those areas of a building which are used infrequently and only for brief periods. These controls turn off lights automatically after being activated for a set period of time.

(4) Switching and Dimmer Controls. Use alternate switching or dimmer controls when spaces are used for multiple purposes and require different amounts of illumination for the various activities. It is possible to provide multiple levels by providing switching for alternate fixtures, alternate sets of lamps in fluorescent fixtures, etc. Dimmer controls can be effective when it is impractical to use selective switching to obtain multiple lighting levels. This is especially true (and relatively low in cost) when incandescent lighting is involved.

(5) Selective Switching. Initial cost economies and lack of knowledge about final space subdivision often lead to the use of central panelboards as the only means of controlling large blocks of lighting. This design approach precludes the potential for turning on only the amount of lighting that is actually needed after the space has been subdivided.

(6) Local Control. Localized switches can be provided near doorways. Remotely controlled switches can be located near panelboards to control groups of lights. Low voltage control circuits can be used to provide local control of switches located in remote locations (these controls usually will save enough energy to prove a payback on the investment within a short period of time).

(7) Monitoring. Lighting use in remote areas can be monitored by providing neon indicator lights at central stations. Personnel will be alerted to investigate and turn off lights not being used.

f. Light Levels. Preference should be given to installing more efficient lighting in addition to the following:

(1) Overhead Lights. During working hours, overhead lighting will be reduced to no more than:

(a) 100 ft. candles for drafting or other precision work

(b) 70 ft. candles at desks

(c) 30 ft. candles in general work areas

(d) 10 ft. candles in nonworking areas and halls.

(2) Off-hour and Exterior Lights. Off-hour and exterior lighting except that essential for safety and security purposes (e.g., exit signs) shall be eliminated.

26. HEATING.

a. General. Supervisors should encourage employees to minimize the need for heating during the winter season by wearing additional clothing (sweaters, heavier suits, etc.) during office hours. The operation of heater blowers, threshold heaters, and portable space heaters in Government-owned or leased space is prohibited except when approved by a second level supervisor for extreme cases such as space where a minimum temperature of 65 degrees cannot be maintained during working hours. Interior space in office buildings tends to have a heat build up generated by light, people, equipment, etc., and does not usually utilize recirculated air mixed with some outside air for ventilation purposes. At unmanned facilities, surveys will be conducted to determine the minimum heating required during periods personnel are not present. All other heating, where possible, is to be put on timer outlets for use only when technical personnel are present.

(1) Thermostats shall be set to maintain space temperatures in accordance with the latest version of Orders 6470.5 for ARTCC's and 6970.3 for other type facilities.

(2) Windows, Draperies, Blinds, Etc. These items shall be used to cut down heat losses by setting them to the closed position during nighttime and on cold, cloudy days, and setting them to the open position during periods of sunshine.

(3) Outside Air. Outside air intake during heating seasons should be reduced to the lowest value permitted by new design guides. Under most conditions a 10 percent outside air intake will be adequate for general office space and most louvers will leak this much when fully closed. Special-purpose space such as laboratories or the like shall have the outside air intake kept consistent with the requirement of the mission. The amount of outside air should not be increased or air-conditioning introduced for the sole purpose of lowering the temperature which might otherwise exceed 68 degrees F. (Dead-band thermostats are helpful in such cases.)

b. Boilers.

(1) Scale Deposits. Inspection of boilers for scale deposits and accumulation of sediment on water side surfaces should be accomplished periodically. The rear portion of the boiler must be checked because it is the area most susceptible to formation of scale. (Scale reduces the efficiency of the boiler while at the same time causes overheating of the furnace along with cracking of tube ends and other problems).

(2) Soot, Flywash and Slag. The fireside of the furnace and tubes must be inspected for deposits of soot, flyash, and slag. Soot on tubes decreases heat transfer and lowers efficiency. (Consideration should be given to the installation of a thermometer in the flue. It can save inspection time and prove more accurate than visual inspection alone). If the gas outlet temperature rises above normal, it can mean that tubes need cleaning. Evidence of heavy sooting in short periods could be a signal of too much fuel and not enough air. Adjustment of the air/fuel ratio is required to obtain a clean burning fire.

(3) Inspection of Door Gaskets. Replace door gaskets if they do not provide a tight seal.

(4) Instrumentation Logs. Daily logs of pressure, temperature, and other data obtained from instrumentation must be kept. This is the best method available to determine the need for tube and nozzle cleaning, pressure or linkage adjustments, and related measures. Using this procedure, variations from normal can be spotted quickly, enabling immediate action to avoid serious trouble. On oil-fired units, indications of problems include, an oil pressure drop (possible plugged strainer, faulty regulating valve, or an air leak in the suction line); an oil temperature drop (possible temperature control malfunction or a fouled heating element). On gas-fired units, a drop in gas pressure can indicate a drop in the gas supply pressure or malfunctioning regulator.

(5) Burners. Note firing rate when log entries are made. Realize that a sharp rise in stack temperature does not necessarily mean poor combustion or fouled waterside or fireside. During load change, stack temperatures can vary as much as 100 degrees F in 5 minutes. Check burner firing period. If it is improper, it could be a sign of faulty controls. Clean mineral or corrosion build-up on gas burners.

(6) Stacks. Stacks should be free of haze. If not, a burner adjustment may be necessary. Check boiler stack temperature. If it is too high (more than 150 degrees F above steam or water temperature) clean tubes and adjust fuel burner. A minimum temperature of 275 degrees F must be maintained to prevent condensation of acids formed by combustion.

