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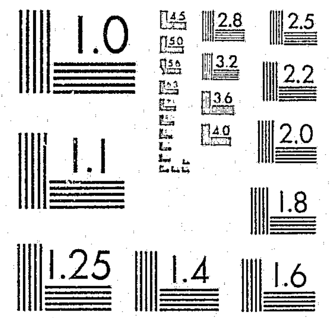

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National Institute of Justice
United States Department of Justice
Washington, D.C. 20531

State of Texas Energy Auditor Training II

TEXAS
ENERGY MANAGEMENT

72830

1980 TEXAS ENERGY AUDITOR TRAINING MANUAL

FOR SCHOOLS, HOSPITALS, LOCAL GOVERNMENTS AND

PUBLIC CARE INSTITUTIONS

PREPARED BY:

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The project directors for the development of the Energy Auditor Training II workbook were Duane Keeran of the Texas Energy and Natural Resources Advisory Council (TENRAC) and Jerry Golden of PLANERGY, Inc. Numerous materials included in the Energy Conservation Grants Program Training Manual (GOER, 1979) were incorporated, with some revisions, in this Energy Auditor Training II workbook (TENRAC, 1980). Additional TENRAC materials have also been included in the sections on Energy Management, State Program Summary, Energy Audit Forms, TA/ECM Applications, and the Appendix. PLANERGY, Inc. has collected valuable resource materials for use by energy auditors which have been included in the sections entitled Total Energy Management; Heating, Ventilating and Air Conditioning Systems; Lighting; and Ancillary Systems. The materials in these sections contain excerpts from the following important resource documents:

A Guide to Reducing Energy Use Budget Costs, U.S. Department of Energy (prepared by the National Association of Counties, National League of Cities, and U.S. Conference of Mayors), reprinted April, 1978.

Identifying Retrofit Projects for Buildings, Federal Energy Administration, Office of Energy Conservation Programs, September, 1976 (FEA/D-76/467).

Instructions for Energy Auditors, Volumes I & II, U.S. Department of Energy (prepared by Fuel and Energy Consultants), September, 1978.

Making Cents of Your Energy Dollar, Volumes I and II, U.S. Department of Energy (prepared by the Energy Conservation and Alternatives Center for Commerce and Industry (ECAC). (Managed by Interplan, Inc.), April, 1979 (draft).

Total Energy Management for Hospitals, U.S. Department of Health, Education and Welfare (developed by Enviro-Management and Research, Inc.), in cooperation with the U.S. Department of Commerce and U.S. Energy Research and Development Administration, 1978.

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AGENDA

DAY ONE

8:30 a.m. REGISTRATION

9:00 a.m. WELCOME

National Energy Conservation Policy Act of 1978 and the Texas Public Buildings Program: the effect of the Act on Texas schools, health care facilities, units of local government and public care institutions.

9:30 a.m. TOTAL ENERGY MANAGEMENT

The major energy systems and how effective operation and maintenance actions should save 15% or more of the typical building's energy usage.

10:15 a.m. COFFEE BREAK

10:30 a.m. ENERGY USE RECORDS AND BILLINGS

How to calculate energy consumption, read bills and curb demand charges.

11:30 a.m. HEATING, VENTILATING AND AIR CONDITIONING SYSTEMS

Energy consuming aspects, and operations and maintenance recommendations for heating, cooling and ventilating systems; reheat, variable air volume, air economizers, etc.

12:00 noon LUNCH

1:00 p.m. HEATING, VENTILATING AND AIR CONDITIONING SYSTEMS (Continued)

2:00 p.m. LIGHTING

Recomended levels of illumination; basics of lighting design; effects of age and dirt; lighting types; lighting surveys and audits; conservation opportunities.

3:00 p.m. COFFEE BREAK

3:15 p.m. BUILDING ENVELOPE

Effects of infiltration/exfiltration, and solar loading; thermal properties; and other aspects of heat gain and heat loss.

4:00 p.m. VIDEOTAPED AUDITS #1 AND #2

4:45 p.m. DISCUSSION

5:00 ADJOURN

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DAY TWO

8:30 a.m.	ANCILLARY
	Hot water, laundries, kitchens, elevators, escalators, computers, office equipment and other incidental equipment
9:15 a.m.	SOLAR AND RENEWABLE ENERGY RESOURCES
	Solar insolation and weather data and their application to NECPA forms; the potential for solar and other renewable energy resources in Texas.
9:45 a.m.	COFFEE BREAK
10:00 a.m.	ENERGY AUDIT FORMS
	Instructions for preparing the required forms and completion of a sample audit form.
12:00 noon	LUNCH
1:00 p.m.	VIDEOTAPED AUDIT #3
1:30 p.m.	DISCUSSION
2:00 p.m.	TECHNICAL ASSISTANCE/ENERGY CONSERVATION MEASURES
	Review of Technical Assistance and Energy Conservation Measures guidelines and applications
2:45 p.m.	COFFEE BREAK
3:00 p.m.	OPEN BOOK EXAMINATION
	Participants will work through a series of questions relating to material covered in the session.
4:30 p.m.	PRESENTATION OF CERTIFICATES OF COMPLETION
5:00 p.m.	ADJOURN

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HOW TO USE THE ENERGY AUDITOR TRAINING MANUAL

The Energy Auditor Training Manual is designed to provide the building owner and employees with information which would be of assistance in saving energy and related costs through the implementation of maintenance and operating procedures and energy conservation measures which provide a quick return on the investment. The Manual also includes all forms and supplementary data necessary to complete the full range of NECPA requirements, and to apply for Technical Assistance and/or Energy Conservation Measures grants. Coupled with the two-day Energy Auditor Training Course, the certified Energy Auditor should be prepared to perform audits that meet State and federal requirements and benefit the building owner/operator.

All sections are tabbed for quick, easy reference. To assist the auditor in making maximum use of the manual, the following suggestions are offered:

1. "NECPA" and "State Program Summary" tabs are background reference material. The NECPA regulations are provided as reference material concerning specific procedures of the federal program including eligible projects, funding limits, grant ranking procedures, State Plan development, and reporting requirements to name a few. The State Program Summary provides the reader with essential information about the State Plan for the program and the major procedures of the State program and the federal regulations.
2. The "Energy Management" tab includes important information on how to organize your efforts to save energy, to record and understand building energy consumption data, to understand the benefits in saving energy, and to develop a comprehensive energy management plan for the institution.
3. "HVAC," "Lighting," "Building Envelope" and "Ancilliary Systems" tabs are detailed explanations of how and why various equipment and features of a building consume energy and how waste can be minimized. There are charts, graphs, tables and other

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key supporting material designed to allow the auditor to understand and apply energy conservation principles and techniques. The materials presented here are deliberately limited to primary maintenance and operations concepts and major TA/ECM opportunities. The purpose of the energy audit is to serve as an intermediary step, and it is not intended to involve the detail and sophistication of the more professional "Technical Assistance" level audit performed by licensed engineers and architects.

Each of these systems discussions contains key maintenance and operations checklists and a sample energy savings calculation for use in conducting the audit. Part III of the Energy Audit form can be completed by using the checklists in performing the energy audit and then transferring the appropriate findings to the marked sections in Part III.

4. The "Solar Applications" tab is a brief description of passive and active solar opportunities. The NECPA emphasis on solar and renewable resources is designed to promote awareness of their potential use and to provide information which demonstrates whether or not the audited building is conducive to using alternate source energy.

   "Solar/Weather Data" provides data on heating/cooling degree days, solar insolation, wind speed and recent historical weather data for use in preparing the Energy Audit form.

5. "PEA/EA Forms" and "TA/ECM Applications" tabs contain all necessary forms and instructions, with examples to assist the institutions in filling out each item. Blank forms are contained in the appendix, and additional copies are distributed to all eligible agencies by direct mail.

6. The "Appendix" contains copies of blank forms, a glossary of energy terms, and the energy conversion factors used for the NECPA program.

A good energy audit follows these steps:

1. Read the sections on energy use and bills and on HVAC, Lighting, Building Envelope, Ancillary Systems and Solar Applications.
2. Complete the energy information required for the Preliminary Energy Audit (PEA) form.
3. Conduct a walk-through energy audit to determine needed maintenance and operations changes using the Energy Audit checklist which accompanies the HVAC, Lighting, Building Envelope and Ancillary Systems sections. Also look for potential energy conservation measures.
4. Transfer the checklist findings to Part III of the Energy Audit form (page 3).
5. Complete the Energy Audit (EA) form.
6. Transfer "Solar/Weather Data" to appropriate sections of the EA, using data for the city nearest the building location.
7. Recheck Energy Use Index calculations contained in the PEA.
8. Calculate the anticipated energy savings for one or more potential ECMs and include the information on page 4 of the Energy Audit form.
9. The PEA and EA forms are included in the Technical Assistance and Energy Conservation Measures Applications. Therefore, this information will be submitted to the Texas Energy and Natural Resources Advisory Council as part of the TA/ECM application.

OVERVIEW

The National Energy Conservation Policy Act (NECPA) of 1978 authorizes $965 million for assistance to schools, hospitals, local governments and public care institutions in conducting energy audits, technical assistance analyses and in implementing energy conservation measures. The phases of the program are described as follows:

PHASE 1

Step 1 - Preliminary Energy Audits (PEA) -- An information gathering survey of building characteristics and energy using characteristics not requiring an on-site audit or outside assistance.

Step 2 - Energy Audit -- A site-specific review of facilities requiring identification of maintenance and operating procedures and opportunities for Energy Conservation Measures (retrofit) by persons who have received state-approved training or by persons who can demonstrate appropriate skills and experience, such as an engineer.

PHASE 2

Step 1 - Technical Assistance -- An on-site, detailed energy analysis by a registered engineer or engineer/architect team. The Technical assistance analysis will result in recommendations for Energy Conservation Measures (ECMs) with the estimated costs, the expected savings and the payback period of each measure.

Step 2 - Energy Conservation Measures -- Energy conservation measures involve the acquisition and installation of materials and/or equipment in eligible buildings for saving energy and related costs. In addition to materials and equipment, allowable costs also include project supervision (excluding institutional administration), project design, and labor.

This Energy Auditor Training Manual is designed for training individuals to perform Phase I, Step II Energy Audits as prescribed by NECPA and appropriate federal and state administrative guidelines and regulations.

BACKGROUND AND PURPOSE OF THE NECPA AND THE ENERGY AUDIT

The Phase I Energy Audit is not a full-scale technical analysis of energy systems, needed improvements, costs and precise estimated savings. It is, rather, an intermediate phase designed mainly to identify quick and low-cost maintenance and operational changes that can affect useful savings, and to qualify building owners for Phase II Technical Assistance support.

The administrative guidelines follow. Here are some important provisions:

Contents of an Energy Audit

A. Preliminary Energy Audit Information

B. Identification of needed maintenance and operational improvements.

C. Indication of the need for Energy Conservation Measures (ECM); based primarily on energy use statistics.

D. Assessment of estimated costs, potential energy savings and simple payback period of ECMs (not a stringently required element).

Auditor Qualifications

A. Completion of a State-approved training course.

B. Be someone other than the person directly responsible for day-to-day operation of the building being audited.

C. Full disclosure of any financial interest with the energy audit, technical assistance or recommended ECMs.

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Cost of Energy Audits

The Federal government will normally pay up to one-half of the allowable costs of the energy audit. The cost of audits, for purposes of determining the federal share, is as follows:

Building Gross S/F	Allowable Federal Audit Cost*
Up to 30,000	$400
30,000 to 100,000	$500
More than 100,000	$600
Complexes	(Sum of individual building allowances up to 150,000 GSF plus 60 percent of individual building allowances above 150,000 GSF, but not to exceed $10,000.)

* The figures identified here represent an estimate for the total cost of the energy audit. These estimates are used as a basis for identifying the amount of the Energy Audit grant. The amount of the Energy Audit grant is one-half ($200, $250, $300, respectively) of the estimated total cost of the Energy Audit identified above.

federal register

Monday
April 2, 1979

Part VI

Department of Energy

Energy Measures and Energy Audits Grant Programs for Schools and Hospitals and Buildings Owned by Units of Local Government and Public Care Institutions

DEPARTMENT OF ENERGY

10 CFR Parts 450, 455

Energy Measures and Energy Audits; Grant Programs for Schools and Hospitals, and Buildings Owned by Units of Local Government and Public Care Institutions

AGENCY: Department of Energy.
ACTION: Final Rule.

SUMMARY: The Department of Energy (DOE) is issuing final regulations to establish grant programs, subject to cost sharing requirements, to reduce consumption, and associated costs, of conventional energy resources in (1) schools and hospitals, and (2) buildings owned by units of local government and public care institutions. This objective is to be achieved through several means, including financial assistance for:

(a) Identifying improved operating and maintenance procedures;

(b) Identifying energy conservation measures, including solar energy or other renewable source measures; and

(c) Implementation, in the case of schools and hospitals, of selected energy conservation measures, including solar energy or renewable resource measures.

Financial assistance under these regulations will be provided through grants which the Secretary may award to States for the conduct of preliminary energy audits and energy audits. A State may participate in either the program for schools and hospitals, or the program for units of local government and public care institutions, or both. Preliminary energy audits and energy audits are part of a larger program which will also provide financial assistance for technical assistance and energy conservation measures; regulations governing the latter programs were proposed and published in the FEDERAL REGISTER on January 5, 1979 (44 FR 1580).

EFFECTIVE DATE: April 2, 1979.

FOR FURTHER INFORMATION CONTACT:
Michael Willingham, Director, Office of State-Specific Programs, Room 4117, 20 Massachusetts Avenue, NW., Department of Energy, Washington, D.C. 20545, Telephone: (202) 376–4149.

Lewis W. Shollenberger, Jr., Office of the General Counsel, Room 3224, 20 Massachusetts Avenue, NW., Department of Energy, Washington, D.C. 20545, Telephone: (202) 376–9472.

A. Introduction

On December 12, 1978, DOE Published a proposed rule (43 FR 58158) to establish a program for preliminary energy audits (PEA) and energy audits (EA) of schools and hospitals, and buildings owned by units of local government and public care institutions.

DOE received 150 written comments and 58 persons testified at hearings held in Washington, D.C.; Chicago, Illinois; and San Francisco, California; January 8 and 9, 1979. Many suggestions were made, a number of which resulted in changes to the final rule.

With the issuance of this final rule, DOE amends Chapter II of Title 10, Code of Federal Regulations, to establish a program to provide financial assistance to conduct preliminary energy audits and energy audits of schools and hospitals, and buildings owned by units of local government and public care institutions, pursuant to Title III of the National Energy Conservation Policy Act (NECPA), Pub. L. 95–619, 92 Stat. 3206 *et seq.*

Preliminary energy audits of schools and hospitals, and of buildings owned by units of local government and public care institutions, are a State responsibility. They are performed to provide the State a basis for making a reasonable estimate of the number and characteristics of buildings owned by eligible institutions which qualify for assistance for the conduct of energy audits. The preliminary energy audit information is to be used in the development of the State plan for technical assistance and energy conservation measures, including solar energy or other renewable resource measures. It may be impossible to perform preliminary energy audits for all eligible institutions within the time available. Therefore, provision has been made to allow States to perform preliminary energy audits on a sampling basis for purposes of developing the State plan. It is essential that the sample, if taken, be followed by an identification of all eligible institutions, and together with the buildings owned by them, so that there is a listing of institutions and buildings which qualify for participation in the program. This information, together with data developed from the preliminary energy audits, will enable a State to establish criteria for determining which institutions should receive priority for assistance in the conduct of energy audits. The preliminary energy audit is designed to gether information and does not require a walk-through of the building by a trained auditor. Energy audits, which incorporate the preliminary energy audit data elements, do require a trained auditor to visit the building and make an on-site inspection. The energy audit is to identify changes in operating and maintenance procedures which could save energy. In addition, the energy audit is to indicate how great a need and potential exists for energy conservation, measures, including solar energy or other renewable resource measures.

B. Notice of Grant Program Cycle

DOE has elected to use a grant program cycle for the preliminary energy audit and energy audit portion of the program as well as for the technical assistance and energy conservation measure portion of the program. For purposes of the preliminary energy audit and energy audit program, the grant program cycle is initiated as of the date of publication of this final rulemaking. State applications for financial assistance under this regulation are due thirty days from this date unless an extension of time is requested and approved. Table 1 presents the amounts allocated to States for the first grant program cycle. These allocations are based on fiscal year 1978 appropriations in the amounts of $20 million for schools and hospitals, and $7.5 million for units of local government and public care institutions. Except as may otherwise be specified by the Secretary, this first grant program cycle shall terminate September 30, 1979.

TABLE 1

State	Allocation factor	Schools and hospitals	Units [1]
Alabama	.0163	$325,921	$122,220
Alaska	.0100	$169,184	$74,694
Arizona	.0119	$238,683	$89,581
Arkansas	.0115	$230,851	$86,494
California	.0729	$1,458,598	$546,974
Colorado	.0143	$286,815	$107,556
Connecticut	.0157	$313,050	$117,394
Delaware	.0070	$140,501	$52,688
District of Columbia	.0076	$152,401	$57,150
Florida	.0312	$624,450	$234,169
Georgia	.0204	$408,081	$153,023
Hawaii	.0067	$133,957	$50,234
Idaho	.0087	$174,116	$65,294
Illinois	.0419	$838,702	$314,513
Indiana	.0227	$453,800	$170,178
Iowa	.0155	$309,517	$116,069
Kansas	.0129	$258,950	$97,106

TABLE 1.—Continued

State	Allocation factor	Schools and hospitals	Units [1]
Kentucky	.0161	$321,892	$120,710
Louisiana	.0167	$333,128	$124,922
Maine	.0100	$199,738	$74,902
Maryland	.0185	$369,398	$138,523
Massachusetts	.0243	$486,787	$182,645
Michigan	.0353	$705,848	$264,693
Minnesota	.0199	$397,059	$148,897
Mississippi	.0120	$240,969	$90,363
Missouri	.0208	$416,576	$156,216
Montana	.0091	$182,895	$68,586
Nebraska	.0111	$221,833	$83,187
Nevada	.0072	$143,094	$53,660
New Hampshire	.0090	$179,289	$67,233
New Jersey	.0290	$580,883	$217,831
New Mexico	.0089	$177,440	$66,540
New York	.0637	$1,274,325	$477,872
North Carolina	.0222	$443,618	$166,357
North Dakota	.0096	$191,631	$71,861
Ohio	.0400	$799,089	$299,659
Oklahoma	.0139	$277,538	$104,077
Oregon	.0124	$248,714	$93,268
Pennsylvania	.0437	$873,290	$327,484
Rhode Island	.0085	$169,209	$63,453
South Carolina	.0136	$272,121	$102,046
South Dakota	.0089	$178,025	$66,759
Tennessee	.0184	$367,708	$137,890
Texas	.0446	$892,824	$334,809
Utah	.0099	$198,229	$74,336
Vermont	.0080	$160,893	$60,335
Virginia	.0211	$421,892	$158,210
Washington	.0168	$336,852	$126,245
West Virginia	.0111	$221,930	$83,224
Wisconsin	.0213	$425,453	$159,545
Wyoming	.0078	$155,998	$58,499
American Samoa	.0050	$99,418	$37,282
Guam	.0050	$100,434	$37,663
Puerto Rico	.0141	$282,480	$105,930
Virgin Island	.0052	$104,126	$39,047
U.S. total	1.0000	$19,999,870	$7,499,972

[1] Units of local government and public care institutions.