(7) Linkage. Periodically inspect linkages for tightness. Adjust when slippage or jerky movements are observed.

(8) Solenoid Valve. Observe the fire when the unit shuts down. If the fire does not cut off immediately, it could indicate a faulty solenoid valve. Repair or replace as necessary.

(9) Flue Gas. Check analysis of the flue gas on a periodic basis. Check oxygen and carbon monoxide as well as carbon dioxide. Oxygen should be present to no more than 1 or 2 percent. There should be no carbon monoxide. CO_2 should be present at 9 or 10 percent for gas-fired units, at 11.5 to 12.8 percent for #2 oil-burning units, and 13 to 13.8 percent for #6 oil-burning units. The air-to-fuel ratio must be maintained properly and flue gas analysis is the only reliable method; flame size and color are not an adequate indicator. If there is insufficient air, the fire will smoke, cause tubes to become covered with soot and carbon, and thus lower heat transfer efficiency. If too much air is used, unused air is heated by combustion and exhausted up the stack, wasting heat energy. Most fuel service companies will test your unit either free of charge or for a token fee only.

(10) Hot Spots and Air Leaks. Inspect all boiler insulation, refractory, brickwork, and boiler casing for hot spots and air leaks. Repair and seal as necessary.

(11) Pressure Vessels. Replace all obsolete or seldom-used pressure vessels.

(12) Procedures. Examine operating procedures when more than one boiler is involved. It is far better to operate one boiler at 90 percent capacity than two at 45 percent capacity each. The more individual boilers used, the greater the heat loss.

(13) Fuel Oil Components. Check and repair oil leaks at pump glands, valves or relief valves. Inspect oil line strainers. Replace dirty oil line strainers. Inspect nozzles or cup of oil-fired units on a regular basis.

(14) Electric Components. Maintain contacts and working parts of relays in good working order on electric boilers. Check heater elements for cleanliness. Replace as necessary. Check controls for proper operation. Adjust as necessary.

c. Central Furnaces, Make-Up Air Heaters and Unit Heaters.

(1) Heat Transfer. All heat exchanger surfaces should be kept clean. Check air to fuel ratio and adjust as necessary. Heat transfer surfaces or radiators, convectors, baseboard, and finned-tube units must be kept clean for efficient operation.

(2) Burner. Inspect burner couplings and linkages. Tighten and adjust as necessary.

(3) Casing. Inspect casing for air leaks and seal as necessary.

(4) Insulation. Inspect insulation and repair or replace as necessary.

(5) Fan and Motor. Follow guidelines suggested for fan and motor maintenance.

d. Radiators, Convectors, Baseboard, and Finned Tube Units.

(1) Obstructions. Inspect for obstructions in front of the unit and remove whenever possible. Air movement in and out of convector unit must be unrestricted.

(2) Hydronic Units. Air will sometimes collect in the high points of hydronic units. It must be vented to enable hot water to circulate freely throughout the system.

e. Electric Heating.

(1) Heat Transfer. Keep heat transfer surfaces of all electric heating units clean and unobstructed. Keep air movement in and out of the units obstructed.

(2) Heating Elements. Inspect heating elements, controls, and, as applicable, fans on a periodic basis to ensure proper functioning. Determine if electric heating equipment is operating at rated voltage as necessary.

(3) Reflectors. Check reflectors on infrared heaters for proper beam direction and cleanliness.

27. COOLING.

a. General. Temperatures shall be maintained in accordance with the latest versions of Orders 6470.5 for ARTCC's and 6970.3 for other facilities. The use of heating energy to achieve the temperature specified for cooling is prohibited.

(1) Windows, Draperies, Blinds, Etc. These items shall be used to reduce additional cooling needs by setting them to the closed position during hot, sunny days and open during nighttime and on cool and cloudy days.

(2) Operation. The hours of operation of air-conditioning and heating equipment should be kept to a minimum, consistent with occupant needs. This refers to 8-hour office type buildings. Generally, these needs can be satisfied by starting the equipment about 6 a.m. and shutting it down about 4 p.m. During weekends and holidays, air-conditioning or heating equipment should be shut down completely except when the building/facility is occupied or when the building/facility houses temperature sensitive equipment (computers, electronic equipment, or water pipes, etc.) that require the maintenance of a special temperature.

b. Refrigeration. Efficiency of refrigeration equipment can be improved considerably through proper maintenance procedures. The following guidelines are to be used:

(1) Circuit and Controls.

(a) Inspect moisture-liquid indicator on a regular basis. If the color of the refrigerant indicates "wet," it means there is moisture in the system. The necessary adjustment and repairs should be made immediately as improper operation or costly damage can result. Bubbles in the refrigerant flow

as seen through the moisture liquid indicator, may indicate that the system is low in refrigerant. Add refrigerant if necessary and inspect equipment for possible refrigerant leakage.

(b) Use a leak detector to check for refrigerant and oil leaks around shaft seals, sight glasses, valve bonnets, flanges, flare connections, relief valve on the condenser assembly and at pipe joints to equipment, valves and instrumentation.

(c) Inspect equipment for any visual changes such as oil spots at connections or on the floor under the equipment.

(d) Inspect the liquid line leaving the strainer. If it feels cooler than the liquid line entering the strainer, it is clogged. If it is very badly clogged, sweat or frost may be visible at the strainer outlet. Clean as required.