C. Summary of Major Comments on the Proposed Rule and DOE Response

DEFINITIONS—Four comments were received concerning leased buildings occupied by eligible institutions. NECPA provides that financial assistance is to be made available for buildings "owned" by eligible institutions. Therefore, buildings occupied on a lease arrangement do not qualify for financial assistance under this program. However, in some cases, a lease is used as a means of acquiring ownership. A definition of the term "owned" has been added to the rule to make it clear that leased buildings, title to which will transfer to the lessee at the end of the lease period, may also be qualified to participate in this program. Other comments regarding the definition of "building" pointed out that in exceptionally moderate climates there are many buildings owned by eligible institutions which have neither heating or cooling systems, but which could save energy through changes to lighting and hot water systems. DOE is constrained to use the definition provided by NECPA which limits eligible "buildings" to those which are heated or cooled. The absence of any reference to hot water systems in the definition, unlike the definition of the term "building" elsewhere in the Energy Policy and Conservation Act, suggests an intent to preclude such systems from qualifying a building for assistance under these programs. DOE considers a mechanical ventilation system for distributing air throughout a building to be a cooling system and has added a definition of the term "heating or cooling system" to the rule which reflects this view. The purpose of this definition is to clarify conditions of eligibility, and should not be construed as restricting consideration of potential energy conservation opportunities to mechanical heating or cooling systems. On the contrary, all participants in this program should consider all available opportunities, including active and passive solar systems and other renewable resource measures. The definition of "energy conservation measure" has also been clarified to make clear the intent to consider passive solar energy systems, such as solaria or thermal ponds, as well as active solar energy systems.

Several comments addressed the definition of the term "complex". One suggested inclusion of all buildings within a given jurisdiction to be considered a "complex". This suggestion was not adopted since it would result in limiting the amount of financial assistance available under cost limits applicable to energy audits. Two comments requested confirmation that a preliminary energy audit or energy audit could be conducted for a "complex" as well as for individual buildings within the "complex". The rule permits this without a language change, however, either approach must observe the cost limits stated in § 450.46.

Three comments were received regarding the definition of "cooling degree days". These, together with others related to the allocation formula, suggested a higher base for calculation of cooling degree days. The provision of the proposed rule has been retained because it is consistent with both the weather data maintained and published by the National Oceanographic and Atmospheric Administration and general engineering practice.

Two comments criticized the definition of "gross square feet" because it allowed inclusion of space which is not heated or cooled such as parking garages. One of the major purposes of defining the term is to permit comparisons of levels of energy use in similar buildings. Because little energy is used in areas which are neither heated nor cooled, a building which has a parking garage is not truly comparable to a building of the same size which does not. The definition has been modified to exclude areas which are not heated or cooled.

Numerous comments touched on the definitions of eligible institutions. These definitions are important because institutions will be accepted for, or barred from, participation based on whether they meet the test of the definition. Two commenters requested clarification. DOE is of the opinion that the States, as a result of licensing and oversight authorities with respect to eligible institutions, are in the best position to apply the definitions to institutions within their jurisdiction. Two comments asked if community colleges, which do not require a high school diploma or its equivalent for admission, are eligible. The NECPA legislative history suggests that the phrase "recognized equivalent" in the definition includes not only high school equivalency, but also whatever entrance requirements short of a high school certificate an institution otherwise qualified chooses to impose for admission. A related question asked for clarification of the standards which will apply in determining institutional eligibility for participation in the programs. This question is representative of many which are sure to arise as the program is implemented, and must be answered on a case-by-case basis, depending on whether or not the institution can satisfy the requirements of the appropriate definition. Two comments requested the definitions be changed with regard to treatment of nursing homes. One suggested nursing homes be treated as hospitals. The other favored inclusion of proprietary nursing homes. Neither action is consistent with the provision of NECPA. However, nursing homes which meet the definition of a "public care institution" qualify for participation in the program. For example, a nursing home which is a facility for long-term care, as defined in section 1633 of the Public Health Service Act (42 U.S.C. 300s-3) is eligible for financial assistance under this grant program.

Seven commenters responded to the question of whether to include "parish" and "borough" in the definition of unit of local government. The final rule has been changed to include "parish" and "borough" under the definition of "unit of local government" for clarity. A related question regarding libraries brought 17 responses, all of which favored including libraries in the program. Accordingly, the definition of the term "unit of local government" has been expanded to describe those libraries which are eligible to participate in the programs. Two comments recommended that the definitions specify other buildings, such as police stations and fire stations, as buildings owned by units of local government. The language of the definition is sufficient, but police and fire stations were added to the categories of buildings owned by units of local government listed in § 450.42, "Contents of a preliminary energy audit", to clarify the intent.

One comment requested inclusion of head start centers under the definition of "school", and two comments sought inclusion of community action agency buildings under "unit of local government". Both are actions which DOE considers to be beyond the authority given in NECPA. However, buildings occupied by such agencies which meet the qualification requirements of either a "school" or "public care institution" as stated in the definitions are eligible to participate in the program.

One comment suggested the definitions of "State health facilities agency" and "State educational facilities agency" be expanded to permit the use of Boards. No change is necessary, as the proposed definitions allow the States discretion to use Boards if there is no agency currently in existence which is broadly representative of institutions in each category.

CONTENT OF A PRELIMINARY ENERGY AUDIT—The "Content of a preliminary energy audit" section defines the information requirements for this activity. This includes identification of the institution, basis for eligibility, description of the functional use of the building, owner of record, size, age, operating schedule, major energy using systems, building characteristics related to the potential use of solar energy or renewable resource measures, energy use and cost data by fuel type, energy use in Btu, an energy use index, and a brief description of energy conservation activities. Preliminary energy audits are to be conducted by States to establish the information base needed for development of State Plans which will be used in the subsequent phase of the grant programs to administer technical assistance and energy conservation measures, including solar energy or other renewable resource measures.

Three comments were made concerning the relevance of considering solar applications under this program. DOE is committed to early consideration of solar and other renewable resource applications. It must be recognized that detailed evaluations and specific recommendations can come only as a result of technical assistance work. The information gathered in the preliminary energy audit and energy audit phase should be useful for making a judgment as to whether a particular building has potential for solar energy or other renewable resource applications. Several data elements intended to provide information necessary to make a preliminary judgment about the potential for solar energy and renewable resource measures have been added to the preliminary energy audit requirements in the final rule so this important information is available for State use in preparing State plans for technical assistance and energy conservation measures, including solar energy or other renewable resource measures.

Suggestions were made that DOE expand this section to require the inclusion of such items as blueprints, drawings, and copies of previous reports. Such expansion would add significantly to the cost of the preliminary energy audit with little benefit to the program. Two comments suggested the States be allowed to categorize buildings as they deem most suitable. However, consistency of building categories is necessary to allow DOE to aggregate the data for the nation. One comment recommended the energy use index include consideration of degree days. Again, this would increase the complexity of the preliminary energy audit, the cost of which appears to outweigh the potential benefits. One comment asked that preliminary energy audit reports be published. DOE does not agree this should be made a requirement, but it should be noted the results of the preliminary energy audits will be described in the State plan for technical assistance and energy conservation measures, including solar energy and other renewable resource measures, under the subsequent portion of the overall program. Of course, reports furnished to DOE will be available to the public in accordance with the Freedom of Information Act.

Four comments questioned the requirement for collecting energy use and cost information for the previous twelve month period. Three recommended allowing States discretion for selecting a year consistent with data availability and a potential need for uniformity. DOE accepted the suggestion and modified the text of the final rule accordingly. The forth comment recommended collection of data for at least two years. More extensive data is desirable, but such a requirement would not be consistent with the need to perform preliminary energy audits economically.

Twenty-five comments were received concerning the Btu conversion factors. Most recommended adoption of a point-of-use conversion factor for electricity. As reflected in the proposal, DOE selected a conversion factor for electricity that approximates the energy required to generate and transmit a kilowatt hour of electricity. The conversion factor adopted for use in conducting preliminary energy audits results from comparisons of buildings which indicate that using an index of Btu per square foot can more accurately indicate conservation potential if electricity used is converted to the Btu's at the point of generation. The requirement for use of this conversion factor in the conduct of preliminary energy audits is not intended to preclude the use of different conversion factors for other purposes.

One comment requested DOE provide a list of existing audit techniques which it would consider acceptable for preliminary energy audits or energy audits. However, a determination as to whether the requirements of existing audit techniques are consistent with this rule, and whether the actual work associated with those audits met such requirements is dependent on the particular circumstances involved. States should be able to determine when previously accomplished work conforms to the requirements of this program.

CONTENT OF AN ENERGY AUDIT—The energy audit is a brief on-site survey and analysis of a building, its energy use patterns, identification of opportunities for saving energy through implementation of operating and maintenance changes, and an assessment of its need for implementation of energy conservation measures, including solar energy or other renewable resource measures. The information regarding energy use patterns is the same as that required by a preliminary energy audit, except that it should provide further data needed for analysis of energy conservation potential. In addition, some data elements have been added as a result of concerns expressed by several comments that the proposed rule did not provide an adequate basis for making a judgment about solar or renewable energy resource potential. The identification of operating and maintenance procedure changes which could save energy is important because there are many such actions that can easily be identified and frequently save substantial amounts of energy. Finally, the energy audit is aimed at making an overall estimate of the potential for retrofit and solar or renewable resource applications. Some simple energy conservation measures may be analyzed to obtain an approximation of their costs and benefits. The results of the energy audit, in addition to providing recommendations to owners and managers concerning actions they can take to save energy at little or no cost, also provide basic information which will be used to select buildings to receive technical assistance grants under the later phases of the programs. In this respect, it is extremely important to audit as many buildings as possible because the information gathered serves as a basis for indicating priority of need for technical assistance which rigorously evaluates both solar energy and other conservation actions.

Five comments requested adopting requirements in this section for consideration of specific products or additional operating and maintenance checks. DOE considers it inappropriate to specify consideration of named products, as this might be interpreted as an endorsement. DOE also concluded that expansion of the energy audit requirements would be unduly burdensome. Seven comments suggested the level of detail be reduced or that some items be made optional. DOE considers each item in the requirements for an energy audit to be justified, and some degree of consistency is essential to the effectiveness of the overall program by providing information which can be used to select buildings to receive technical assistance.

Eleven requests for clarification were received concerning subparagraph (b)(1) or § 450.43, which provides a waiver of the need to use the checklist in subparagraph (b)(2). As background, it should be understood that the purpose of this paragraph is to allow institutions which have aggressively pursued energy conservation through changes in operating and maintenance procedures to omit the portion of the energy audit requiring an evaluation of such actions. The 20 percent reduction in energy use specified is not a target which must be met through the energy audit. Neither is it intended that institutions be able to take credit for energy use reductions resulting from weather variances, retrofit actions, or changes in occupancy patterns. It was suggested that DOE set a base year in this section, but DOE is indifferent concerning the base year, so long as factors other than operating and maintenance actions are equivalent in the base year and the year of comparison. This section has been expanded in the final rule to require similarity of weather conditions in the base year and year of comparison.

Two comments asked whether a single specification for the content of an energy audit was appropriate in view of differing code and operational requirements. The requirements are stated in terms of principles which may be applicable to a greater or lesser degree as a result of codes or operating constraints. For example, consideration of lighting levels is required, but obviously the potential reduction differs for a drafting room as compared with a hallway. The applicable code and operating requirements are properly a matter to be covered as an element of State training. Accordingly, DOE has retained the provisions of the proposed rule.

Two comments were directed toward the requirement concerning the plan for scheduled preventive maintenance. The proposed rule, as published, did not reflect DOE's objective merely to require the auditor to examine any existing scheduled preventive maintenance plan. This error has been corrected in the final rule.

Two comments stated objections to the provision that States could add requirements to those in the rule. DOE prefers to retain the provision because it gives States flexibility to consider items not listed which may facilitate the use of programs already in place or allow States to address problems peculiar to their circumstances. However, language has been added to make it clear that such additions shall not be so extensive as to significantly increase the cost of an energy audit.

Three comments asked that DOE establish a dollar limit to distinguish between an operating and maintenance action and a capital improvement. The practical difficulty is that most eligible institutions have their own limits which could vary from $50 to $5,000. In addition, the distinction is not critical to the conduct of an energy audit under these grant programs.

Eleven comments touched on the issue of audits performed without the use of Federal funds. There are no provisions under this program for reimbursement for work performed independently (a point discussed in more detail under the section on cost sharing). However, such audits may satisfy the prerequisite for application for a technical assistance grant, and that aspect of the issue will be addressed in conjunction with the final rule on the technical assistance portion of the overall program. One of the comments, however, went on to suggest that the rule allow any work done using the Public Schools Energy Conservation Survey (PSECS) to be accepted as an energy audit. This cannot be done for several reasons, but primarily because NECPA requirements cannot adequately be addressed short of an on-site examination which PSECS does not require. However, DOE does regard PSECS as a useful tool which can be used by States advantageously in conducting energy audits.

AUDITOR QUALIFICATIONS—The person conducting an energy audit must be familiar with the systems and operations of the type of building to be audited. He or she must also have received State training, or have education and experience such that the State determines training is unnecessary. The energy audit is to be conducted using materials provided by the State. The auditor need not be a professional architect or engineer so long as he or she meets the qualification requirements established by the State.

Seven comments suggested that only professional architects or engineers are qualified to conduct energy audits. Nine comments favored the proposed provision allowing use of technical personnel of less than professional stature. A major objective of those who suggest the use of professional personnel is to do a more thorough energy audit. This is worthwhile, but in many cases it would increase the cost of the energy audit significantly, which in turn would reduce the numbers of institutions which could receive assistance. DOE does not object to the use of professional personnel as such, and those institutions which are willing to pay any extra costs from their own resources should feel free to employ them. It was also suggested that only a professional could properly evaluate complex systems or assume responsibility for changes which could affect health and safety of building occupants. DOE concurs, but such considerations are not within the purview of an energy audit required under this program. Regarding complex systems, it is considered feasible for the energy auditor to identify conditions which could potentially save energy but which require professional judgment and expertise to evaluate. On the health and safety aspect, the results of the energy audit are recommendations only. Implementation is a prerogative of the building owner or manager, and consideration of health and safety implications are normally part of the building owner's or manager's responsibility. Those who supported the language of the proposed rule felt it was important to use their own personnel (except the operator of the building audited) to perform energy audits. DOE agrees, because training to perform energy audits should increase the capacity of the institution to manage its energy resources.

Several related suggestions were made concerning the possible use of engineers or architects as resources which could be called upon by the energy auditor in cases where he or she has a question, as supervisors for energy auditors, or at the State level in the development and implementation of the energy audit programs. DOE has partially adopted the last suggestion by adopting a provision that architects or engineers must be used in conducting auditor training, and further urges States to consider using professionals as resource personnel for supervision of groups of auditors. In a similar vein, two comments favored the use of a team to conduct energy audits, and one asked if the use of a team was a requirement. Since the proposed language would permit States to employ professionals in the manner suggested and allows either an individual or a team to perform the energy audit, DOE has made no change.

Eight comments were received concerning the provision that energy audits be conducted by someone other than the person responsible for the day-to-day operation of the building. Opinion was equally divided between retaining and deleting the provision. Since the accuracy and extent of results from an energy audit depend on questions of whether and when actions are taken in operating the building, it is important to assure objectivity. Therefore, the provision has been retained. However, the provision is not intended to preclude building operators from participating in the audit if they are supervised by the energy auditor.

One comment suggested that the rule state classes of persons who are qualified to perform energy audits. This is a question which is better left to the discretion of the States and the language of the proposed rule has been retained. Another comment questioned whether the rule permitted only the use of "in-house" auditors or if an energy audit could be performed by contractors or State personnel. Any of these arrangements are permitted.

One comment pointed out that more complex buildings might require a more highly qualified auditor and suggested the States should be allowed to set requirements according to the need. Since the proposed rule merely says States will establish auditor qualifications, the approach recommended is permitted.

A question was raised concerning the provision for financial disclosure. This is not intended to prohibit any particular person from performing an energy audit, but only to assure disclosure of any potential biases. Neither does the requirement extend to quantification of a financial interest as in providing a financial statement. In general, if the energy auditor owns, has stock in, or is employed by (1) a firm which provides consulting services in the energy field, (2) a manufacturer of equipment which could save energy, or (3) an energy supplier, that fact should be stated in the audit report.

AUDIT REPORTS—The report on the results of the energy audit is a record of findings and recommendations. A copy of the report is to be submitted to the owner or manager of the building for such action as may be deemed appropriate. The report is also forwarded to the State for its use in managing the program and reporting results.