(e) Observe the noise made by the system. Any unusual sounds could indicate a problem. Determine cause and correct.

(f) Establish what normal operating pressures for the system temperatures should be. Check all gauges frequently to ensure that design conditions are being met. Increased system pressure may be due to dirty condensers, which will decrease system efficiency. High discharge temperatures primarily are caused by defective or broken compressor valves.

(g) Inspect tension and alignment of all belts and adjust if necessary.

(h) Where applicable, lubricate motor bearings and all moving parts according to manufacturer's recommendations.

(i) Inspect insulation on suction and liquid lines. Repair or replace as necessary.

(2) Compressor.

(a) Look for unusual indications such as continuous running or frequent stopping and starting, either of which may indicate inefficient operation. Determine the cause and, if necessary, correct.

(b) Observe the noise made by the compressor. If it seems to be excessively noisy, it may be a sign of a loose drive coupling. Tighten compressor and motor on the base.

(c) Check all compressor joints for leakage. Seal as necessary.

(d) Inspect instrumentation frequently to ensure that operating oil pressure and temperature agree with manufacturer's specifications.

(3) Air-Cooled Condenser.

(a) Keep fan belt drive and motor properly aligned and lubricated.

(b) Inspect refrigeration piping connections to the condenser coil for tightness. Repair all leaks.

(c) Keep condenser coil face clean to permit proper air flow.

(d) Determine if hot air is being bypassed from the fan outlet to the coil inlet. If so, correct the problem.

(4) Evaporative Condenser.

(a) Inspect piping joints and seal all leaks.

(b) Remove all dirt from the coil surface by washing it down with high velocity water jets or a nylon brush.

(c) Inspect air inlet screen, spray nozzle or water distribution holes, and pump screen. Clean as necessary.

(d) Use water treatment techniques if local water supply leaves surface deposits on the coil.

(e) Follow guidelines for fan and pump maintenance.

(5) Watercooled Condenser.

(a) Clean condenser shell and tubes by swabbing with a suitable brush and flushing out with clean water. Chemical cleaning also is possible, although it is suggested that a water treatment company be consulted first.

(b) Keep condenser coil face clean to permit proper air flow.

(c) Determine if hot air is being bypassed from the fan outlet to the coil inlet. If so, correct the problem.

(6) Cooling Towers.

(a) Perform chemical test to determine if solid concentrations are being maintained at an acceptable level.

(b) Check overflow pipe clearance for proper operating water level.

(c) Check fan by listening for any unusual noise or vibration. Inspect condition of V-belt. Align fan and motor as necessary.

(d) Follow guidelines for fan maintenance.

(e) Clean intake strainer.

(f) Determine if there is air bypass from tower outlet back to inlet. If so, bypass may be reduced through addition of baffles or higher discharge stacks.

(g) Inspect spray filled or distributed towers for proper nozzle performance. Clean nozzles as necessary.

(h) Monitor effectiveness of any water treatment program which may be underway.

(i) Keep the tower clean to minimize both air and water pressure drop.

(7) Chillers.

(a) Chillers must be kept clean. Inspect on a regular basis. Clean as necessary.

(b) Inspect for evidence of clogging. Service equipment in accordance with manufacturer's specifications.

(8) Self-Contained Units. (Windows and through-the-wall units; heat pump, etc.)

(a) Clean evaporator and condenser coils.

(b) Keep intake louvers, filters, and controls clean.

(c) Keep inside and outside air flow around units unrestricted.

(d) Caulk openings between unit and windows or wall frames.

(e) Check line voltage at the unit. Full voltage is essential for proper operation.

(f) Follow applicable guidelines suggested for compressor, air-cooled condenser, and fans.

28-29. RESERVED.

30. VENTILATION.

a. General. Ventilation has significant impact on a building's total energy consumption. Each cubic foot of air brought into the building must be either heated or cooled and, in some cases, humidified and/or dehumidified. Limit outdoor air to the minimum required to balance the exhaust requirements and maintain a slight positive pressure to retard infiltration-caused heat losses and heat gains. Reduce or eliminate the need for using outdoor air for odor control by installing chemical or activated charcoal odor-absorbing devices. Consider installing economizer controls on air handling units to minimize the energy required by using outdoor air for "free cooling" when ambient conditions permit.

b. Dampers. Inspect all outside air dampers. They should be reasonably airtight when closed. Check operation of position indicators for accuracy. Install, repair, or replace position indicators as needed. Close outdoor air dampers during the first and last hours of occupancy when the air must be heated or cooled. Consider adding controls to shut down the ventilation system whenever the building is closed for an extended period as during the evening, weekends, etc., except when the economizer cycle is in use.

c. Filters. Inspect filters carefully. Utilize high efficiency filters.

d. Exhaust. Establish a ventilation operation schedule so exhaust system operates only when it is needed most. If possible, concentrate smoking areas together so they can be served by one exhaust system. Reduce volume of toilet exhausts in buildings which have multiple toilet exhaust fans having a total fan capacity in excess of outside air requirements. This can be done by wiring a fan interlock into toilet room lights through a relay so the fan is activated only when lights are on. An administrative request plus signs to the effect that lights should be turned off when the room is not in use will help ensure that lights (and thus the fan) are off when the room is not being used.

e. Baffles. Install baffles to prevent wind from blowing directly into an outdoor air intake.