DOE solicited suggestions on how owners and managers could be encouraged to act on recommendations resulting from energy audits. Four were received, and one that suggested the audit report advise owners and managers that implementation of recommendations would be a factor in considering applications for technical assistance support was incorporated into the final rule.

Information compiled by, or on behalf of, an eligible institution and contained in a preliminary energy audit or energy audit report shall be available for public release unless, in accordance with the Freedom of Information Act, a proper claim of confidentiality is made.

COST OF AN ENERGY AUDIT—The provisions governing cost limits are intended to be used for calculating the maximum amount of Federal assistance available for conducting an energy audit of any given building or complex. The limits were established to define the extent of the work involved and assure equitable treatment of all eligible institutions. They do not preclude States or institutions from spending more than the amounts cited, but all of the funds above these amounts must come from non-Federal sources. The cost limits recognize that more effort is required to audit a large building than a small building, but the scale is not based strictly on gross square feet. This is because a substantial part of the cost of an energy audit is expected to be the training of the energy auditor, and is the same regardless of building size. Also, larger buildings tend to have large sections which are duplicates of one another, so less effort per square foot is required.

Twenty-three comments were received which expressed the opinion the cost limits proposed were too low. Most favored increasing the allowance sufficiently to permit the use of professional personnel to conduct the energy audit. For reasons already discussed, DOE has not adopted that position. Three comments raised points considered valid by DOE. One was that buildings in remote locations could require an additional allowance to provide for the expense of travel. The second was that small institutions having only a few buildings would not be able to prorate the expense of sending an auditor to be trained and still conduct energy audits within the cost limits. Finally, it was suggested that some allowance be made for unusually complex buildings. The final rule incorporates an exception procedure whereby the cost limits can be increased by a State to deal with these circumstances. However, a State may not use more than 15 percent of its allocation in any grant program cycle for such purposes.

Four comments suggested clarification of the provision for a complex, one of which also identified the need for a ceiling on the allowance for a complex. Changes have been made in the final rule in response to these comments.

FINANCIAL ASSISTANCE—The financial assistance section states to whom grants may be awarded.

Six comments suggested the rule provide a mechanism whereby units of local government and public care insititutions could apply directly to DOE for grant assistance. DOE has retained the proposed procedure to promote timely administration of the grant program. This objective can best be assured by allowing each State to process all requests for financial assistance.

COST SHARING—The preliminary energy audit/energy audit program is a matching grant program. This section deals with the requirement for matching funds, an exception procedure, credit to States for certain energy audit program costs and sources of matching funds.

Twenty-three comments were received concerning the provisions governing Federal matches above the 50 percent level. Eight of these wanted the rule to provide for grants in excess of the 50 percent limit for units of local government and public care institutions, as is allowed for schools and hospitals. Such action would go beyond the authority of NECPA. The balance of the comments primarily sought clarification of the manner in which the exception provision operates. An illustration should suffice. Suppose a State's preliminary energy audit and energy audit allocation is $200,000, of which no more than 25 percent, or $50,000, is to be used by the State for conducting preliminary energy audit, providing training of energy auditors and managing the program. Assume further that this State can arrange for matching funds from institutions in the amount of $150,000 to match the amount available to conduct energy audits, but has only $20,000 available for its match and requests a partial waiver of the 50 percent match provision giving as justification that the additional funds can be obtained only through appropriation by the State legislature, and not from any other source, and that the legislature is not scheduled to meet for six months. Should DOE accept this justification, the State would receive a grant of $200,000. Because it did not fully match the $50,000, the amount of the unmatched funds, $30,000, would be deducted from the State's future allocations for technical assistance and energy conservation measures and redistributed to all other States. Because the preliminary energy audit and energy audit program plays a fundamental role in the preparation of State Plans and selection of candidates for technical assistance, as well as providing significant potential energy savings from energy audits, DOE intends to waive the 50% match requirement only where essential to allow States to participate in the program, and then only to the extent clearly justified by the State. Further, any relaxation of the match requirements results in a lesser amount being available to do the audits. In the example above, were the State to make its 50 percent match, there would be $100,000 available instead of $70,000 to cover preliminary energy audits and other State expenses.

Three comments suggested that the goods or services acceptable as an in-kind match be specified in the rule. The omission of such a list was deliberate, and places no restrictions on in-kind contributions other than those imposed by the Office of Management and Budget Circular A-102, dated September 12, 1977 (42 FR 45828), entitled "Uniform Administrative Requirements for Grants-in-Aid to State and Local Governments".

One comment asked whether the match had to be made on each energy audit, or if the State could simply assure the requirement was met on a Statewide basis. The rule requires the match be met on each energy audit to meet requirements of NECPA and to assure equitable distribution of funds among eligible insititutions.

Sixteen comments asked for a change to the provision of the proposed rule concerning credit for work already accomplished. Most wanted a date earlier than November 9, 1978; of these, several mentioned April 20, 1977. Additionally, it was suggested that the provision be broadened to include activities beyond those related to preliminary energy audits. DOE has not adopted the suggestion with regard to the date change. The conference committee report accompanying NECPA indicates that project costs incurred prior to November 9, 1978, are not to be considered eligible for grant funding. Suggestions to broaden coverage of this provision were partially adopted. States may request that the cost of work commenced on or after November 9, 1978, in the conduct of preliminary energy audits and energy audits be counted toward their matching requirements, and the Secretary may allow such requests, when, in her or his judgment, the work has substantially contributed to early achievement of program objectives.

Two comments questioned whether or not medicare and medicaid funds are considered to be derived from other than Federal sources. For purposes of this rule and to the extent that such payments are made as reimbursements for services rendered to individuals, such monies are not considered by DOE to be Federal funds for State matching purposes. DOE recognizes that other situations may occur, as in the case of funds available from Federal loans or payments made in lieu of taxes. DOE will consider these on a case-by-case basis. Six comments requested deletion of the restriction on use of funds from Federal sources entirely. This is not possible because of NECPA limitations.

ALLOCATION OF FUNDS—The allocation of funds section states the method by which DOE will allocate funds among States. There are two separate appropriations, one for schools and hospitals and another for units of local government and public care institutions. A single formula is used, and the amount available to each State is determined by multiplying the allocation factor resulting from the formula by the amount appropriated.

Nineteen comments received pertained to the allocation formula. Most suggested greater weight be placed on climate, especially heating degree days. One objective of the program is to audit as many eligible buildings as possible. Also, climate is not a major consideration with respect to energy savings which may be possible through changes in operating and maintenance procedures. Several related comments recommended modifying the calculation of cooling degree days by raising the base temperature. While in some buildings cooling is not required until the outside temperature reaches 70° or 75°, others require cooling at temperatures well below 65°. For these reasons, DOE did not change the weight given climate, and the 65° base has been retained in the allocation formula.

In the course of investigating the comments on this subject, some errors were discovered in the climate data published in the proposed rule. These have been corrected, and a revised Table 2 is presented below to display the results. Because the data also affect the allocation factor, a revised Table 3 is also presented.

TABLE 2

State	Heating degree (days)	Cooling degree (days)	State share (HDD + CDD)	State share X.2
Alabama	2,695	1,090	0.0135	0.0027
Alaska	12,012	8	0.0340	0.0060
Arizona	2,290	2,624	0.0142	0.0028
Arkansas	3,214	1,802	0.0147	0.0020
California	2,720	680	0.0093	0.0020
Colorado	7,004	353	0.0211	0.0042
Connecticut	6,130	507	0.0191	0.0038
Delaware	4,790	1,021	0.0167	0.0033
District of Columbia	4,750	1,415	0.0177	0.0035
Florida	704	3,390	0.0117	0.0023
Georgia	2,684	1,659	0.0131	0.0026
Hawaii	0	3,526	0.0101	0.0020
Idaho	6,917	416	0.0211	0.0042
Illinois	6,058	950	0.0202	0.0040
Indiana	5,713	952	0.0192	0.0038
Iowa	6,834	870	0.0222	0.0044
Kansas	4,800	1,543	0.0185	0.0037
Kentucky	4,414	1,254	0.0163	0.0033
Louisiana	1,701	2,636	0.0125	0.0025
Maine	8,002	222	0.0237	0.0047
Maryland	4,782	1,015	0.0167	0.0033
Massachusetts	6,232	467	0.0193	0.0039
Michigan	6,739	593	0.0211	0.0042
Minnesota	8,729	473	0.0265	0.0053
Mississippi	2,411	2,223	0.0133	0.0027
Missouri	5,024	1,332	0.0183	0.0037
Montana	8,292	239	0.0245	0.0049
Nebraska	6,347	1,099	0.0214	0.0043
Nevada	4,370	1,500	0.0169	0.0034
New Hampshire	7,535	297	0.0225	0.0045
New Jersey	5,470	877	0.0183	0.0037
New Mexico	4,768	972	0.0165	0.0033
New York	5,890	677	0.0189	0.0038
North Carolina	3,392	1,454	0.0139	0.0028
North Dakota	9,484	421	0.0285	0.0057
Ohio	5,779	797	0.0189	0.0038
Oklahoma	3,508	2,003	0.0158	0.0032
Oregon	5,254	193	0.0157	0.0031
Pennsylvania	5,755	723	0.0186	0.0037
Rhode Island	5,924	445	0.0183	0.0037
South Carolina	2,697	1,885	0.0132	0.0026
South Dakota	7,681	801	0.0244	0.0049
Tennessee	3,801	1,450	0.0151	0.0030
Texas	2,015	2,669	0.0135	0.0027
Utah	6,580	630	0.0207	0.0041
Vermont	7,873	293	0.0235	0.0047
Virginia	4,208	1,113	0.0155	0.0031
Washington	5,752	171	0.0170	0.0034
West Virginia	5,108	849	0.0171	0.0034
Wisconsin	7,531	541	0.0232	0.0046
Wyoming	7,895	326	0.0238	0.0047
American Samoa	0	5,325	0.0153	0.0031
Guam	0	5,011	0.0144	0.0029
Puerto Rico	0	4,907	0.0141	0.0028
Virgin Islands	0	5,427	0.0156	0.0031
U.S. total	270,449	77,280	1.0000	0.2000

TABLE 3

State	.1 × 1/N + .7 × SP/NP + .2 × SC/NC = Allocation factor			
Alabama	.0018	.0118	.0027	.0163
Alaska	.0018	.0012	.0069	.0100
Arizona	.0018	.0073	.0028	.0119
Arkansas	.0018	.0068	.0029	.0115
California	.0018	.0692	.0020	.0729
Colorado	.0018	.0083	.0042	.0143
Connecticut	.0018	.0100	.0038	.0157
Delaware	.0018	.0019	.0033	.0070
District of Columbia	.0018	.0023	.0035	.0078
Florida	.0018	.0271	.0023	.0312
Georgia	.0018	.0160	.0026	.0204
Hawaii	.0018	.0029	.0020	.0067
Idaho	.0018	.0027	.0042	.0087
Illinois	.0018	.0361	.0040	.0419
Indiana	.0018	.0170	.0038	.0227
Iowa	.0018	.0092	.0044	.0155
Kansas	.0018	.0074	.0037	.0129
Kentucky	.0018	.0110	.0033	.0161
Louisiana	.0018	.0123	.0025	.0167
Maine	.0018	.0034	.0047	.0100
Maryland	.0018	.0138	.0033	.0185
Massachusetts	.0018	.0187	.0039	.0243
Michigan	.0018	.0293	.0042	.0353
Minnesota	.0018	.0127	.0053	.0199
Mississippi	.0018	.0076	.0027	.0120
Missouri	.0018	.0154	.0037	.0208
Montana	.0018	.0024	.0049	.0091
Nebraska	.0018	.0050	.0043	.0111
Nevada	.0018	.0020	.0034	.0072
New Hampshire	.0018	.0026	.0045	.0090
New Jersey	.0018	.0236	.0037	.0290
New Mexico	.0018	.0038	.0033	.0089
New York	.0018	.0581	.0038	.0637
North Carolina	.0018	.0176	.0028	.0222
North Dakota	.0018	.0021	.0057	.0096
Ohio	.0018	.0344	.0038	.0400
Oklahoma	.0018	.0089	.0032	.0139
Oregon	.0018	.0075	.0031	.0124
Pennsylvania	.0018	.0381	.0037	.0437
Rhode Island	.0018	.0030	.0037	.0085
South Carolina	.0018	.0092	.0026	.0136
South Dakota	.0018	.0022	.0049	.0089
Tennessee	.0018	.0135	.0030	.0184
Texas	.0018	.0401	.0027	.0446
Utah	.0018	.0039	.0041	.0069
Vermont	.0018	.0015	.0047	.0080
Virginia	.0018	.0162	.0031	.0211
Washington	.0018	.0116	.0034	.0168
West Virginia	.0018	.0059	.0034	.0111
Wisconsin	.0018	.0148	.0046	.0213
Wyoming	.0018	.0013	.0047	.0078
American Samoa	.0018	.0001	.0031	.0050
Guam	.0018	.0003	.0029	.0050
Puerto Rico	.0018	.0095	.0028	.0141
Virgin Islands	.0018	.0003	.0031	.0052
U.S. total	.1000	.7000	.2000	1.0000

While a building census would be the ideal basis for the major factor in the allocation formula, reliable and generally accepted data are not available. DOE is required by NECPA to consider population and climate, and has weighted population most heavily because it is the best available indicator of building numbers. One comment pointed out that more densely populated States are likely to have fewer, but larger, buildings per capita than other States. However, the equal share portion of the formula has a countervailing effect. Another comment suggested increasing the amount to be shared equally, but that would give less populous States far more than an equitable share of the funds on a per capita basis. For these reasons, the allocation formula set forth in the proposed rule has been retained.

SUBMISSION AND REVIEW OF APPLICATIONS—This section states the procedures which shall be used in submitting and processing grant applications under this Subpart.

Six comments stated the time allowed for submission of applications in the first grant program cycle is not sufficient. It would be preferable if circumstances were such that more time could be made available for the preparation and submission of applications. However, NECPA requires that preliminary energy audits be conducted and the results incorporated in State Plans required for later phases of this program shortly after publication of the applicable final rule. The timetable is such that, at best, there are about 120 days available in which to conduct preliminary energy audits. Extending the time for submission of preliminary energy audit/energy audit applications would almost certainly require a later submission of State Plans. The requirement for submission of applications was retained. However, while DOE discourages such requests, both the proposed and final rule provide the States may request and be granted additional time if necessary.

Five comments requested an avenue be established for units of local government and public care institutions to appeal to DOE during the review period when a State application is considered unsatisfactory by such institutions. DOE does not anticipate a need for such a procedure. However, should an eligible institution be aggrieved by any action taken by either a State or DOE with respect to this program, such grievances may be presented to either a State or DOE, or both. Eight other comments suggested strengthening the provisions for consultation with representatives of affected institutions prior to submission of the State application. One recommended that public hearings be required. However desirable and beneficial more extensive consultation might be, the time limits on submitting the application preclude making this requirement more stringent.

Five comments recommended reducing the number of copies of the application required to be submitted. The provision of the proposed rule has been changed to require one instead of ten copies. One comment requested the Governor be allowed to delegate authority to sign the State application. The definition of the term "Governor" includes his designee, so there is no bar to such delegation of authority.

CONTENT OF APPLICATION—The time limit for submitting applications is also reflected in the content of the application. A large part of the application must necessarily be a statement of how the State intends to implement the program, rather than a detailed description of what has been done in preparation. An example of the distinction can be seen in the provision for equitable apportionment of allotted funds among eligible institutions. Because of the time constraints, the application is to describe how the funds are to be apportioned. For example, to assure equitable treatment of rural institutions as compared with urban institutions, a State could indicate it planned to allot funds proportionally to the gross square feet of buildings owned by eligible institutions. Were more time available, the provision would more likely call for the amounts apportioned to each sub-category of eligible institutions. Similarly, the provision requiring disclosure of the sources, amounts, and intended use of non-Federal funds is to be taken as a description of sources of the funds to be obtained by both the State and participating institutions, rather than an identification of institutions by name and the amounts each is to contribute. The information requested in the application is a result of the provisions of NECPA, the requirements of the Office of Management and Budget, and DOE program management requirements. This information is the minimum necessary to provide adequate information on which to base a decision to approve or disapprove an application.

Eight comments were directed toward the provision for conducting preliminary energy audits on a sampling basis. It was recommended that the rule provide the method for sampling. Such guidance is not appropriate for incorporation in the rule. DOE will provide such a methodology to States for their consideration and possible use.

Nine comments suggested DOE set minimum requirements for auditor training. The proposed rule made this primarily a State responsibility since States are best able to deal with a number of significant variables including code requirements, programs already in place, level of qualifications required and the material adopted for conducting energy audits. Accordingly, this provision of the proposed rule has been retained in the final. However, the provision has been expanded to require that States use professional architects or engineers to participate in conducting the training sessions.

Two comments suggested that regional commissions or other coordinating bodies be allowed to apply on behalf of groups of eligible institutions. DOE has no objection to State development and use of such procedures. Such an arrangement must, of course, be acceptable to the affected institutions as well. One comment expressed a general concern about equity of treatment of rural institutions relative to urban institutions. The rule requires States to develop and describe procedures for equitable allocation of funds when resources are insufficient to provide energy audits to all eligible institutions. It will be DOE's responsibility to review the equity aspects of these State procedures.

Two comments objected to allowing States to conduct energy audits or provide services to support the conduct of energy audits as well as making grant funds available to the institutions to conduct the energy audits. It was suggested the rule require States to make grant funds available to eligible institutions. DOE agrees in principle that the intent of these programs is to assure preliminary energy audits and energy audits of eligible institutions, and that making funds available to eligible institutions may be the preferred method for conducting energy audits. At the same time, however, there are circumstances under which a cash payment would be less economical than some alternative method of conducting an energy audit. In other cases, an institution might not have the capability or desire to conduct its own energy audit. Accordingly, language has been added to the rule which requires that a State specify in its application the procedures by which assistance will be provided to institutions willing and able to undertake their own energy audits.

Two comments suggested that States be required to notify institutions of the availability of assistance and the amounts. There is a requirement for a State to institute such a notification as part of its implementation, and this has been made explicit in the final rule. Also, States should plan to use preliminary energy audit and energy audit funds within one year of the date of the notice of grant award, in order that the technical assistance and energy conservation measures phase of the program can be implemented quickly. One comment suggested a requirement that persons administering the program at the State level have at least one year's experience managing a building. DOE prefers to allow States maximum latitude to use personnel having backgrounds which will enable the State to implement the programs quickly and effectively. Therefore, this suggestion was not adopted. One comment raised a question as to whether it is reasonable to require State adoption of specific material, such as a workbook, for the conduct of energy audits before the State application is submitted. This question appears to stem from a misunderstanding of the provision which requires a State to describe the material it intends to adopt to conduct energy audits. Such a description is not considered excessively onerous. A copy of the material finally adopted is required to be submitted with a State's second quarterly report.

USE OF FUNDS—NECPA imposed a number of constraints on the manner in which funds may be used in this program. Other limits such as the requirement that at least 75 percent of the State allocation be used in conducting energy audits, are established by DOE in support of the objectives of the program.

Twenty comments were received concerning the sublimits placed on the use of funds within the 25 percent maximum available to the State for administrative expenses, development of materials, training of personnel, conduct of preliminary energy audits, monitoring and evaluation. There was general agreement the 25 percent limit was appropriate, but several States pointed out that alternative methods of implementation could be used. Depending on the degree of emphasis placed on various activities, some effective and economical methods of implementation might be excluded if the sublimits contained in the proposed rule were retained in the final rule. DOE has reconsidered, and the sublimits have been removed from the final rule. Also, from a number of comments it was clear there was some confusion about whether the costs of training auditors were to be borne by the State or charged to the performance of energy audits. It is intended that the time and expense of the individuals being trained be charged to the expense associated with the performance of energy audits. Only the time and expense of the instructor, and the cost of the materials, space, and related expenses are considered training expenses chargeable to the State. This point is clarified in the final rule.

One comment questioned what level of sampling would be considered adequate in connection with the State responsibility for quality control and follow-up to determine the extent to which recommendations in the energy audit have been implemented. The number chosen for purposes of this monitoring and evaluation sample will depend on variables such as the number of trained auditors available. As a general rule, a sample of between one and five percent should be adequate. Within these limits, the State should select a sample size it considers appropriate to the purpose.

Two comments criticized the limitation on amounts which could be spent for equipment, favoring an increase to $500. The energy audit is not intended to a be a complex procedure, and there should be a little need for expensive equipment. DOE has adopted in the final rule a limit of $300, consistent with the definition of non-expendable personal property contained in the Office of Management and Budget Circular A-102. Moreover, in exceptional situations where a more expensive item can be justified, provision is made to allow a State to request DOE approval for such expenditure.

One comment questioned whether State expenses in preparing an application are allowable expenses under the proposed rule. DOE considers that such expenses may be allowable as part of the State's matching contribution under the provisions of paragraph (c) of section 455.12. Another comment suggested that seasonal use buildings should be eligible for financial assistance under this program. The limitation stems from the language of NECPA and cannot be changed by DOE. One comment recommended a minimum building size or energy use level be established as a requirement to qualify for energy audit assistance. While such a provision would perhaps enable the program to focus more on buildings having a higher potential for saving energy, it does not seem consistent with the concern for equitable treatment of eligible institutions expressed in NECPA. DOE has, therefore, not adopted such a provision. Four comments were received suggesting there is no reason to exclude the administrative buildings of local educational agencies. DOE has reconsidered the provision, and deleted it from the final rule.

REPORT REQUIREMENTS—DOE regards the reporting requirements incorporated in the rule as the minimum necessary for evaluating the program and tracking State progress in meeting its implementation schedule. Reasonably frequent reporting is a necessity because the preliminary energy audit and energy audit phase of the program will be of short duration.

One comment suggested consolidating the reports required under this program with other reports associated with State grant programs. Because there is little, if any, duplication of information anticipated, DOE has not adopted this approach.

COMMENTS RELATIVE TO TECHNICAL ASSISTANCE AND ENERGY CONSERVATION MEASURES—Forty comments were received which touched on matters associated with the proposed rulemaking governing programs for technical assistance and energy conservation measures published January 5, 1979. For example, comments have been received regarding the definition of "energy conservation measure", procedures for applying for a technical assistance grant, and provisions for using energy audits performed without the use of Federal funds to qualify for technical assistance. These comments are being held and will be considered together with other comments received on that proposed rulemaking.

MISCELLANEOUS—There were a number of comments made about various aspects of the program which cannot be adequately addressed in the context of a specific section or provision, but which are worthy of response.

Four comments proposed that the rule be modified to eliminate duplication between the preliminary energy audit and energy audit so that there is only one inspection of a building under this program. DOE does not anticipate an on-site inspection by a trained auditor will be required to obtain the preliminary energy audit information.

Another set of four comments complained of the multiplicity of activities under the term "energy audit". While acknowledging the possibility of confusion, the terms for this program are defined by NECPA. In the development of this regulation, an effort has been made to achieve consistency to the extent possible between this program and others of a similar nature.

Three commenters suggested DOE place limits on itself in terms of time to process State applications. Uncertainties remain, including the prospect that some discussions with the States will be necessary after receipt of applications, which makes the establishment of such time limits impractical. However, State applications will be processed as rapidly as possible.

One commenter requested all information concerning the funds available under the program, the timing and relationship between preliminary energy audits, energy audits, technical assistance, and energy conservation measures be made available as soon as possible. DOE is aware of this need and will make this information broadly available as quickly as possible.

Three comments touched on the possibility of transferring funds from the technical assistance and energy conservation measures phase of the overall program to perform energy audits. Such action is clearly beyond the scope of the NECPA authority.

Three comments asked that DOE incorporate forms and procedures in the final rule. States will be invited by letter to participate in this program, and the forms and procedures will be provided by DOE at that time. Two comments suggested that funds for fiscal years 1978 and 1979 be made available in the initial State allocations. DOE has decided against such a consolidation in the interest of sound fiscal administration. Congress has appropriated $200 and $100 million for schools and hospitals in fiscal years 1978 and 1979, respectively. The amount appropriated for units of local government and public care institutions is $25 and $7 million for fiscal years 1978 and 1979, respectively.

Three comments highlighted an apparent inconsistency between the language of § 455.1 and § 455.11. Section 455.1 is general and applies to both preliminary energy audits and energy audits, and to technical assistance and energy conservation measures, while § 455.11 applies only to preliminary energy audits.

As noted in the preamble to the proposed rule, DOE has proposed a rule on nondiscrimination in Federally assisted programs (10 CFR Chapter X, 43 FR 53658, November 16, 1978). When issued as a final rule, detailed guidance will be provided concerning actions necessary to comply with nondiscrimination requirements in all DOE assistance programs. It will apply to this part under the provisions of section 455.3(b). DOE intends to provide a copy of this final rule to all grant recipients under this program. If the necessary civil rights actions are not taken, the grant will be subject to suspension or termination.

D. Environmental Assessment

DOE prepared an environmental assessment of the entire Title III NECPA programs. Notice of the public availability of that environmental assessment, together with the negative determination of environmental impact reached pursuant to an evaluation of the environmental assessment, was published in the Federal Register on March 12, 1979 (44 FR 13554). The negative determination concluded that the Title III NECPA programs did not constitute major Federal actions significantly affecting the quality of the human environment pursuant to Section 102(2)(C) of the National Environmental Policy Act of 1969, as amended (42 U.S.C. 4321 *et seq.*). No material comments were received during the public comment and review. Consequently, DOE will act in accordance with that negative determination.

In consideration of the foregoing, Part 450 of Chapter II, Title 10 of the Code of Federal Regulations is amended as follows, and a new Part 455 is added to Chapter II, Title 10 of the Code of Federal Regulations as set forth below. In light of NECPA requirements that this regulation be issued within a specific period after enactment, and in consideration of the urgent need to initiate preliminary energy audits, good cause exists to make this regulation effective upon publication, as indicated in the proposed rule, rather than 30 days thereafter as would otherwise be required by the Administration Procedures Act. Accordingly, these amendments and additions shall be effective upon publication in the Federal Register.

Issued in Washington, D.C., March 26, 1979.

Maxine Savitz,

Deputy Assistant Secretary, Conservation and Solar Applications, Department of Energy.

1. In 10 CFR Part 450, the authority is revised as follows:

Authority: Part C of Title III, Energy Policy and Conservation Act, (42 U.S.C. 6321 *et seq.*), as amended by Part B of Title IV, Energy Conservation and Production Act, and Parts G and H of Title III, Energy Policy and Conservation Act, as added by Title III of the National Energy Conservation Policy Act, 92 Stat. 3206 *et seq.*; Department of Energy Organization Act, (42 U.S.C. 7101 *et seq.*)

PART 450—ENERGY MEASURES AND ENERGY AUDITS

§ 450.1 [Amended]

2. 10 CFR 450.1 is amended by designating the provisions of the first sentence as paragraph (a), the second sentence as paragraph (b) and deleting the word "also" following the word "part" in that sentence, and adding a new paragraph (c) as follows:

* * * * *

(c) This part also provides the requirements for the conduct of preliminary energy audits and energy audits in accordance with Section 393 and Section 400 C of the Energy Policy and Conservation Act, Pub. L. 94–163, 42 U.S.C. 6321, as amended by Title III of the National Energy Conservation Policy Act, Pub. L. 95–619, 92 Stat. 3206 *et seq.*

§ 450.2 [Amended]

3. 10 CFR 450.2 is amended to add a new paragraph (d) as follows:

* * * * *

(d) To establish minimum requirements for the preliminary energy audits and energy audits to be carried out under the program of financial assistance for schools and hospitals and the program of financial assistance for units of local government and public care institutions.

§ 450.3 [Amended]

4. 10 CFR 450.3 is amended by deleting the definitions of "Administrator", "Cooling degree-days", "FEA", "Heating degree days", "Regional Administrator" and by adding in the appropriate alphabetical order definitions of "Cooling degree days", "DOE", "Heating degree days", "Regional Representative" and "Secretary" as follows:

* * * * *

"Cooling degree days" means the annual sum of the number of Fahrenheit degrees of each day's mean temperature above 65° for a given locality.

* * * * *

"DOE" means the Department of Energy.

* * * * *

"Heating degree days" means the annual sum of the number of Fahrenheit degrees of each day's mean temperature below 65° for a given locality.

* * * * *

"Regional Representative" means a Regional Representative of the Department of Energy.

* * * * *

"Secretary" means the Secretary of the Department of Energy.

§ 450.21 [Revised]

5. Paragraph (b)(5) of 10 CFR 450.21 is revised to read as follows:

* * * * *

(b) * * *

(5) For the purposes of paragraph (b)(4) of this section, the conversion factors set forth in paragraph (a)(12) of § 450.42 shall be used.

6. 10 CFR Part 450 is amended by establishing a new Subpart E as follows:

Subpart E—Preliminary Energy Audits and Energy Audits

Authority: Title III of the National Energy Conservation Policy Act, Pub. L. 95-619, 92 Stat. 3206 *et seq.*, which establishes Parts G and H of Title III of the Energy Policy and Conservation Act, Pub. L. 94-163, 42 U.S.C. 6321 *et seq.*; Sec. 365(e)(2), 42 U.S.C. 6325(e)(2), of the Energy Conservation and Production Act, Pub. L. 94-385, 42 U.S.C. 3801 *et seq.*; Department of Energy Organization Act, Pub. L. 95-91, 42 U.S.C. 7101 *et seq.*

Subpart E—Preliminary Energy Audits and Energy Audits

§ 450.40 Purpose and scope.

This subpart establishes requirements for the conduct of preliminary energy audits and energy audits, the qualifications of persons conducting them and allowable costs of energy audits. Preliminary energy audits and energy audits are required in the program of financial assistance for schools and hospitals and the program of financial assistance for units of local government and public care institutions, as provided under Subpart B, Part 455, Chapter II of Title 10, Code of Federal Regulations.

§ 450.41 Definitions.

For purposes of this subpart—

"Building" means any structure, the construction of which was completed on or before April 20, 1977, which includes a heating or cooling system, or both.

"Complex" means a closely situated group of buildings on a contiguous site or a closely situated group of buildings served by a central utility plant, such as a college campus or a multi-building hospital.

"Construction completion" means the date of issuance of an occupancy permit for a building.

"Energy audit" means a survey of a building or complex that is conducted in accordance with the requirements of this subpart which—

(1) Identifies the type, size, energy use level and the major energy using systems;

(2) Determines appropriate energy conservation maintenance and operating procedures; and

(3) Indicates the need, if any, for the acquisition and installation of energy conservation measures, including solar energy and other renewable resource measures.

"Energy conservation maintenance and operating procedure" means modifications in the maintenance and operating procedures of a building, and any installations therein, which are designed to reduce energy consumption in such building and which require no significant expenditure of funds.

"Energy conservation measure" means an installation or modification of an installation in a building which is primarily intended to reduce energy consumption or allow the use of an alternative energy source, including, but not limited to—

(1) Insulation of the building structure and systems within the building;

(2) Storm windows and doors, multiglazed windows and doors, heat absorbing or heat reflective glazed and coated windows and door systems, additional glazing, reductions in glass area, and other window and door system modifications;

(3) Automatic energy control systems;

(4) Equipment required to operate variable steam, hydraulic, and ventilating systems adjusted by automatic energy control systems;

(5) Active or passive solar space heating or cooling systems, solar electric generating systems, or any combination thereof;

(6) Active or passive solar water heating systems;

(7) Furnace or utility plant and distribution system modifications including—

(A) Replacement burners, furnaces, boilers, or any combination thereof, which substantially increase the energy efficiency of the heating system;

(B) Devices for modifying flue openings which will increase the energy efficiency of the heating system;

(C) Electrical or mechanical furnace ignition systems which replace standing gas pilot lights; and

(D) Utility plant system conversion measures including conversion of existing oil- and gas-fired boiler installations to alternative energy sources, including coal;

(8) Caulking and weatherstripping;

(9) Replacement or modification of lighting fixtures to increase the energy efficiency of the lighting system without increasing the overall illumination of a building, unless such increase in illumination is necessary to conform to any applicable State or local building code or, if no such code applies, the increase is considered appropriate by the Secretary;

(10) Energy recovery systems;

(11) Cogeneration systems which produce steam or forms of energy such as heat, as well as electricity for use primarily within a building or a complex of buildings owned by a school or hospital and which meet such fuel efficiency requirements as the Secretary may by rule prescribe;

(12) Such other measures as the Secretary identifies by rule for purposes of this part, as set forth in Subpart D of this part; and

(13) Such other measures as a grant application shows will save a substantial amount of energy and as are identified in an energy audit in accordance with Subpart C of this part.

"Fuel" means any commercial source of energy used within the building or complex being surveyed such as natural gas, fuel oil, electricity or coal.

"Gross square feet" means the sum of all heated or cooled floor areas enclosed in a building, calculated from the outside dimensions, or from the centerline of common walls.

"Heating or cooling system" means any mechanical system for heating or cooling areas of a building. For purposes of this subpart, any mechanical system for distributing air throughout the building is considered a cooling system.

"Hospital" means a public or nonprofit institution which is a general hospital, tuberculosis hospital, or any other type of hospital, other than a hospital furnishing primarily domiciliary care; and is duly authorized to provide hospital services under the laws of the State in which it is situated.

"Hospital facilities" means buildings housing a hospital and related facilities, including laboratories, laundries, outpatient departments, nurses' home and training facilities and central service facilities operated in connection with a hospital, and also includes buildings housing education or training facilities for health professions personnel operated as an integral part of a hospital.

"Indian tribe" means any tribe, band, nation, or other organized group or community of Indians, including any Alaska native village, or regional or village corporation, as defined in or established pursuant to the Alaska Native Claims Settlement Act, Pub. L. 92-203; 85 Stat. 688, which (a) is recognized as eligible for the special programs and services provided by the United States to Indians because of their status as Indians; or (b) is located on, or in proximity to, a Federal or State reservation or rancheria.

"Local educational agency" means a public board of education or other public authority or a non-profit institution legally constituted within, or otherwise recognized by, a State for either administrative control or direction of, or to perform administrative services for, a group of schools within a State.

"Maintenance" means activities undertaken in a building to assure that equipment and energy-using systems operate effectively and efficiently.

"Operating" means the operation of equipment and energy-using systems in a building to achieve or maintain specified levels of environmental conditions or service.

"Preliminary energy audit" means a determination of the energy consumption characteristics of a building, including the size, type, rate of energy consumption, and major energy-using systems of such building.

"Public care institution" means a public or non-profit institution which owns—

(1) A facility for long-term care, rehabilitation facility, or public health center, as described in Section 1633 of the Public Health Service Act (42 U.S.C. 300s-3; 88 Stat. 2270);

(2) A residential child care center, which is an institution, other than a foster home, operated by a public or non-profit institution and is primarily intended to provide full-time residential care with an average length of stay of at least 30 days for at least 10 minor persons who are in the care of such institution as a result of a finding of abandonment or neglect or of being persons in need of treatment or supervision.

"Public or nonprofit institution" means an institution owned and operated by—

(1) A State, a political subdivision of a State or an agency or instrumentality of either;

(2) A school or hospital which is, or would be in the case of such entities situated in America Samoa, Guam, Puerto Rico and the Virgin Islands, exempt from income tax under Section 501(c)(3) of the Internal Revenue Code of 1954; or

(3) A unit of local government or a public care institution which is, or would be in the case of such entities situated in America Samoa, Guam, Puerto Rico and the Virgin Islands, exempt from income tax under Section 501(c)(3) or 501(c)(4) of the Internal Revenue Code of 1954.

"School" means a public or nonprofit institution which—

(1) Provides, and is legally authorized to provide, elementary education or secondary education, or both on a day or residential basis;

(2)(A) Provides, and is legally authorized to provide, a program of education beyond secondary education, on a day or residential basis;

(B) Admits as students only persons having a certificate of graduation from a school providing secondary education, or the recognized equivalent of such certificate;

(C) Is accredited by a nationally recognized accrediting agency or association; and

(D) Provides an educational program for which it awards a bachelor's degree or higher degree or provides not less than a two-year program which is acceptable for full credit toward such a degree at any institution which meets the preceding requirements and which provides such a program;

(3) Provides not less than a one-year program of training to prepare students for gainful employment in a recognized occupation and which meets the provisions cited in subdivisions (A), (B), and (C) of subparagraph (2) above; or

(4) Is a local education agency.