31. DISTRIBUTION SYSTEMS.

a. General. A distribution system is the equipment and materials necessary for conveying the heating and cooling media - water, steam, or air. Most versions of the general systems previously discussed employ one or more of the following distribution systems:

(1) Hydronic Systems. Hydronic systems are those which utilize water for transferring heating and cooling. Some of the modifications which can be made to these systems are as follows:

(a) Install insulation on all hot and chilled water pipes, fittings, and valves passing through unconditioned spaces, to minimize heat losses and heat gains.

(b) Replace fine mesh strainer baskets with ones having the largest practical openings to reduce pressure losses.

(c) Remove orifice plates not regularly used for flow measurement.

(d) Balance hydronic systems to attain minimally satisfactory temperature and water flow.

(2) Air Distribution Systems. Air distribution systems are those which use air for heating and/or cooling. Ways in which air distribution systems can be modified to effect energy conservation are:

(a) Test, adjust and balance entire air distribution system in accordance with methodology suggested in the ASHRAE Handbook.

(b) Insulate all ductwork carrying conditioned air through unoccupied spaces with a least 1-1/2 inch of fibrous glass insulation or its equivalent.

(c) Reduce system resistance to air flow by replacing those duct sections and fittings which impose unnecessary resistance on the system; replace dirty filters with adequately sized filter media which has high efficiency and low air flow resistance; remove unnecessary dampers and other obstructions from ductwork and replacing high resistance inlets and outlets with diffusers providing low resistance.

(d) If air volume has been decreased to effect energy savings, determine resulting load on the fan motor. If it is less than 80 percent of name-plate rating, consider replacing motor with a smaller more efficient motor.

32. DOMESTIC HOT AND COLD WATER. Domestic hot water consumes from 2 percent to 4 percent of the total energy used in large buildings and more in smaller ones. The following guidelines should be considered in an effort to conserve energy:

a. Water Supply. Inspect water supply system and repair all leaks, including drips at the faucets.

b. Hot Water. Inspect and test hot water controls to determine if they are working properly. If not, adjust, repair, or replace. Inspect insulation on storage tanks and piping. Repair or replace as needed. Increase the amount of insulation on hot water pipes and storage tanks or replace existing insulation with a type having better thermal properties (higher "R" value). Consider replacing existing hot water faucets with spray-type faucets with flow restrictors. Consider installing spring-activated hot water taps. If water pressure exceeds 40 to 50 pounds, consider installing a pressure reducing valve on the main service to restrict the amount of hot water that flows from the tap. Reduce generating and storage temperature levels to the minimum required for washing hands, usually about 90 degrees F to 100 degrees F. If hot water is distributed through forced circulation, turn off the pump when the building is unoccupied. Consider relocating the water heater as close to the point of use as possible. The longer the run, the more hot water sits in it which is cooled down between periods when hot water is drawn. Instantaneous point-of-use heaters can eliminate the need for circulating hot water systems.

33. PIPING SYSTEMS. Proper maintenance of hot and chilled water piping will improve the efficiency of the piping system. Guidelines for effective maintenance of piping systems include:

a. Hot and Chilled Water Piping.

(1) Controls. Inspect all controls. Test them for proper operation. Adjust, repair, or replace as necessary. Also check for leakage at joints.

(2) Instrumentation. Check flow measurement instrumentation for accuracy. Adjust, repair, or replace as necessary. Recalibration of gauges and meters is often neglected, but this is necessary for accurate data.

(3) Insulation. Inspect insulation of hot and chilled water pipes. Repair or replace as necessary. Be certain to replace any insulation damaged by water. Determine source of water leakage and correct.

(4) Strainers. Inspect and clean strainers regularly.

(5) Exchangers. Inspect heating and cooling heat exchangers. Large temperature differences may be an indication of air binding, clogged strainers, or excessive amounts of scale. Determine cause of condition and correct.

(6) Vents. Inspect vents and remove all clogs. Clogged vents retard efficient air elimination and reduce efficiency of the system.

b. Steam Piping. Proper maintenance of steam piping will, among other things, prevent unnecessary wastage of steam. Effective maintenance procedures include:

(1) Insulation. Inspect insulation of all mains, risers and branches, economizers and condensate receiver tanks. Repair or replace as necessary.

(2) Controls. Check the automatic temperature-control system, related control valves, and accessory equipment to ensure that they are regulating the system properly. Inspect zone shut-off valves. All should be operable so steam going into unoccupied space can be shut off. Inspect all pressure-reducing and regulating valves and related equipment. Adjust, repair or replace as necessary.

(3) Trap. Listen to the trap to determine if it is opening and closing when it should be. Feel the pipe on the downstream side of the trap. If it is excessively hot, the trap probably is passing steam. This can be caused by dirt in the trap, valve off stem, excessive steam pressure, or worn trap parts (especially valve and seats). If it is moderately hot - as hot as a hot water pipe, for example, - it probably is passing condensate, which it should do. If it is cold, the trap is not working at all.

(4) Vents. Inspect condensate tank vents. Plumes of steam are an indication of one or more defective traps. Determine which traps are defective and adjust, repair, or replace as necessary.

(5) Indicators. Check accuracy of recording pressure gauges and thermometers.

(6) Pump. Inspect pump for satisfactory operation, looking particularly for leakage at the packing glands.