"School facilities" means buildings housing classrooms, laboratories, dormitories, athletic facilities, or related facilities operated in connection with a school.

"State" means, in addition to the several States of the Union, the District of Columbia, Puerto Rico, Guam, American Samoa, and the Virgin Islands.

"Unit of local government" means the government of a county, municipality, parish, borough, or township, which is a unit of general purpose government below the State, determined on the basis of the same principles as are used by the Bureau of the Census for general statistical purposes; the District of Columbia, American Samoa, Guam and the Virgin Islands; the recognized governing body of an Indian tribe which governing body performs substantial governmental functions; libraries owned by any of the foregoing; and public libraries which serve all residents of a political subdivision below the State level, such as a community, district or region, free of charge and which derive at least 40 percent of their operating funds from tax revenues of a taxing authority below the State level.

§ 450.42 Contents of a preliminary energy audit.

(a) A preliminary energy audit shall provide a description of the building or complex audited and determine its energy-using characteristics, including—

(1) The name or other identification, and address of the building;

(2) A statement that the building meets the requirements of one of the following categories—

(i) A school facility;

(ii) A hospital facility; or

(iii) A building owned and primarily occupied either by offices or agencies of a unit of local government or by a public care institution, neither of which shall include any building intended for seasonal use or any building used primarily by a school or hospital;

(3) A description of the functional use made of the building identifying whether it is a—

(i) School—

(A) Elementary;

(B) Secondary;

(C) College or university;

(D) Vocational;

(E) Local education agency administrative building; or

(F) Other;

(ii) Hospital—

(A) General;

(B) Tuberculosis; or

(C) Other;

(iii) Local government building—

(A) Office;

(B) Storage;

(C) Service;

(D) Library;

(E) Police station;

(F) Fire station; or

(G) Other, or

(iv) Public care building—

(A) Nursing home;

(B) Long term care other than a nursing home;

(C) Rehabilitation facility;

(D) Public health center; or

(E) Residential child care center;

(4) The name and address of the owner of record, indicating whether owned by a public institution, private nonprofit institution or an Indian tribe;

(5) The size of the building, expressed in gross square feet;

(6) The age of the building;

(7) Approximate daily hours of operation, including periods of partial use if applicable;

(8) An indication of whether the building is partially used during vacation periods or other times when

the building is not fully utilized, for periods of a week or more, by quarter;

(9) *An identification of major energy-using systems, including—*

(i) *Type of heating system or cooling system or both;*

(ii) *Fuel used for heating system, cooling system;*

(iii) Fuel used for domestic hot water, such as electric or natural gas;

(iv) Special energy using systems, such as food service or laundry; and

(v) Lighting, such as incandescent or fluorescent;

(10) Fuel use in physical units and cost data by type for a preceding 12 month period, by month if practicable, using actual data or an estimate if actual figures are unavailable;

(11) Total annual energy use expressed in Btu's per gross square foot and energy cost per gross square foot. Energy use shall be calculated using the *conversion factors set forth below—*

(i) Electricity—11,600 Btu per kilowatt hour.

(ii) Natural gas—1,030 Btu per cubic foot.

(iii) Distillate fuel oil—138,690 Btu per gallon.

(iv) Residual fuel oil—149,690 Btu per gallon.

(v) Coal—24.5 million Btu per standard short ton.

(vi) Liquified petroleum gases including propane and butane—95,475 Btu per gallon.

(vii) Steam—1,390 Btu per pound.

Conversion factors may be taken from engineering reference manuals for fuels not listed.

(b) A preliminary energy audit shall provide a brief description of activities which have been undertaken to conserve energy in the building or complex being audited, including whether—

(1) A person has been designated to monitor and evaluate energy use;

(2) Work partially or fully satisfying the *requirements of an energy audit has* been performed;

(3) Detailed studies have been conducted by architects, engineers or architect-engineer teams of energy use and energy conservation; and

(4) Any major energy conservation measures have been implemented, together with a listing of such measures, and estimates of their costs and energy savings if available.

(c) A preliminary energy audit shall provide information regarding site, building, and heating and hot water systems related to solar energy or other renewable resource potential including—

(1) An indication of whether open land, such as fields, yards and parking *areas, is available within the immediate* vicinity of the building which is not heavily shaded by tall buildings, trees or other obstructions;

(2) *A statement of whether the* building is located generally within an urban, suburban or rural area;

(3) An approximation of whether more than half the building's roof area or southern oriented wall surface is heavily shaded by shrubs, trees, buildings or other obstructions for more than about four hours per day;

(4) The number of stories;

(5) A general description of the building's shape, such as square, rectangular, E-shaped, H-shaped or L-shaped;

(6) An indication of whether the roof is flat or pitched, and if pitched whether it has a southern orientation;

(7) *Whether there are existing roof-top* obstructions, such as chimneys, space *conditioning* equipment, water towers, mechanical rooms, stairwells or other permanent structures;

(8) An indication of the exterior material of the southern facing wall, such as masonry, wood, aluminum;

(9) An approximation of the proportion of glass area of the southern facing wall, such as less than 25 percent, 25–75 percent, more than 75 percent;

(10) Location of primary space heating and water heating systems—

(i) Whether outside of or within the building;

(ii) If within the building, whether on the ground floor, in the basement, or on the roof; and

(iii) If within the building, whether centrally located, in multiple units, or a combination thereof.

§ 450.43 Contents of an energy audit.

(a) An energy audit shall contain the information required for a preliminary energy audit, in accordance with § 450.42, and shall also include a description of—

(1) Major changes in functional use or mode of operation planned in the next fifteen years, such as demolition, disposal, rehabilitation, or conversion from office to warehouse;

(2) For a building in excess of 200,000 gross square feet, if available—

(i) Peak electric demand for both daily and annual cycles; and

(ii) Annual energy use by fuel type of the major mechancial or electrical systems if the information is available or can be reasonably estimated;

(3) Terminal heating or cooling, or both, such as radiators, unit ventilators, *fancoil units, or double-duct reheat* systems;

(4) *Building site and structual* characteristics related to solar energy or other renewable resource potential, including but not limited to—

(i) Climatic factors, specifically—

(A) Average annual heating degree days and cooling degree days;

(B) Average solar insolation by month;

(C) Average monthly wind speed; and

(ii) Roof characteristics, including—

(A) An identification of primary structural component such as steel, wood, concrete; and

(B) Type of roofing material such as shingles, slate, or built-up materials; and

(5) A *description of general building* conditions.

(b) An energy audit shall—

(1) Indicate that appropriate energy conservation maintenance and operating procedures have been implemented for the building, supported by a demonstration based on actual records, that energy use has been reduced in a given year through changes in maintenance and operating procedures, by not less than 20 percent from a corresponding base period having a degree day variance of less than 10 percent; or

(2) Recommend appropriate energy conservation maintenance and *operating procedures, on the basis of an* on-site inspection and review of any *scheduled preventive maintenance plan,* together with a general estimate or range of energy and cost savings if practical, which may result from—

(i) Effective operation of ventilation systems and control of infiltration conditions, including—

(A) Repair of caulking or weatherstripping around windows and doors;

(B) Reduction of outside air intake, shutting down ventilation systems in unoccupied areas, and shutting down ventilation systems when the building is not occupied; and

(C) *Assuring central or unitary* ventilation controls, or both, are *operating properly;*

(ii) Changes in the operation of heating or cooling systems through—

(A) Lowering or raising indoor temperatures;

(B) Locking thermostats;

(C) Adjusting supply or heat transfer medium temperatures; and

(D) Reducing or eliminating heating or cooling at night or at times when a building or complex is unoccupied;

(iii) Changes in the operation of lighting systems through—

(A) Reducing illumination levels;

(B) Maximizing use of daylight;

(C) Using higher efficiency lamps; and

(D) Reducing or eliminating evening cleaning of buildings;

(iv) Changes in the operation of water systems through—

(A) Repairing leaks;

(B) Reducing the quantity of water used, e.g., flow restrictors;

(C) Lowering settings for hot water temperatures;

(D) Raising settings for chilled water temperatures; and

(v) Changes in the maintenance and operating procedures of the utility plant and distribution system through—

(A) Cleaning equipment;

(B) Adjusting air/fuel ratio;

(C) Monitoring combustion;

(D) Adjusting fan, motor, or belt drive systems;

(E) Maintaining steam traps; and

(F) Repairing distribution pipe insulation; and

(vi) Such other actions as the State may determine useful or necessary, consistent with the purposes of the energy audit and acceptable cost constraints of section 450.46.

(c) Based on information gathered under paragraphs (a) and (b) of § 450.42, and paragraphs (a)(1) and (2) of this section, an energy audit shall indicate the need, if any, for the acquisition and installation of energy conservation measures and shall include an evaluation of the need and potential for retrofit based on consideration of one or more of the following—

(1) An energy use index or indices, for example, Btu's per gross square foot per year;

(2) An energy cost index or indices, for example, annual energy costs per gross square foot; or

(3) The physical characterisitics of the building envelope and major energy-using systems.

(d) Based on information gathered under paragraph (c) of § 450.42 and subparagraph (a)(4) of this section, an energy audit shall include an indication of whether building conditions or characteristics present an opportunity for use of solar heating and cooling systems or solar hot water systems.

(e) An energy audit may include an assessment of the estimated costs and energy and cost savings likely to result from the purchase and installation of one or more energy conservation measures.

§ 450.44 Auditor qualifications.

Subject to the approval of the Secretary, a State shall develop procedures for establishing the qualifications of auditors who will conduct energy audits in accordance with Subpart B of 10 CFR Part 455 which—

(a) Ascertain that a person conducting the energy audit is qualified by virtue of successful completion of an approved training program or demonstration of equivalent skills gained by prior training and experience, together with familiarity with the systems and operations of the types of buildings being audited.

(b) Assure that the person responsible for the energy audit is not the person directly responsible for the day-to-day operation of the building being audited.

(c) Assure disclosure by an auditor of her or his financial interests relating to the energy audit or any energy conservation measures, including solar energy or renewable resource measures, reviewed or recommended by the audit.

§ 450.45 Audit reports.

(a) The results of a preliminary energy audit or an energy audit, conducted in accordance with the requirements of this subpart, shall be contained in an audit report. Unless a claim of confidentiality is made by an audited institution based upon a specific provision of the Freedom of Information Act, 5 U.S.C. 552, and both the claim and reason for confidentiality are submitted with the audit report or within 10 days from the date the owner receives the report, an audit report shall be considered public information and will be made available for public review upon request.

(b) Preliminary energy audit reports and energy audit reports shall be furnished to the State, and the owner and operator of the building audited.

(c) An audit report for an energy audit shall include a statement signed by the auditor that—

(1) The auditor meets the applicable qualifications as set forth in § 450.44;

(2) The auditor has indicated any financial interests in accordance with § 450.44; and

(3) The audit was conducted in accordance with the requirements of § 450.43.

(d) The audit report shall state that implementation of energy conservation maintenance and operating procedures are a condition for eligibility for receiving Federal assistance under the technical assistance program, described in 10 CFR Part 455.

§ 450.46 Cost of energy audits.

(a) Except as provided in paragraph (b) of this section, the allowable cost of an energy audit under this program for the purpose of calculating the Federal share thereof, shall not exceed the following—

Building gross square foot	Allowable cost for calculating Federal share
Up to 30,000	$400 00
30,000 to 100,000	$500 00
100,000 and above	$600.00
Complex	(1)

[1] The sum of individual building allowances for the first 150,000 gross square feet, and 80 percent of individual building allowances above 150,000 gross square feet but not to exceed $10,000.

(b) Where necessary, States may increase the allowable cost of a particular energy audit, provided that the total of all such increases does not exceed 15 percent of the applicable State allocation. A State may permit increases for—

(1) The amount necessary to enable personnel from insitutions having few buildings or in remote locations to attend training sessions qualifying them to perform energy audits;

(2) The amount necessary to provide transportation to perform energy audits of buildings in remote locations; and

(3) The amount necessary to conduct energy audits for a building having an unusually complicated system or configuration; however, this increase may not exceed 50 percent of the allowable cost for an individual building.

PART 455—GRANT PROGRAMS FOR SCHOOLS AND HOSPITALS AND BUILDINGS OWNED BY UNITS OF LOCAL GOVERNMENT AND PUBLIC CARE INSTITUTIONS

7. Subchapter D, Chapter II of Title 10 Code of Federal Regulations, is amended by establishing Part 455 as follows:

Subpart A—General Provisions

Sec.

Subpart B—Preliminary Energy Audit and Energy Audit Grant Procedures

Authority: Title III of the National Energy Conservation Policy Act, Pub. L. 95–619, 92 Stat. 3206 *et seq.*, which establishes Parts G and H of Title III of the Energy Policy and Conservation Act, Pub. L. 94–163, (42 U.S.C. 6321 *et seq.*); sec. 365(e)(2), (42 U.S.C. 6325(e)(2), of the Energy Conservation and

Production Act, Pub. L. 94–385, (42 U.S.C. 6801 *et seq.*); Department of Energy Organization Act, Pub. L. 95–91, (42 U.S.C. 7101 *et seq.)*

Subpart A—General Provisions

§ 455.1 Purpose and scope.

(a) This part establishes programs of financial assistance pursuant to Parts 1 and 2 of Title III of the National Energy Conservation Policy Act, Pub. L. 95–619, 92 Stat. 306 *et seq.*, which adds Parts G and H, respectively, to Title III of the Energy Policy and Conservation Act, Pub. L. 94–163, 42 U.S.C. 6321 *et seq.*

(b) This subpart authorizes grants to States or to public or non-profits schools and hospitals to assist them in conducting preliminary energy audits and energy audits, in identifying and implementing energy conservation maintenance and operating procedures and in evaluating, acquiring and installing energy conservation measures, including solar energy or other renewable resource measures, to reduce the energy use and anticipated energy costs of buildings owned by schools, and hospitals.

(c) This subpart also autorizes grants to States or units of local government and public care institutions to assist them in conducting preliminary energy audits and energy audits, in identifying and implementing energy conservation maintenance and oprating procedures and in evaluating energy conservation measures, including solar energy or other renewable resources measures, to reduce the energy use and anticipated energy costs of buildings owned by units of local government and public care institutions.

§ 455.2 Definitions.

"Act", as used in this part, means the Energy Policy and Conservation Act, Pub. L. 94–163, 42 U.S.C. 6321 *et seq., as amended* by the National Energy Conservation Policy Act, Pub. L. 95–619, 92 Stat. 3206.

"Auditor" means any person who is qualified in accordance with 10 CFR 450.44 to conduct an energy audit.

"Building" means any structure, the construction of which was completed on or before April 20, 1977, which includes a heating or cooling system, or both.

"Complex" means a closely situated group of buildings on a continguous site, or a closely situated group fo buildings served by a central utility plant, such as a college campus or a multi-building hospital.

"Construction completion" means the date of issuance of an occupancy permit for a building.

"Cooling degree days" means the annual sum of the number of Fahrenheit degrees of each day's mean temperature above 65° for a given locality.

"DOE" means the Department of Energy.

"Energy audit" means any survey of a building or complex conducted in accordance with the requirements of Subpart E of 10 CFR Part 450.

"Energy conservation maintenance and operating procedure" means modificating in the maintenance and operations of a building, and any installations therein, which are designed to reduce the energy use in such building and which require no significant expenditure of funds.

"Energy conservation measure" means an installation or modification of an installation in a building which is primarily intended to reduce energy consumption or allow the use of an alternative energy source, including, but not limited to—

(1) Insulation of the building structure and systems within the building;

(2) Storm windows and doors, multiglazed windows and doors, heat absorbing or heat reflective glazed and coated windows and door systems, additional glazing, reductions in glass area, and other window and door system modifications;

(3) Automatic energy control systems;

(4) Equipment required to operate variable steam, hydraulic, and ventilating systems adjusted by automatic energy control systems;

(5) Active or passive solar space heating or cooling systems, solar electric generating systems, or any combination thereof;

(6) Active or passive solar water heating systems;

(7) Furnace or utility plant and distribution system modifications including—

(A) Replacement burners, furnaces, boilers, or any combination thereof, which substantially increase the energy efficiency of the heating system;

(B) Devices for modifying flue openings which will increase the energy efficiency of the heating system;

(C) Electrical or mechanical furnace ignition systems which replace standing gas pilot lights; and

(D) Utility plant system conversion measures including conversion of existing oil and gas-fired boiler installations to alternative energy sources, including coal;

(8) Caulking and weatherstripping;

(9) Replacement or modification of lighting fixtures to increase the energy efficiency of the lighting system without increasing the overall illumination of a facility, unless such increase in illumination is necessary to conform to any applicable State or local building code or, if no such code applies, the increase is considered appropriate by the Secretary;

(10) Energy recovery systems;

(11) Cogeneration systems which produce steam or forms of energy such as heat, as well as electricity for use primarily within a building or a complex of buildings owned by an eligible institution and which meet such fuel efficiency requirements as the Secretary may by rule prescribe;

(12) Such other measures as the Secretary identifies by rule for purposes of this part, as set forth in Subpart D of 10 CFR Part 450; and

(13) Such other measures as a grant application shows will save a substantial amount of energy and as are identified in an energy audit in accordance with Subpart C of 10 CFR Part 450.

"Grantee" means the person named in the Notification of Grant Award as the recipient of the grant.

"Grant program cycle" means the period of time specified by DOE which relates to the fiscal year or years for which monies are appropriated for grants under this part, during which one complete cycle of grant activity occurs, including fund allocations to the States, receipt, applications review, approval or disapproval, and grant awards.

"Governor" means the chief executive officer of a State, including the Mayor of the District of Columbia, or a person duly designated in writing by the Governor to act on her or his behalf.

"Heating or Cooling System" means any mechanical systems for heating or cooling conditioned areas of a building. For purposes of this part, any mechanical system for distributing air throughout the building is considered a cooling system.