(7) Steam. Correct sluggish or uneven circulation of steam. It usually is caused by inadequate drainage, improper venting, inadequate piping, or faulty traps and other accessory equipment.

(8) Noise. Correct any excessive noise which may occur in the system to provide more efficient heating and to prevent fittings from being ruptured by water hammer.

(9) Vacuum. Check vacuum return system for leaks. Air drawn into the system causes unnecessary pump operation, induces corrosion and causes the entire system to be less efficient.

34-35. RESERVED.

36. INFILTRATION. Unwanted outside air infiltrates into a building through inadvertent openings in the building envelope, open doors, etc. Since outdoor air, regardless of source, must be heated or cooled (and sometimes humidified and/or dehumidified), infiltration imposes a significant load on the heating and cooling system, thus increasing total energy consumption. The following guidelines should be observed to inspect for sources of infiltration.

a. Windows. Replace broken or cracked window panes. Replace worn or broken weatherstripping around operable windows. If possible, install weatherstripping where none was installed previously. Weatherstrip operable sash if cracks are evident. Caulk around window frames (exterior and interior) if cracks are evident. Consider posting a small sign next to each operable window instructing occupants not to open window while the building is being heated or cooled.

b. Doors. Rehang misaligned doors. Caulk around door frames. Inspect all automatic door closers to ensure they are functioning properly. Consider adjustment to enable faster closing. Inspect gasketing on garage, loading dock, and other overhead doors. Repair, replace, or install as necessary. Consider placing a small sign next to each door leading to the exterior or nonconditioned spaces advising occupants to keep door closed at all times when not in use. Establish rules for all building personnel regarding opening and closing of doors, directing them to keep them closed whenever possible.

37. TRANSMISSION (INSULATION). Transmission losses generally can be reduced either through addition of insulation or modification of glazing characteristics. It is advised strongly that expert technical assistance be obtained before undertaking any insulating to help ensure that the proper type and correct amount are installed, that cost effectiveness will result, and that any potential problems, such as moisture condensation, can be avoided. Where roof insulation is not practical, consider insulating the ceiling on top floor. This can be done easily with blown insulation. In most cases, ceiling insulation also will require a vapor barrier. Consider adding insulation to all exterior walls as well as those which separate conditioned and nonconditioned spaces. As a general guide, the U value for the gross external walls (including windows and doors) of 0.35-.40 BTU/Hr Square Foot degrees F is considered to be a minimum goal. If open space is available, consider planting trees or large shrubs to act as windbreaks on the windward side of the building. The windbreak can have positive value on reducing wind impact, at least on lower floors. Trees and shrubs can be used to reduce solar penetration, discussed elsewhere.

a. Shading Devices. Inspect condition of indoor shading devices such as drapes and blinds which can reduce heat gain as much as 50 percent. Keep indoor shading devices clean and in good repair. During the heating season, close all interior shading devices before leaving space to reduce nighttime heat losses. Install indoor shading devices where none now exist, even if exterior shading devices are used. They should be light colored and opaque. Consider installation of outdoor shading devices such as sunshades, which reflect solar heat before it has a chance to enter the building, and which dissipate heat outdoors rather than indoors. Adjustable sunshades enable entrance of warming rays during the heating season.

b. Reflective Material. Consider adding reflective and/or heat absorbing film to glazing to reduce solar heat gains by as much as 80 percent. Do be aware that such films will reduce substantially the benefits of natural lighting, and can cause cracking by increasing glass temperature. Consider adding reflective materials to the window side of draperies to reflect solar heat when draperies are drawn. Repaint when required or clean exterior finish to improve reflective characteristics.

c. Windows. Consider installation of storm windows if practical. Consider reglazing with double or triple glazing, or with heat absorbing and/or reflective glazing materials, if practical.

d. Weatherproofing and Sealing. Caulk, gasket, or otherwise weatherstrip all exterior joints, such as those between wall and foundation or wall and roof, and between wall panels. Caulk, gasket, or otherwise weatherstrip all openings, such as those provided for entrance of electrical conduits, piping, through-the-wall cooling and other units, outside air louvers, etc. Where practical, cover all window and through-the-wall cooling units when not in use. Specially designed covers can be obtained at relatively low cost. Seal elevator and cable shafts at each floor level. This is a significant item at Airport Traffic Control Towers (ATCT's). Where applicable, to increase insulation qualities in addition to sealing cracks, consider the use of a sprayed-on stucco-type material to existing walls.

38. CONTROL ADJUSTMENTS. A program of control adjustments and modifications should consider the following guidelines:

a. Controls. Adjust controls at the time of testing, adjusting, and balancing of all heating and cooling systems. Check operation of entire heating/cooling control system, including control valves and dampers. Correct all improper operations. Check control system for instrument calibration and setpoint, actuator travel and action, and proper sequence of operation. Adjust controls where applicable to prevent simultaneous operation of heating and cooling systems to achieve desired temperature.

b. Thermostats. Inspect locations of thermostats. Relocate if they currently are positioned near outside walls, in areas that are seldom used, or if they are subject to outside drafts. Consider installation of key-lock plastic covers over thermostats to prevent building occupants from adjusting settings. Consider changing existing thermostats on multizone air handlers to dead-band thermostats which are now available. These provide "no energy consumed" operation of HVAC systems when room temperatures are within the dead-band.

c. Timers. Consider installation of night set-back and morning start-up timer controls which enable you to schedule heating and cooling operations for each zone on the basis of occupancy patterns. Such controls easily can save from 10 percent to 30 percent on fuel consumption. Consider installation of program clocks and manual timers in control circuits to schedule operation of fans, refrigeration equipment, heating equipment and so on. Additional economies may result from decreased costs of labor and maintenance. Adjust automatic timers or add time clocks to deactivate heating and cooling systems during evenings, weekends, holidays, and other periods when the building is unoccupied.

d. Damper Control. Consider adding an automatic draft damper control to reduce heat loss through breeching when the gas or oil burner is not in operation. Consider adding time clocks on self-contained heating and cooling units for automatic shutoff.

39. AIR COMPRESSORS. Efficiency of pneumatic air compressors can be improved by following these guidelines:

a. Leaks. Inspect all connections for air leaks using a soap solution. Seal as necessary. If compressor seems to run excessively, it could be a sign of pressure loss at the controls or somewhere in the piping system. Determine cause and correct. Inspect air pressure in supply tank and pressure regulator adjustment in supply line for proper limits.

b. Belt and Filter. Check belt tension and alignment. Inspect air compressor intake filter pads and clean or replace as necessary.

c. Lubrication. Lubricate electric motor bearings according to manufacturer's recommendations.

40. AIR-HANDLING SYSTEMS REVISIONS. The only way to determine the efficiency of your heating/cooling system is to have the entire system tested and balanced. The extent of testing required and its cost will depend primarily on the type of system involved. In all cases the survey itself should be conducted by qualified personnel who have a thorough knowledge of heating and cooling systems, experience in testing and balancing, and the instrumentation and manpower required to collect and analyze the necessary data. Regional support in this area is anticipated and should be available upon request. The most prevalent types of systems and steps which can be taken to make them more energy efficient are discussed as follows:

a. Single Zone System. A zone is an area in a building which experiences similar amounts of heat gain and heat loss. A single zone system is one which provides heating and cooling to one zone controlled by the zone thermostat. The unit may be installed within or remote from the space it serves, either with or without air distribution ductwork. Steps to improve efficiency include:

(1) Air Volume. In some systems air volume may be reduced to minimum required; therefore, reducing fan power input requirements. Fan brake horsepower varies directly with the cube of air volume. Thus, for example, a 10 percent reduction in air volume will permit a reduction in fan power input by about 27 percent of original. This modification will limit the degree to which the zone serviced can be heated or cooled as compared to current capabilities.

(2) Temperature. Raise supply air temperatures during the cooling season and reduce them during the heating season. This procedure reduces the amount of heating and cooling which a system must provide, but, as with air volume reduction, limits heating and cooling capabilities.

b. Multizone System. A multizone system heats and cools several zones - each with different load requirements - from a single, central unit. A thermostat in each zone controls dampers at the unit which mix the hot and cold air to meet the varying load requirements of the zone involved. Steps which can be taken to improve energy efficiency of multizone systems include:

(1) Temperature. Reduce hot deck temperatures and increase cold deck temperatures. While this will lower energy consumption, it also will reduce the system's heating and cooling capabilities as compared to current capabilities.

(2) Demand Controls. Consider installing demand reset controls which will regulate hot and cold deck temperatures according to demand. When properly installed, and with all hot deck or cold deck dampers partially closed, the control will reduce hot and raise cold deck temperature progressively until one or more zone dampers is fully open.

c. Constant Volume System. Most constant volume systems either are part of another system - typically dual duct systems - or serve to provide precise air supply at a constant volume. Opportunities for conserving energy consumed by such systems include determining the minimum amount of air flow which is satisfactory and resetting the constant volume device accordingly.

d. Dual-Duct System. The central unit of a dual-duct system provides both heated and cooled air, each at a constant temperature. Each space is served by two ducts, one carrying hot air, the other carrying cold air. The ducts feed into a mixing box in each space which, by means of dampers, mixes the hot and cold air to achieve that air temperature required to meet load conditions in the space or zone involved. Methods for improving the energy consumption characteristics of this system include lowering hot deck temperature and raising cold deck temperature and reducing air flow to all boxes to a minimally acceptable level.

e. Fan Coil System. A fan coil system is usually comprised of several fan coil units, each of which consists of a fan and a heating and/or cooling coil. The individual units can be located either in or remote from the space or zone being served. Guidelines for reducing energy consumption of such systems include reducing air flow and balancing water flow to minimally satisfactory levels, and when heating and cooling loads are minimal, shutting off fans thus enabling the coil to act as a convector.

f. General. Regardless of the type system currently installed, consider adding to the system portable electric baseboard unit, infrared, or other type of supplemental heating units to overcome cold conditions which cannot be overcome by the current system, or to heat remote or occasionally-used areas which otherwise could be heated only through activation of all or substantially all of a central system.

41-48. RESERVED.

CHAPTER 6. REPORTS

49. ENERGY MANAGEMENT REPORT BY COST CENTER BY FACILITY. (RIS: SW 1052-2). This report will be furnished to each sector. It shows the kilowatt hours used and the kilowatt hours cost for the current fiscal year compared to a like period of the previous fiscal year. The report specifies each electric service and can be employed by sector managers in analyzing effects of conservation programs. It can also be a tool to check excessive utility bills attributable to incorrect application of rate structures or excessive consumption. When reviewing the report it may be worthwhile to give consideration to installing additional FAA purchased meters, so that separate facility type consumption can be monitored and compared where the current breakdown is inadequate. Additionally, good energy conservation management dictates the requirement to plot out kilowatt utilization to show trend data as well as the effects of sector conservation programs.