"Heating degree days" means the annual sum of the number of Fahrenheit degrees of each day's mean temperature below 65° for a given locality.

"Hospital" means a public or nonprofit institution which is a general hospital, tuberculosis hospital, or any other type of hospital, other than a hospital furnishing primarily domiciliary care; and which is duly authorized to provide hospital services under the laws of the State in which it is situated.

"Hospital facilities" means buildings housing a hospital and related facilities, including laboratories, laundries, outpatient departments, nurses' home and training facilities and central service facilities operated in connection with a hospital, and also includes buildings housing education or training facilities for health professions personnel operated as an integral part of a hospital.

"Indian tribe" means any tribe, band, nation, or other organized group or community of Indians, including any Alaska native village, or regional or village corporation, as defined in or established pursuant to the Alaska Native Claims Settlement Act, Pub. L. 92-203; 85 Stat. 688, which (a) is recognized as eligible for the special programs and services provided by the United States to Indians because of their status as Indians; or (b) is located on, or in proximity to, a Federal or State reservation or rancheria.

"Local educational agency" means a public board of education or other public authority or a nonprofit institution legally constituted within, or otherwise recognized by, a State for either administrative control or direction of, or to perform administrative services for, a group of schools within a State.

"Maintenance" means activities undertaken in a building to assure that equipment and energy-using systems operate effectively and efficiently.

"Native American" means a person who is a member of an Indian tribe.

"Operating" means the operation of equipment and energy-using systems in a building to achieve or maintain specified levels of environmental conditions or service.

"Owned" or "Owns" means a property interest, including without limitation a leasehold interest, which is, or shall become, a fee simple title in a building or complex.

"Preliminary energy audit" means any survey of a building or complex conducted in accordance with the requirements of Subpart E, of 10 CFR Part 450.

"Public care institution" means a public or nonprofit institution which owns—

(1) A facility for long-term care, rehabilitation facility, or public health center, as described in Section 1633 of the Public Health Service Act (42 U.S.C. 300s-3; 88 Stat. 2270); or

(2) A residential child care center, which is an institution, other than a foster home, operated by a public or non-profit institution and is primarily intended to provide full-time residential care with an average length of stay of at least 30 days for at least 10 minor persons who are in the care of such institution as a result of a finding of abandonment or neglect or of being persons in need of, treatment or supervision.

"Public or nonprofit institution" means an institution owned and operated by—

(1) A State, a political subdivision of a State or an agency or instrumentality of either; or

(2) A school or hospital which is, or would be in the case of such entities situated in American Samoa, Guam, Puerto Rico, and the Virgin Islands, exempt from income tax under Section 501(c)(3) of the Internal Revenue Code of 1954; or

(3) A unit of local government or public care institution which is, or would be in the case of such entities situated in American Samoa, Guam, Puerto Rico, and the Virgin Islands, exempt from income tax under Section 501(c)(3) or 501(c)(4) of the Internal Revenue Code of 1954.

"School" means a public or nonprofit institution which—

(1) Provides, and is legally authorized to provide, elementary education or secondary education, or both, on a day or residential basis;

(2)(A) Provides, and is legally authorized to provide, a program of education beyond secondary education, on a day or residential basis;

(B) Admits as students only persons having a certificate of graduation from a school providing secondary education, or the recognized equivalent of such certificate;

(C) Is accredited by a nationally recognized accrediting agency or association; and

(D) Provides an educational program for which it awards a bachelor's degree or higher degree or provides not less than a two-year program which is acceptable for full credit toward such a degree at any institution which meets the preceding requirements and which provides such a program;

(E) Provides not less than a one-year program of training to prepare students for gainful employment in a recognized occupation and which meets the provisions cited in subdivisions (A), (B), and (C) of subparagraph (2) above; or

(4) Is a local educational agency.

"School facilities" means buildings housing classrooms, laboratories, dormitories, athletic facilities, or related facilities operated in connection with a school.

"Secretary" means the Secretary of the Department of Energy.

"State" means, in addition to the several States of the Union, the District of Columbia, Puerto Rico, Guam, American Samoa, and the Virgin Islands.

"State energy agency" means the State agency responsible for developing State energy conservation plans pursuant to Section 362 of the Energy Policy and Conservation Act, or, if no such agency exists, a State agency designated by the Governor of such State to prepare and submit the State plan required under Section 394 of the Energy Policy and Conservation Act, as amended by the Energy Conservation and Production Act.

"State hospital facilities agency" means an existing agency which is broadly representative of the public hospitals and the nonprofit hospitals, or, if no such agency exists, an agency designated by the Governor of such State which conforms to the requirements of this definition.

"State school facilities agency" means an existing agency which is broadly representative of public institutions of higher education, nonprofit institutions of higher education, public elementary and secondary schools, nonproft elementary and secondary schools, public vocational education institutions, nonprofit vocational education institutions, and the interests of handicapped persons in a State or, if no such agency exists, an agency which is designated by the Governor of such State which conforms to the requirements of this definition.

"Technical assistance" means a program or activity for (1) the conduct of specialized studies to identify and specify energy savings and related cost savings that are likely to be realized as a result of either modifying maintenance and operating procedures in a building, or both, and (2) the planning or administration of such specialized studies. For States, schools and hosptials, which are eligible to receive grants to carry out energy conservation measures, the term also means the planning or administration of specific remodeling, renovation, repair, replacement, or insulation projects related to the installation of energy conservation, solar energy or renewable resource measures in a building.

"Unit of local government" means the government of a county, municipality, parish, borough, or township, which is a unit of general purpose government below the State, determined on the basis of the same principles as are used by the Bureau of the Census for general statistical purposes; the District of Columbia, American Samoa, Guam, and the Virgin Islands; the recognized governing body of an Indian tribe which governing body performs substantial governmental functions; libraries owned by any of the foregoing; and public libraries which serve all residents of a political subdivision below the State level, such as a community, district or region, free of charge and which derive at least 40 percent of their operating

Production Act, Pub. L. 94–385, (42 U.S.C. 6801 *et seq.*); Department of Energy Organization Act, Pub. L. 95–91, (42 U.S.C. 7101 *et seq.*)

Subpart A—General Provisions

§ 455.1 Purpose and scope.

(a) This part establishes programs of financial assistance pursuant to Parts 1 and 2 of Title III of the National Energy Conservation Policy Act, Pub. L. 95–619, 92 Stat. 308 *et seq.*, which adds Parts G and H, respectively, to Title III of the Energy Policy and Conservation Act, Pub. L. 94–163, 42 U.S.C. 6321 *et seq.*

(b) This subpart authorizes grants to States or to public or non-profits schools and hospitals to assist them in conducting preliminary energy audits and energy audits, in identifying and implementing energy conservation maintenance and operating procedures and in evaluating, acquiring and installing energy conservation measures, including solar energy or other renewable resource measures, to reduce the energy use and anticipated energy costs of buildings owned by schools, and hospitals.

(c) This subpart also autorizes grants to States or units of local government and public care institutions to assist them in conducting preliminary energy audits and energy audits, in identifying and implementing energy conservation maintenance and oprating procedures and in evaluating energy conservation measures, including solar energy or other renewable resources measures, to reduce the energy use and anticipated energy costs of buildings owned by units of local government and public care institutions.

§ 455.2 Definitions.

"Act", as used in this part, means the Energy Policy and Conservation Act, Pub. L. 94–163, 42 U.S.C. 6321 *et seq., as amended* by the National Energy Conservation Policy Act, Pub. L. 95–619, 92 Stat. 3206.

"Auditor" means any person who is qualified in accordance with 10 CFR 450.44 to conduct an energy audit.

"Building" means any structure, the construction of which was completed on or before April 20, 1977, which includes a heating or cooling system, or both.

"Complex" means a closely situated group of buildings on a continguous site, or a closely situated group fo buildings served by a central utility plant, such as a college campus or a multi-building hospital.

"Construction completion" means the date of issuance of an occupancy permit for a building.

"Cooling degree days" means the annual sum of the number of Fahrenheit degrees of each day's mean temperature above 65° for a given locality.

"DOE" means the Department of Energy.

"Energy audit" means any survey of a building or complex conducted in accordance with the requirements of Subpart E of 10 CFR Part 450.

"Energy conservation maintenance and operating procedure" means modificating in the maintenance and operations of a building, and any installations therein, which are designed to reduce the energy use in such building and which require no significant expenditure of funds.

"Energy conservation measure" means an installation or modification of an installation in a building which is primarily intended to reduce energy consumption or allow the use of an alternative energy source, including, but not limited to—

(1) Insulation of the building structure and systems within the building;

(2) Storm windows and doors, multiglazed windows and doors, heat absorbing or heat reflective glazed and coated windows and door systems, additional glazing, reductions in glass area, and other window and door system modifications;

(3) Automatic energy control systems;

(4) Equipment required to operate variable steam, hydraulic, and ventilating systems adjusted by automatic energy control systems;

(5) Active or passive solar space heating or cooling systems, solar electric generating systems, or any combination thereof;

(6) Active or passive solar water heating systems;

(7) Furnace or utility plant and distribution system modifications including—

(A) Replacement burners, furnaces, boilers, or any combination thereof, which substantially increase the energy efficiency of the heating system;

(B) Devices for modifying flue openings which will increase the energy efficiency of the heating system;

(C) Electrical or mechanical furnace ignition systems which replace standing gas pilot lights; and

(D) Utility plant system conversion measures including conversion of existing oil and gas-fired boiler installations to alternative energy sources, including coal;

(8) Caulking and weatherstripping;

(9) Replacement or modification of lighting fixtures to increase the energy efficiency of the lighting system without increasing the overall illumination of a facility, unless such increase in illumination is necessary to conform to any applicable State or local building code or, if no such code applies, the increase is considered appropriate by the Secretary;

(10) Energy recovery systems;

(11) Cogeneration systems which produce steam or forms of energy such as heat, as well as electricity for use primarily within a building or a complex of buildings owned by an eligible institution and which meet such fuel efficiency requirements as the Secretary may by rule prescribe;

(12) Such other measures as the Secretary identifies by rule for purposes of this part, as set forth in Subpart D of 10 CFR Part 450; and

(13) Such other measures as a grant application shows will save a substantial amount of energy and as are identified in an energy audit in accordance with Subpart C of 10 CFR Part 450.

"Grantee" means the person named in the Notification of Grant Award as the recipient of the grant.

"Grant program cycle" means the period of time specified by DOE which relates to the fiscal year or years for which monies are appropriated for grants under this part, during which one complete cycle of grant activity occurs, including fund allocations to the States, receipt, applications review, approval or disapproval, and grant awards.

"Governor" means the chief executive officer of a State, including the Mayor of the District of Columbia, or a person duly designated in writing by the Governor to act on her or his behalf.

"Heating or Cooling System" means any mechanical systems for heating or cooling conditioned areas of a building. For purposes of this part, any mechanical system for distributing air throughout the building is considered a cooling system.

"Heating degree days" means the annual sum of the number of Fahrenheit degrees of each day's mean temperature below 65° for a given locality.

"Hospital" means a public or nonprofit institution which is a general hospital, tuberculosis hospital, or any other type of hospital, other than a hospital furnishing primarily domiciliary care; and which is duly authorized to provide hospital services under the laws of the State in which it is situated.

"Hospital facilities" means buildings housing a hospital and related facilities, including laboratories, laundries, outpatient departments, nurses' home and training facilities and central service facilities operated in connection with a hospital, and also includes buildings housing education or training facilities for health professions personnel operated as an integral part of a hospital.

"Indian tribe" means any tribe, band, nation, or other organized group or community of Indians, including any Alaska native village, or regional or village corporation, as defined in or established pursuant to the Alaska Native Claims Settlement Act, Pub. L. 92–203; 85 Stat. 688, which (a) is recognized as eligible for the special programs and services provided by the United States to Indians because of their status as Indians; or (b) is located on, or in proximity to, a Federal or State reservation or rancheria.

"Local educational agency" means a public board of education or other public authority or a nonprofit institution legally constituted within, or otherwise recognized by, a State for either administrative control or direction of, or to perform administrative services for, a group of schools within a State.

"Maintenance" means activities undertaken in a building to assure that equipment and energy-using systems operate effectively and efficiently.

"Native American" means a person who is a member of an Indian tribe.

"Operating" means the operation of equipment and energy-using systems in a building to achieve or maintain specified levels of environmental conditions or service.

"Owned" or "Owns" means a property interest, including without limitation a leasehold interest, which is, or shall become, a fee simple title in a building or complex.

"Preliminary energy audit" means any survey of a building or complex conducted in accordance with the requirements of Subpart E, of 10 CFR Part 450.

"Public care institution" means a public or nonprofit institution which owns—

(1) A facility for long-term care, rehabilitation facility, or public health center, as described in Section 1633 of the Public Health Service Act (42 U.S.C. 300s-3; 88 Stat. 2270); or

(2) A residential child care center, which is an institution, other than a foster home, operated by a public or non-profit institution and is primarily intended to provide full-time residential care with an average length of stay of at least 30 days for at least 10 minor persons who are in the care of such institution as a result of a finding of abandonment or neglect or of being persons in need of, treatment or supervision.

"Public or nonprofit institution" means an institution owned and operated by—

(1) A State, a political subdivision of a State or an agency or instrumentality of either; or

(2) A school or hospital which is, or would be in the case of such entities situated in American Samoa, Guam, Puerto Rico, and the Virgin Islands, exempt from income tax under Section 501(c)(3) of the Internal Revenue Code of 1954; or

(3) A unit of local government or public care institution which is, or would be in the case of such entities situated in American Samoa, Guam, Puerto Rico, and the Virgin Islands, exempt from income tax under Section 501(c)(3) or 501(c)(4) of the Internal Revenue Code of 1954.

"School" means a public or nonprofit institution which—

(1) Provides, and is legally authorized to provide, elementary education or secondary education, or both, on a day or residential basis;

(2)(A) Provides, and is legally authorized to provide, a program of education beyond secondary education, on a day or residential basis;

(B) Admits as students only persons having a certificate of graduation from a school providing secondary education, or the recognized equivalent of such certificate;

(C) Is accredited by a nationally recognized accrediting agency or association; and

(D) Provides an educational program for which it awards a bachelor's degree or higher degree or provides not less than a two-year program which is acceptable for full credit toward such a degree at any institution which meets the preceding requirements and which provides such a program;

(E) Provides not less than a one-year program of training to prepare students for gainful employment in a recognized occupation and which meets the provisions cited in subdivisions (A), (B), and (C) of subparagraph (2) above; or

(4) Is a local educational agency.

"School facilities" means buildings housing classrooms, laboratories, dormitories, athletic facilities, or related facilities operated in connection with a school.

"Secretary" means the Secretary of the Department of Energy.

"State" means, in addition to the several States of the Union, the District of Columbia, Puerto Rico, Guam, American Samoa, and the Virgin Islands.

"State energy agency" means the State agency responsible for developing State energy conservation plans pursuant to Section 362 of the Energy Policy and Conservation Act, or, if no such agency exists, a State agency designated by the Governor of such State to prepare and submit the State plan required under Section 394 of the Energy Policy and Conservation Act, as amended by the Energy Conservation and Production Act.

"State hospital facilities agency" means an existing agency which is broadly representative of the public hospitals and the nonprofit hospitals, or, if no such agency exists, an agency designated by the Governor of such State which conforms to the requirements of this definition.

"State school facilities agency" means an existing agency which is broadly representative of public institutions of higher education, nonprofit institutions of higher education, public elementary and secondary schools, nonproft elementary and secondary schools, public vocational education institutions, nonprofit vocational education institutions, and the interests of handicapped persons in a State or, if no such agency exists, an agency which is designated by the Governor of such State which conforms to the requirements of this definition.

"Technical assistance" means a program or activity for (1) the conduct of specialized studies to identify and specify energy savings and related cost savings that are likely to be realized as a result of either modifying maintenance and operating procedures in a building, or both, and (2) the planning or administration of such specialized studies. For States, schools and hosptials, which are eligible to receive grants to carry out energy conservation measures, the term also means the planning or administration of specific remodeling, renovation, repair, replacement, or insulation projects related to the installation of energy conservation, solar energy or renewable resource measures in a building.

"Unit of local government" means the government of a county, municipality, parish, borough, or township, which is a unit of general purpose government below the State, determined on the basis of the same principles as are used by the Bureau of the Census for general statistical purposes; the District of Columbia, American Samoa, Guam, and the Virgin Islands; the recognized governing body of an Indian tribe which governing body performs substantial governmental functions; libraries owned by any of the foregoing; and public libraries which serve all residents of a political subdivision below the State level, such as a community, district or region, free of charge and which derive at least 40 percent of their operating funds from tax revenues of a taxing authority below the State level.

§ 455.3 Administration of grants.

(a) Grants provided under this part shall comply with applicable law including, but without limitation, the requirements of—

(1) Federal Management Circular 73-2, 34 CFR Part 251, entitled "Audit of Federal Operations and Programs by Executive Branch Agencies";

(2) Federal Management Circular 74-4, 34 CFR Part 255, entitled "Cost Principles Applicable to Grants and Contracts with State and Local Governments";

(3) Office of Management and Budget Circular A-102, 42 FR 45828, entitled "Uniform Administrative Requirements for Grants-in-Aid to State and Local Governments";

(4) Office of Management and Budget Circular A-110, 41 FR 32016, entitled "Grants and Agreements with Institutions of Higher Education, Hospitals, and Other Nonprofit Organizations";

(5) Office of Management and Budget Circular A-89, entitled "Catalog of Federal Domestic Assistance";

(6) Office of Management and Budget Circular A-97, entitled "Rules and Regulations Permitting Federal Agencies to Provide Specialized or Technical Services to State and Local Units of Government under Title III of the Intergovernmental Coordination Act of 1968";

(7) Treasury Circular 1082, entitled "Notification to States of Grant-in-Aid Information" and

(8) Civil rights requirements of law administered pursuant to the DOE Organization Act and the following public laws. Title VI of the Civil Rights Act of 1964; Section 16 of the Federal Energy Administration Act of 1974; Section 401 of the Energy Reorganization Act of 1974; Title IX of the Higher Education Amendments of 1972; Section 504 of the Rehabilitation Act of 1973; and the Age Discrimination Act of 1975.

(b) Grants provided under this part shall comply with such additional procedures applicable to this part as DOE may from time to time prescribe for the administration of grants.

§ 455.4 Recordkeeping.

Each State or other entity within a State receiving financial assistance under this part shall make and retain records required by DOE, including records which fully disclose the amount and disposition of the financial assistance received; the total cost of the administration and the activities for which assistance is given or used; the source and amount of any funds not supplied by DOE; and any data and information which DOE determines are necessary to protect the interest of the United States and to facilitate an effective financial audit and performance evaluation. The Secretary, or any of her or his duly authorized representatives, shall have access, until three years after the completion of the activities involved, to any books, documents, receipts or other records which the Secretary determines are related or pertinent, either directly or indirectly, to any financial assistance provided under this part.

§ 455.5 Suspension and termination of grants.

The Secretary may suspend or terminate financial assistance under a previously approved application if the Secretary determines the applicant has failed to comply substantially with the terms and conditions set forth in the application and this part. Suspension and termination procedures shall be as set forth in OMB circulars A-102 and A-110 as applicable.

Subpart B—Preliminary Energy Audit and Energy Audit Grant Procedures

§ 455.10 Purpose and scope.

(a) This subpart contains the regulations whereby the Federal Government shall provide financial assistance for preliminary energy audits and energy audits.

(b) Preliminary energy audits are to be performed by States for the purpose of—

(1) Determining the energy use characteristics of eligible school and hospital facilities, and buildings owned by units of local government and public care insitutions, including the size, type, rate of energy use and major energy using systems of such buildings within the State;

(2) Establishing a data base from which reasonably accurate estimates can be made of the number of eligible institutions, the number of qualifying buildings, and patterns of energy conservation needs including an indication of the opportunities for use of solar or other renewable energy sources; and

(3) Assisting States in development of a sound and complete State Plan which is a prerequisite to receipt of financial assistance for technical assistance or energy conservation, measures, including solar energy or other renewable resource measures.

(c) Energy Audits are to be performed by States or elgible schools, hospitals, units of local government and public care institutions for the purpose of—

(1) Determining the energy use characteristics of eligible school and hospital facilities, and buildings owned by units of local government and public care institutions, including the size, type, rate of energy use and major energy using systems of such buildings within the State;

(2) Identifying and encouraging adoption of energy conservation maintenance and operating procedures;

(3) Indicating potential, if any, for acquiring and installing energy conservation measures, including possible use of solar energy or other renewable resources; and

(4) Providing, to the greatest extent practical, consistent information necessary to identify those buildings to receive priority for additional financial assistance.

§ 455.11 Financial assistance.

(a) DOE shall provide financial assistance from sums appropriated only upon application in accordance with the provisions of this subpart.

(b) The Secretary may make grants for purposes of conducting preliminary energy audits and energy audits of school facilities and hospital facilities.

(c) The Secretary may make grants for purposes of conducting preliminary energy audits and energy audits of buildings owned by units of local government and public care insititutions.

§ 455.12 Cost sharing.

(a) Amounts made available under this subpart, together with any other amounts made available from other Federal sources, may not be used to pay more than 50 percent of the costs of a preliminary energy audit or an energy audit, except as provided in paragraph (b) of this section.

(b) The Governor of a State may request a grant of up to 100 percent of the costs of any preliminary energy audit or energy audit for schools or hospitals. When financial assistance in excess of the 50 percent cost share limitation is provided to a State, the sum allocated to that State for technical assistance and energy conservation measures, including solar or other renewable resource measures shall be reduced by an equal amount. Such funds shall be reallocated among all other States on the same basis as the initial allocation. The Secretary may make such a grant if the State has demonstrated that—

(1) The State would otherwise be unable to participate in the program; and

(2) The amount of the additional financial assistance requested is the minimum necessary to allow the State to participate.

(c) Where a State has expended funds without financial assistance under this subpart for the conduct of preliminary energy audits or energy audits commenced on or after November 9, 1978, the Secretary may, upon application and approval under this subpart, accept all or any portion of such expenditures as constituting State matching funds.

(d) To the extent that funds allocated to a State for preliminary energy audits and energy audits are not needed because all potentially eligible buildings have had or will have an energy audit or its equivalent conducted, such funds may be made available for technical assistance or energy conservation measures. DOE shall, upon request by the State, redistribute funds not needed for preliminary energy audits and energy audits to the State allocation for technical assistance or energy conservation measures, as appropriate, and such funds shall be in addition to those which would otherwise be available for such purposes.

(e) Amounts made available from other than Federal sources shall come from State, local, or private sources and shall not be derived from revenue-sharing or any other Federal source, as determined by the Secretary.

§ 455.13 Allocation of funds.

(a) Financial assistance for conducting preliminary energy audits and energy audits of school facilities and hospital facilities shall be allocated among the States by multiplying the sum available by the allocation factor (F).

(b) Financial assistance for conducting preliminary energy audits and energy audits of buildings owned by units of local government and public care institutions shall be allocated among the States by multiplying the sum available by the allocation factor (F).

(c) The allocation factor (F) shall be determined by the formula—

$$F = \left(\frac{.1}{n}\right) + \left(\frac{.7\ SP}{NP}\right) + \left(\frac{.2\ SC}{NC}\right)$$

where, as determined by DOE—

(1) n is the total number of States;

(2) SP is the population of the State, as determined from 1976 census estimates, "Current Population Reports" Series p–25, number 642, or territory as determined from 1973 census estimates, "Current Population Reports", Series p–25, number 603;

(3) NP is 217,820,000, the total population of all States;

(4) SC is the sum of the State's heating and cooling degree days, as determined from National Oceanic and Atmospheric Administration data for the thirty year period, 1941 through 1970; and

(5) NC is 347,729, the sum of all States' heating and cooling degree days.

(d) Financial assistance allocated to a State pursuant to this subpart for a grant program cycle which remains unobligated at the end of the grant program cycle shall, if available, be reallocated under paragraphs (a) or (b) of this section, as appropriate, in the subsequent grant program cycle.

§ 455.14 Submission and review of applications.

(a) To be eligible to receive financial assistance, a State shall complete and submit an original copy of the application to the Secretary. Such application shall be signed by the Governor or his designee.

(b) The first State application shall be submitted not later than 30 days after the effective date of this subpart. Subsequent State applications shall be submitted for each grant program cycle on or before the date established by the Secretary for—

(1) Schools and hospitals;

(2) Buildings owned by units of local government and public care institutions; or

(3) Both.

(c) The State shall consult with representatives of schools, hospitals, units of local government and public care institutions during the preparation of applications for financial assistance for preliminary energy audits and energy audits.

(d) The Governor may request an extension of the submission date for a State's application by sending a written request to the Secretary prior to the date upon which it is due. An extension will only be provided for good cause shown. Such a request shall include a brief discussion of work remaining to be done on the application and time required for its completion. An extension shall not exceed 60 days except where additional time may be required by a State to enact enabling legislation, or where the Secretary finds an additional extension to be consistent with the overall objectives of the Act and the requirements of this subpart.

(e) The Secretary shall review each timely State application and provide financial assistance if the Secretary determines that the application meets the objectives of the Act and the requirements of this subpart.

(f) All or any portion of an application under this section may be disapproved to the extent that funds are not available under this subpart to carry out such application or portion thereof.

(g) The Secretary shall state in writing the reasons any application is disapproved. Applications not approved by the Secretary may be resubmitted by the applicant at any time within the grant program cycle in the same manner as the original application, and the secretary shall approve such resubmitted application if it is found to be in compliance with the requirements of this subpart. Amendments of an application shall, except as the secretary may otherwise provide, be subject to approval in the same manner as the original application.

§ 455.15 Content of applications.

(a) An application shall contain—

(1) The name and mailing address of the proposed State grantee;

(2) A budget which shall include identification of the sources, amounts, and intended use of non-Federal funds required to meet the cost-sharing provisions of section 455.12; and

(3) Assurance that audit procedures to be employed will meet the requirements of Subpart E of 10 CFR Part 450.

(b) For each program for which financial assistance is sought, a State application shall also contain—

(1) A timetable, including a listing of milestones for the activities to be carried out by calendar quarters for each program for which financial assistance will be provided;

(2) A description of materials to be developed and adopted, or an identification of existing materials to be used, to meet the requirements for conducting preliminary energy audits and energy audits set forth in Subpart E of 10 CFT Part 450, including provision of data concerning heating degree days, cooling degree days, insulation, and wind speed for regions within the State;

(3) A description of the training to be provided those persons who will conduct energy audits. Such training shall, at a minimum, use as instructors architects or engineers who have had practical experience in performing energy audits. The minimum qualifications of those attending the training course, and the minimum qualifications of those who will be permitted to perform energy audits

without having attended the training course, shall also be described.

(4) An explanation of how the size of the sample and the selection of sample buildings will be determined in those instances where a sampling methodology is used in the conduct of preliminary energy audits.

(5) A description of the method which will be used to advise eligible institutions of the availability of assistance under this subpart, and the amounts available by categories of institutions as determined under paragraphs (c)(3) and (d)(2) of this section.

(c) A State application for financial assistance to conduct preliminary energy audits and energy audits of school and hospital facilities shall contain—

(1) A description of the procedures the State will use to provide funding or services to those schools and hospitals which are willing and able to conduct their own energy audits;

(2) A justification for any funding applied for in excess of the 50 percent limit provided in paragraph (a) of § 455.12;

(3) A description of the method by which funds will be apportioned between school facilities and hospital facilities, including a justification for the apportionment if fewer than all such facilities will be audited;

(4) An explanation of the manner in which activities to be conducted shall be consistent with—

(i) Related State programs for educational facilities in such State; and

(ii) State health plans under Sections 1524(c)(2) (42 U.S.C. 300m–3; 88 Stat. 2247) and 1603 (42 U.S.C. 300o–2; 88 Stat. 2259) of the Public Health Service Act; and

(5) A description of the actions taken by the State to solicit and consider the views of representatives of schools and hospitals during the preparation of the State's application.

(d) A State application for financial assistance to conduct preliminary energy audits and energy audits of buildings owned by units of local government and public care institutions shall contain a description of—

(1) The procedures the State will use to provide funding or services to those units of local government and public care institutions which are willing and able to conduct their own energy audits.

(2) The method by which funds will be apportioned between buildings owned by units of local government and public care institutions including a justification for the apportionment if fewer than all these buildings will be audited; and

(3) The action taken by the State to solicit and consider the views of representatives of units of local government and public care institutions during the preparation of the State's application.

(e) A State application shall set forth procedures—

(1) By which buildings or complexes eligible for preliminary energy audits and energy audits will be identified, and a listing thereof prepared and maintained.

(2) For the State to participate, on a selective sampling basis, in the performance of on-site energy audits to assure that the findings present a reasonably thorough and accurate assessment of the buildings surveyed; and

(3) For the State to conduct follow-up visits, on a selective sampling basis, to ascertain the degree of implementation of energy audit results.

§ 455.16 Use of funds.

(a) A State shall either carry out preliminary energy audits and energy audits of schools and hospitals, or provide for the conduct of such audits by schools and hospitals, through use of funds which the State has received pursuant to paragraph (b) of § 455.11.

(b) A State shall either carry out preliminary energy audits and energy audits of buildings owned by units of local government and public care institutions, or provide for the conduct of such audits by units of local government and public care institutions, through the use of funds which the State has received pursuant to paragraph (c) of § 455.11.

(c) No financial assistance provided under this subpart shall be expended for—

(1) The audit of—

(i) A vacant, unused or condemned building;

(ii) A stadium which is part of a school facility used primarily for exhibitions for which admission is charged and which is not also generally used for intramural sports and physical fitness programs generally available to all students; or

(iii) A building or complex owned by a unit of local government or a public care institution—

(A) Not primarily occupied by such institution; or

(B) Which is intended for seasonal use; and

(2) The purchase or acquisition of any single piece of equipment or personal or personal property costing more than $300 to be used in conducting preliminary energy audits or energy audits, unless prior written approval has been obtained from DOE.

(d) Of the financial assistance privided to a State under this subpart, not more than 15 percent shall be expended for—

(1) Administrative expenses;

(2) Development of materials for the conduct of preliminary energy audits and energy audits;

(3) Training of personnel to conduct energy audits;

(4) For conducting preliminary energy audits and sample energy audits; and

(5) For monitoring and evaluation.

(e) At least 75 percent of the financial assistance provided under this part shall be used in conducting energy audits of buildings, including costs of personnel attending training sessions conducting by the State preparatory to performing energy audits.

§ 455.17 Reporting requirements.

(a) Each State receiving financial assistance under this part shall submit to DOE to a quarterly program performance report and a quarterly financial statement. The reports shall be submitted to DOE within 15 days following the end of each calendar quarter.

(b) The quarterly program performance report shall include—

(1) For those buildings which have received a preliminary energy audit or an energy audit, a summary of the categories, types of ownership, functional uses, gross square feet and energy use levels; and

(2) For those buildings which have received an energy audit—

(A) An estimae of the savings anticipated from energy conservaion operation and maintenance procedure changes identified; and

(B) An approximation of the energy savings indicated from applicable energy conservation measures if the procedure used by the State results in such information or a summary of the number of buildings for which the energy audit indicates potential for energy conservaion measures, including solar energy and renewable resource measures.

(c) The second quarterly report shall also include—

The total sum required for energy audits of buildings whose owners have been advised of selection to receive an energy audit;

(2) A copy of the materials adopted by the State for conducting energy audits;

(3) The apportionmant of funds pursuant to subparagraphs (c)(3) and (d)(2) of § 455.15 and the data on which such apportionment was based;

(4) The listing of institutions and their buildings compiled pursuant to the provisions of paragraph (e)(1) § 455.15, summarized by category, types of ownership, and functional use;

(5) Any necessary revisions to the estimate of the characteristics and energy conservation potential of buildings owned by eligible insititutions resulting from the sample preliminary energy audits, if a sampling approach was used.

(d) Copies of preliminary energy audit and energy audit reports made by or furnished to the State under § 450.45 of 10 CFR Part 450 shall be submitted to DOE together with the quarterly report.

(e) Reports shall contain such other information as may be required by DOE.

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Part II

Department of Energy

Technical Assistance and Energy Conservation Measures: Grant Programs for Schools and Hospitals and for Buildings Owned by Units of Local Government and Public Care Institutions

DEPARTMENT OF ENERGY

10 CFR Part 455

Technical Assistance and Energy Conservation Measures: Grant Programs for Schools and Hospitals and for Buildings Owned by Units of Local Government and Public Care Institutions

AGENCY: Department of Energy.

ACTION: Final rule.

SUMMARY: The Department of Energy (DOE) is issuing a final regulation for cost sharing grant programs to reduce the energy use and anticipated energy costs for (1) schools and hospitals and (2) buildings owned by units of local government and public care institutions. These objectives are to be achieved by providing financial assistance for identifying energy conservation maintenance and operating procedures; conducting technical assistance programs to identify and evaluate attainable energy conservation objectives; and, for schools and hospitals, acquiring and installing energy conservation measures, including solar and other renewable resource measures. This is the second and final segment of DOE regulations for implementation of programs established pursuant to Title III of the National Energy Conservation Policy Act (NECPA), Pub. L. 95–619, 92 Stat. 3206. The first portion of the programs provides financial assistance for the conduct of preliminary energy audits and energy audits for schools, hospitals, units of local government and public care institutions pursuant to regulations published in the Federal Register on April 2, 1979 (44 FR 19340). Participation in both phases of the programs is voluntary. The Secretary may make grants to schools, hospitals, units of local government and public care institutions for technical assistance programs; to schools and hospitals for energy conservation measures, including solar and other renewable resource measures; and to States for defraying administrative costs.

DATES: This regulation is effective April 17, 1979. States must submit State Plans to the Secretary on or before August 15, 1979. The first grant program cycle for technical assistance and energy conservation measures, including solar and other renewable resource measures, will begin on April 17, 1979 and will end on February 1, 1980.

FOR FURTHER INFORMATION CONTACT:

Michael Willingham, or Ronald Milner, Institutional Buildings Grants Programs Division, Office of Conservation and Solar Applications, Room 4117, 20 Massachusetts Avenue, N.W., Washington, D.C. 20545 (202) 376–4149.

Lewis W. Shollenberger, Jr., or Dennis M. Moore, Office of the General Counsel, Department of Energy, Room 3224, 20 Massachusetts Avenue, N.W., Washington, D.C. 20545 (202) 376–4011.

Mark Friedrichs, Office of Policy and Evaluation, Department of Energy, Room 5316, 1200 Pennsylvania Avenue, N.W., Washington, D.C. 20461 (202) 633–8595.

SUPPLEMENTARY INFORMATION:

I. Introduction

With the issuance of this final regulation, the Department of Energy (DOE) amends Chapter II of Title 10, Code of Federal Regulations, by adding Subparts C through I to Part 455. This regulation fulfills the remaining requirements of Title III of the National Energy Conservation Policy Act (NECPA), Pub. L. 95–619, 92 Stat. 3206, which amended Title III of the Energy Policy and Conservation Act (EPCA), Pub. L. 94–163, 89 Stat. 871, by adding Parts G and H, to establish cost sharing energy conservation grant programs to fund technical assistance programs for schools, hospitals, buildings owned by units of local government and public care institutions, and to fund the acquisition and installation of energy conservation measures, including solar and other renewable resource measures, for schools and hospitals.

On January 5, 1979, DOE published a proposed regulation which described this grant progam and solicited comments from interested persons (44 FR 1580). DOE received and considered 324 written comments and the testimony of 54 persons presented at hearings held in Washington, D.C.; Chicago, Illinois; and Seattle, Washington, on January 22–24, 1979. Summaries of the major comments received, a number of which resulted in changes to the final rule, are discussed below.