50. ANNUAL ENERGY CONSERVATION REPORT. (RIS: SW 1052-4). This report will document the energy conservation achievements of each individual sector for the previous fiscal year. Sector input will be requested by ASW-460 notice during the last quarter of each fiscal year. This notice will include a sample format. Sector reports will be consolidated in a management report to be distributed to all interested parties.

* 51. QUARTERLY ENERGY CONSERVATION PERFORMANCE REPORT. (RIS: SW 1052-1). SW Form 1052-1, Energy Conservation Performance Report (See Appendix 2), shall be submitted quarterly to the Technical Standards Section, ASW-461, instead of the letter required by paragraph 8b of Order SW 1052.1A, Energy Conservation - Program Responsibilities and Reporting Requirements. Consumption of electricity and natural gas is required in addition to diesel fuel, LPG/propane, and gasoline requested by Order SW 1052.1A. The data for electricity and natural gas may be obtained from the data processing information being distributed to the sector offices. If there are any discrepancies in the data processing information found by the sector, the fiscal quarter baseline for the previous fiscal year will be modified in accordance with instructions on SW Form 1052-1. This form may be obtained from regional distribution. *

52.-54. RESERVED.

APPENDIX 1. SUGGESTED BUILDING INFORMATION FOR ENERGY AUDIT USE

Surveyed By:_____

Survey Date:_____

Facility_____

Address_____

I. PHYSICAL DATA: (Attach copy of floor plan from as-built drawings).

Length, feet and orientation_____ft. N.W.E.S.

Width, feet and orientation _____ft. N.W.E.S.

Height from floor to ceiling_____

Floor area, gross conditioned square feet_____

Floor Area:

_____ft^2 Electronic equipment

_____ft^2 Shop area

_____ft^2 Administrative

_____ft^2 Other

WINDOWS:

Glazing:

Exposure	No.	*Type	Gross Area	Remarks (Exterior Shading, Drapes, Blinds)
N	_____	_____	_____	_____
S	_____	_____	_____	_____
E	_____	_____	_____	_____
W	_____	_____	_____	_____

*Type: Single, double, insulating, reflective, fixed sash, casement, double hung, etc.

DOORS:

Door Types and Numbers:

1-single; 2-vestibule; 3-revolving

North - No._____ Type_____ West - No._____ Type_____

East - No._____ Type_____ South - No._____ Type_____

WALLS:

Orientation	Gross Wall Area	Construction Materials and Thickness
North	_____	_____
South	_____	_____
West	_____	_____
East	_____	_____

_____

_____

ROOF and FLOORS:

Roof Construction: (Materials, Thickness, Color) _____

Roof/Ceiling Insulation: Type:_____Thickness:_____

"U" Value:_____

Floor Construction: (Note Insulation) _____

AIR LEAKAGE:

Structural damage (through the wall/ceiling cracks)_____

Broken or defective windows_____

Ventilation louvers that remain open all the time_____

_____

Gasketing and weatherstripping around windows and doors_____

_____

II. BUILDING OCCUPANCY AND USE (Occupants, Hours, When Cleaned)_____

III. SYSTEMS AND EQUIPMENT DATA

A. HVAC SYSTEMS:

1. Air Handling Systems (describe): _____

2. Ventilation: _____

3. Heating, Fuel Source (gas, oil, electric): _____

Equipment _____

B. LIGHTING:

Area Served	Type (Flourescent, Incandescent Etc.)	Density (Watts/Ft.^{2})	Method of Control (Breaker Panel, Wall Switches, Control Switching)
Interior			
Adm. Off.			
Storage Rm.			
Corridors			
Lobbies			
Computer Rm.			
Kitchens			
Toilets, etc.			

Exterior	Type	Total kW
Parking Lot		
Security		

Equipment condition and maintenance schedules

C. DOMESTIC HOT WATER:

Size_____ Rated input_____

Energy Source: (gas, oil, electric) _____

Thermostat setting_____°F

D. ELECTRICAL POWER:

Panel Board Designation (Volt, Ø)	Equipment/ Load	Breaker Numbers	Breaker Size	Current Reading

APPENDIX 2. ENERGY CONSERVATION PERFORMANCE REPORT
(RIS: SW 1052-1)

FEDERAL AVIATION ADMINISTRATION
SOUTHWEST REGION

ENERGY CONSERVATION PERFORMANCE REPORT

A. IDENTIFICATION DATA:

Airway Facilities Sector _____

Prepared By _____ Title _____ Phone Number _____

B. REPORT PERIOD: Fiscal Quarter ☐ Fiscal Year ☐☐ Date Submitted _____

C. SUMMARIZED TABULAR DATA:

	Building, Facilities, Vehicle, and Equipment Operation	Fiscal Quarter Baseline Previous Fiscal Year	Consumption in this Fiscal Quarter	Percent Change in Consumption
1	Electricity - KWH			
2	Fuel Oil - Gallons			
3	Natural Gas - Cubic Feet			
4	LPG or Propane - Gallons			
5	Gasoline - Gallons			

D. CONVERSION TO BTU's: Enter the aggregate energy consumption in terms of BTU's in the blocks below.

	Fiscal Quarter Baseline Previous Fiscal Year	Consumption in this Fiscal Quarter	Percent Change in Consumption
TOTAL BTU's			

☐ If you adjusted the previous fiscal year quarterly baseline to reflect changes, check this box and attach a statement, on a separate sheet, to explain the adjustments you made.

Instructions for Preparing the Energy Conservation Performance Report

A. IDENTIFICATION DATA: (Please print all entries on the form).

1. Airway Facilities Sector: Fill in the name of your sector and complete this report.

2. Enter the name of the person who completed the report and his/her title and phone number.

B. REPORT PERIOD: This report is to be completed quarterly by each of the sectors and is to be submitted to ASW-461 no later than 15 days after the end of each fiscal quarter to which the report pertains.

For example, the report covering the first fiscal quarter (October-December) of FY 1983 is due no later than January 15, 1975.

1. Fiscal Quarter: Enter a 1, 2, 3, or 4 to indicate the appropriate fiscal quarter of the fiscal year surveyed (e.g., July-September - 4, etc.).

2. Fiscal Year: Enter the last two digits of the fiscal year covered by the report.

3. Date Submitted: Enter in digits the month, day, and year the report was completed.

C. SUMMARIZED TABULAR DATA:

1. Column 1, "Building and Facilities Operations; Vehicle and Equipment Operations":

This form is for automatic data processing. REPORT ONLY IN THE UNITS REQUESTED IN COLUMN 1 FOR EACH ENERGY SOURCE IN COLUMNS 2-4.

Report electrical energy consumption in Kilowatt Hours (KWH). Report Fuel Oil, LPG or Propane, Gasoline, Diesel, and Petroleum Distillate Fuel in gallons; and Natural Gas in cubic feet.

2. Column 2, "Fiscal Quarter Baseline": This is the actual consumption for each energy source, by fiscal quarter in the previous fiscal year. Figures in this column will be used as the "baseline" against which to measure agencies' success in saving energy.

Adjustment of Fiscal Quarter Energy Consumption to Reflect Program Changes:

If your base of building, facility, vehicle, and equipment operations is different for the reporting quarter than for the same quarter in the previous fiscal year (because of installation or removal of equipment, acquisition or loss of vehicles, or addition to or reduction of plant capacity, etc.), adjust the actual consumption for the previous year fiscal quarter to reflect the total energy consumption that might reasonably have been expected to occur if the program changes above had taken place prior to the appropriate fiscal quarter. Then, given the same base of building, facility, vehicle and equipment operations, we can measure the real effect of energy reduction measures. If you adjusted your actual previous year fiscal quarter energy consumption to reflect program changes, please attach a note describing the adjustments.

3. Column 3, "Consumption in this Fiscal Quarter": For each applicable energy source, report the total consumption for the appropriate fiscal quarter.

4. Column 4, "Percent Change in Consumption": The percent change of energy consumption is derived, for each pair of entries in columns 2 and 3, by using the following formula:

$$\text{Column 4} = 100.00 - \left(\frac{\text{Column 3}}{\text{Column 2}} \times 100.00\right) = \text{Percent Change}$$

Column 4 entries should be rounded to the nearest hundredth of an integer.

If there was an increase, instead of a decrease, in energy consumption for any energy source (the formula above yields a negative value), place the percentage increase in parenthesis.

D. CONVERSION TO BTU's:

Use the following conversion factors to generate BTU-equivalents of the energy units reported in Part C of this report.

Source	BTU Content Per Unit	Source	BTU Content Per Unit
Electricity	11,600 BTU's per KWH	Automotive Gasoline	125,000 BTU's per gal.
Fuel Oil	138,700 BTU's per gal.	Diesel and Petroleum	
Natural Gas	1,031 BTU's per cf.	Distillate Fuel	138,700 BTU's per gal.
Liquified Petroleum Gas (Including Propane & Butane)	95,500 BTU's Per gal.		
Coal	24,580,000 BTU's per short ton 1,390 BTU's per pound		

CHANGE

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

SW 1052.3 CHG 1

SOUTHWEST REGION

6/28/83

SUBJ: ENERGY MANAGEMENT PROGRAM

1. PURPOSE. This change transmits a new paragraph to Order SW 1052.3.

2. EXPLANATION.

a. Paragraph 51 has been added to provide a standard format for the quarterly Energy Conservation Performance Report (RIS: SW 1052-1) required by paragraph 8 of Order 1052.1A, Energy Conservation Program Responsibilities and Reporting Requirements. In addition, the sectors are required to report electricity and natural gas usage. This information is necessary to determine our effectiveness in meeting the annual energy conservation goal. The report form and instructions for providing this information are covered in Appendix 2.

b. The distribution has been expanded to cover the Logistics Division.

3. PEN AND INK CHANGE.

a. Front Cover. In the Distribution Legend at the bottom of the page, change "A-X(AF)-4" to read "A-X(AF/LG)-4."

b. Foreword. In paragraph 2 add the words "and the Logistics Division with" after the words "Airway Facilities Division."

PAGE CONTROL CHART

Remove Pages	Dated	Insert Pages	Dated
iii and iv	8/11/82	iii and iv	6/28/83
33 (and 34)	8/11/82	33 (and 34)	6/28/83
		APPENDIX 2	6/28/83

Clinton A. Murphy
Manager, Airway Facilities Division

Distribution: A-X(AF/LG)-4; A-FAF-0 (LTD)

Initiated By: ASW-460