On April 2, 1979, DOE published a final regulation implementing the first portion of the energy conservation grant programs established under Title III of NECPA (44 FR 19340). The first portion of these programs will provide financial assistance for the conduct of preliminary energy audits and energy audits to identify buildings suitable for further energy conservation analysis, to identify maintenance and operating changes which could save energy, and to estimate the State-wide need and potential for conserving energy in eligible institutions.

This second portion of the energy conservation grant programs authorized by Title III of NECPA provides financial assistance for schools, hospitals, units of local government and public care institutions and coordinating agencies for conducting technical assistance programs to identify energy and cost savings likely to be realized as a result of modifying maintenance and operating procedures in a building and as a result of implementing energy conservation measures, including solar and other renewable resource measures, in a building. This regulation also provides financial assistance for schools and hospitals and coordinating agencies to acquire and install energy conservation measures to reduce energy consumption or to allow the use of alternative energy sources.

II. Elements of the Program

Initially, a State must formulate a State Plan for the operation of these grant programs and have the State Plan approved by DOE. Upon approval of the State Plan, a State energy agency will receive, review and rank applications for financial assistance for eligible schools, hospitals, units of local government and public care institutions. Applicants must prepare and forward their applications to the State in accordance with this regulation and the approved State Plan. If applications are determined by the State to be eligible for assistance under this regulation and the State Plan, the State will rank all buildings covered by those applications in order of priority for funding. The State will then forward to DOE once each grant program cycle all eligible applications together with its rankings of the buildings covered by those applications. Among other things, the State will also identify those buildings proposed by the State for grant funding, based on the priority ranking, and set forth the funding, by building, recommended for each applicant.

Upon approval of State recommendations, DOE will make grant awards to applicants for up to 50 percent of the cost of a technical assistance program or energy conservation measure. In addition, DOE may make grant awards in excess of 50 percent of total costs to schools or hospitals in a class of severe hardship in amounts recommended by the State in accordance with its State Plan for up to 90 percent of the cost of a technical assistance program or energy conservation measure. The total amount of all such hardship funding in a State may not exceed 10 percent of funds allocated to that State in a grant program cycle.

A State may also receive grants in amounts not exceeding 5 percent of all grants made in a State during a given grant program cycle for the purposes of defraying the costs of administering technical assistance programs and energy conservation measures grants.

III. Notice of Grant Program Cycle

DOE has elected to use "grant program cycles" for all NECPA Title III grant programs. For purposes of making grants for technical assistance programs and energy conservation measures, including solar and other renewable resource measures, the first grant program cycle begins on the date of publication of this regulation. State Plans under this regulation are due 120 days from the beginning of the cycle. For fiscal year 1978, NECPA authorizes appropriations in the amount of $180 million for schools and hospitals and $17.5 million for units of local government and public care institutions. Subject to the availability of these monies, Table 5 presents the amounts allocated to States for the first grant program cycle. Except as may otherwise be specified by the Secretary, this first grant program cycle for technical assistance and energy conservation measures shall end February 1, 1980.

IV. Discussion of Major Comments and Revisions

State Plan Submissions

Sections 394(a) and 400D(a) of EPCA direct the Secretary to invite State energy agencies of each State to submit State plans to DOE within 90 days after the effective date of this regulation. However, the law also permits the establishment of a longer period of time for this purpose if there is "good cause" for such action. Because the final regulation for preliminary energy audits and energy audits has been so recently issued, and since the development of State Plans in great measure depends on the results of the preliminary energy audits conducted in accordance with those final regulations, there is good cause for extending the time in which State Plans may be submitted to DOE. Accordingly, § 455.91 has been revised to permit 120 days, rather than the 90 days proposed, for their submission. This extension should permit States to conduct a sufficient number of preliminary energy audits to insure complete and comprehensive State energy planning.

Eligible Institutions and Buildings

Several comments addressed the range of institutions that may be eligible to receive grant funding. The definitions that determine which institutions are eligible for Federal grant funds are set forth in 10 CFR 455.2. States, as a result of their licensing and oversight authorities with respect to such institutions, are in the best position to apply those definitions to institutions within their jurisdictions when they review and evaluate grant applications.

Comments also addressed the range of buildings that may be eligible for Federal financial assistance. Buildings covered by applications from eligible institutions that house resources for the arts, humanities and for historic preservation (such as libraries, arts centers, etc.) in connection with schools, hospitals, units of local government and public care institutions may be eligible for financial assistance if such buildings conform to the requirements of Part 455. Although buildings owned by local educational agencies and used primarily as administrative buildings are eligible for preliminary energy audit and energy audit funding, such administrative buildings are not eligible for grants for technical assistance programs or energy conservation measures.

Energy Conservation Maintenance and Operating Procedures

An important element of these grants programs is the identification of energy conservation maintenance and operating procedures which require no significant expenditure of funds. The implementation of such procedures, once identified by an energy audit or technical assistance program, should result in substantial energy savings. Therefore, as a prerequisite to further participation in this program, the proposed regulation required applicants to implement all identified energy conservation maintenance and operating procedures prior to submitting a grant application for a technical assistance program or energy conservation measure.

This requirement has been modified in the final regulation to permit applicants to be eligible for technical assistance program or energy conservation measure grants without having implemented all energy conservation maintenance and operating procedures if satisfactory written justification for not implementing any such procedure is provided. Such justification will be considered satisfactory if it demonstrates that implementation of a maintenance and operating procedure recommended by an energy audit report or technical assistance report would violate an applicable health or safety code, would require special training for maintenance or operating personnel which cannot be completed prior to submitting a grant application, or would create other such overriding circumstances that make implementation impractical.

Technical Assistance Analyst Qualifications

NECPA directs that DOE establish factors which may be used by a State in prescribing criteria for identifying persons qualified to conduct technical assistance programs. It is essential that only those individuals possessing the relevant background, training and experience be considered as qualified technical assistance analysts. Therefore the proposed regulation required as a minimum that technical assistance analysts have experience in energy conservation and be registered professional engineers or architect-engineer teams. Numerous comments were received regarding these qualification factors. Among other things, it was suggested that the qualifications were overly restrictive and that they excluded certain groups from participating in the technical assistance phase of the program. Others suggested that States should be responsible for establishing programs for qualifying technical assistance analysts. A number of comments stated that many architects and architectural firms have the necessary experience to perform technical assistance programs, and suggested that architects be permitted to conduct a technical assistance program independently.

It is the intent of this regulation to establish minimum qualifications for technical assistance analysts to insure that participating institutions select individuals or firms able to perform the very complex and detailed technical assistance program. Accordingly, the final regulation specifies that the technical assistance analyst should be a registered professional engineer or, ideally, an architect and an engineer working as a team. However, the final regulation has been modified to permit a State to specify such alternative qualifications as it may deem appropriate and as are included in its approved State Plan. Such alternative qualifications must insure that the technical assistance analyst has sufficient experience and training to perform all of the minimum requirements of a technical assistance program.

An architect-engineer team provides an especially suitable combination of professional skills to perform the comprehensive analysis of the building or buildings required for a technical assistance program. Several comments raised questions concerning the effect of the minimum requirements for technical assistance analysts and the contractual relationship between architectural firms and engineering firms which desire to perform jointly technical assistance programs. No prior relationship is required nor was it DOE's intent to preclude either member of the team, individually, from functioning as the prime contractor for a technical assistance program.

Several comments pointed out that the provision which requires that technical assistance analysts be free from conflicting financial interests may prevent technical assistance analysts from performing the detailed design functions which may be necessary under the energy conservation measures phase of these programs. This provision is intended to exclude those individuals having a financial interest in the products or equipment acquired and installed under an energy conservation measures grant. A State must establish procedures, as a part of its State Plan, to implement these requirements. These procedures must also exclude any other individuals having financial interests which conflict with the proper performance of their duties. This requirement should not be construed to preclude technical assistance analysts from performing detailed design or inspection services under the energy conservation measures phase of these programs.

Technical Assistance Procedures

It is essential that a technical assistance program consist of a thorough survey and analysis of both the building envelope and the building's energy-using systems. A few comments suggested that thermographic inspections of the building be required as part of a technical assistance program. While such methods are a valuable tool in analyzing a building, the final regulation does not specify any methods to be utilized as part of a technical assistance program. It is left to the discretion of the technical assistance analyst to select the methods which, in the analyst's judgment, are the most appropriate for the building which is being analyzed.

Eligible Energy Conservation Measures

Several comments suggested that DOE expand the grant programs for schools and hospitals to fund experimental energy conservation measures. A list of previously demonstrated energy conservation measures, including solar and other renewable resource measures, is set forth in § 455.52. Solar measures eligible for funding include both active and passive solar energy systems, as well as other renewable resource measures. This list is not all inclusive. Other measures identified in a technical assistance program or an energy audit performed pursuant to Subpart C of 10 CFR Part 450, which have an average simple payback of more than 1 year and less than 15 years, may be included in any grant application. A complete description of such measures must accompany the application. The description must include calculations and other technical data which indicate the projected cost and energy savings of such measures. An experimental energy conservation measure for which an applicant cannot adequately project costs and energy savings will not be considered for funding.

Consideration of Solar and Other Renewable Resource Measures

In view of comments received, and due to the desirability of increased utilization of solar energy to reduce consumption of non-renewable energy resources, the final regulation reflects greater emphasis on conversions to solar and other renewable resource systems, where appropriate. Specifically, certain basic data regarding a building's potential for solar applications will be collected during the preliminary energy audit and energy audit phase of the program. Upon analysis of preliminary energy audit data, the State should be able to specify in its State Plan the extent to which, and by which methods, utilization of solar systems will be encouraged within that State. Each technical assistance program must include an evaluation of the building's potential for solar conversion and an identification of any known zoning ordinances and building codes which may place restrictions on or barriers to the installation of solar energy systems. It is intended that, initially, the technical assistance analyst will evaluate the data collected during the preliminary energy audit and energy audit phase of the program. If, upon completion of this initial evaluation, it is determined that the building has potential for conversion to solar or other renewable resource measures, the technical assistance analyst will undertake a more detailed analysis of the costs and energy cost savings associated with the acquisition and installation of such measures.

Leased Equipment

Several comments suggested that the installation and use of equipment which is normally leased, such as computer control systems, qualify as an eligible energy conservation measure. The final regulation has been changed to permit grants for the costs of installing and connecting leased equipment, such as a computer-operated energy monitoring or control system. However, the recurring lease costs associated with leased equipment, which typically include maintenance and service costs, are not eligible for funding. To calculate the simple payback period for leased equipment, the procedure set forth in § 455.52(w) shall be used. This procedure is required to insure that recurring lease costs are considered in the overall evaluation of such a proposed measure.

Starting Date for Eligible Programs and Measures

Several comments requested a change in a provision of the proposed regulation to permit the funding of technical assistance programs and energy conservation measures, including solar and other renewable resource measures, begun prior to November 9, 1978. The conference committee report accompanying NECPA indicates that project costs incurred prior to November 9, 1978 are not to be considered eligible for grant funding. Accordingly, this suggestion has not been adopted. However, expenditures for a technical assistance program commenced on or after November 9, 1978, may be wholly or partially classified by the Secretary as non-Federal funds for the purposes of matching a grant for the acquisition and installation of energy conservation measures identified by such technical assistance program.

Applicant's Submissions to States

A number of comments raised questions concerning the manner in which institutions are to file applications for technical assistance program grants and energy conservation measures grants. The requirements governing applications for grant funds are contained in Subpart E of Part 455 and have been modified only slightly from their proposed form. Since applicants must forward grant applications to a State for review, evaluation and ranking, applicants may also be required to submit their grant applications in conformity with any additional procedures or requirements prescribed by the State in the State Plan. This regulation, however, does not prohibit two or more institutions from submitting a single application to the State. Indeed, DOE encourages States to permit institutions to apply for grant funds through a coordinating agency (such as the State, a State hospital or school facilities agency, or a regional or district organization representing schools or hospitals) which could act as an agent for institutions whose buildings are covered by the coordinating agency's application. The use of coordinating agencies may: (1) Reduce the administrative workload for institutions, (2) introduce economies of scale for applicants, (3) allow institutions, which might otherwise lack the expertise or resources, to participate, and (4) expedite the processing of applications and the administration of the program.

State Evaluation and Ranking of Grant Applications

The State evaluation and ranking requirements set forth in §§ 455.70 and 455.71 elicited a number of comments and requests for clarification. These provisions have been revised primarily to incorporate several suggested changes to the ranking criteria and to clarify the procedure to be used for ranking applications for technical assistance programs and energy conservation measures.

The evaluation and ranking process prescribed by Subpart F requires the State to make two determinations. First, a State will review and evaluate an application to determine whether the applicant is eligible for financial assistance and thus a candidate for inclusion in the State's ranking process. Eligible applicants must conform to all of the requirements of Subparts C, D and E of Part 455, the requirements of the approved State Plan, any State environmental laws, and any other applicable laws or regulations. Applications of schools and hospitals must receive certifications from the State school or hospital facilities agency, as the case may be, in order to be eligible for Federal assistance. This certification process will take place concurrently with the State's evaluation and ranking in a manner such that no unnecessary delay results. An applicant that does not conform to these requirements or that fails to receive certification is not eligible for Federal assistance and its application should be returned immediately to it, together with an explanation of the application's deficiencies.

Second, a State will rank buildings for which an eligible applicant has requested financial assistance to determine, in accordance with the criteria established in its State Plan, which buildings should be recommended for up to 50 percent funding. Although a few comments recommended that States rank metered facilities rather than buildings, DOE has retained the more refined requirement of a building-by-building ranking, since estimated energy consumption for individual buildings can be calculated using standard engineering procedures.

Section 455.71(a) establishes detailed criteria for ranking buildings for technical assistance programs. Buildings will be ranked on the basis of energy conservation potential as indicated by energy audits of those buildings and in accordance with the methods prescribed by the State Plan. Preference will be given to buildings for which an energy audit was completed without the use of Federal funds in the case of buildings having equivalent energy conservation potential

The ranking criteria applicable to energy conservation measures set forth in § 455.71(b) have been modified only slightly to reflect, among other things, a preference for savings of oil over savings of natural gas. Weights for each prescribed criterion will be assigned by the State.

The product of the State ranking process for technical assistance programs and energy conservation measures will be three lists of buildings ranked in order of descending priority based upon the criteria prescribed by § 455.71. There will be a separate list of buildings for technical assistance programs for units of local government and public care institutions, for technical assistance programs for schools and hospitals, and for energy conservation measures for schools and hospitals.

At the request of an applicant for an energy conservation measure grant, a group of buildings may be ranked as a single building if the application requests funding for the acquisition and installation of a single energy conservation measure which directly involves all of the buildings. This permits applicants the option to seek funding for measures that affect more than one building. In such cases, an applicant will submit the average simple payback of the single measure proposed for all of the buildings affected by that measure as well as averaged data for all the buildings for the other ranking criteria. States will rank the buildings covered by such an application based upon those averages.

Within each list, a State will indicate the ranking and the amount of financial assistance requested for each eligible building. The State will also indicate the amount of funding recommended by the State for each building. Where the amount recommended for any building by the State is less than the amount requested by the applicant, the State shall also indicate the reason for such recommendation. Those buildings ranking highest on the list will receive financial assistance within the amount of funds allocated for each State for grants up to 50 percent of eligible costs.

The State will perform two additional reviews of each list of school and hospital buildings. First, the State must assure that neither schools nor hospitals are recommended for more than 70 percent of the total funds allocated for technical assistance programs and energy conservation measures.

Second, the State must evaluate school and hospital buildings for which "severe hardship" claims have been made. With respect to those school and hospital applications requesting such funding, only those applications which would otherwise qualify for grants up to 50 percent may be considered by the State. For such qualified applications, the State must perform a separate evaluation of the relative need of each applicant. The evaluation must be performed in accordance with the procedures established by the State in its State Plan in accordance with the criteria set forth in § 455.72(d)(2). The results of this evaluation will determine the amount of additional Federal funding, in excess of 50 percent, for which each applicant is qualified. After this evaluation has been completed, buildings in a class of severe hardship shall be recommended for funding in descending order of their energy saving potential, determined pursuant to §§ 455.71 (a) and (b). These results will be recorded within each list for schools and hospitals by indicating: (1) The amount of additional hardship funding requested for each building by each application qualified for hardship funding; and (2) the amount of hardship funding recommended by the State based upon relative need, as determined in accordance with its State Plan, to the limit of the hardship funds available.

Requests for hardship funding, as determined by the State and indicated in the State ranking, will be approved by DOE to the extent that the total of all such requests for hardship funding does not exceed 10 percent of the total allocation of funds to the State for schools and hospitals in the applicable grant programs cycle.

Prior to forwarding applications to the Secretary, each State must certify that each institution recommended for funding in any amount has given its assurance that it is willing and able to participate in the program based on the amounts recommended by the State and set forth in the State's ranking of all applications pursuant to § 455.71.

It is anticipated that in some cases the amounts requested by eligible applicants will be less than the total amount allocated to the State in a particular grant program cycle. In such cases, the State is exempt from the ranking requirements of § 455.71. With respect to eligible applications for schools and hospitals, the State is exempt from the ranking requirements only if the total amount requested for grants up to 50 percent is less than or equal to the funds available for such grants and the total amount recommended for hardship funding is less than or equal to the amount reserved by the State for that purpose. Unobligated funds remaining at the close of a grant program cycle will be reallocated, if available, to all States in the succeeding grant program cycle.

Economic Analysis Ranking Factor

NECPA requires that DOE establish criteria for ranking applications for energy conservation measures, including solar and other renewable resource measures. The primary ranking factor selected for this phase of the program is the measure's cost-effectiveness. The proposed regulation specified a simple payback methodology for this ranking factor. A number of comments were received regarding the use of this methodology. Most of the comments indicated that simple payback is not as accurate in determining the cost-effectiveness of a measure as is life-cycle costing. A life-cycle costing methodology considers the time value of money, fuel price escalations and future operating, maintenance and other costs over the life of the building or measure. The use of discounted payback was also suggested. Because simple payback provides only an approximate indication of actual cost-effectiveness, DOE has undertaken the development of a life-cycle costing methodology which it currently plans to adopt for evaluating energy conservation measures under this program. However, this methodology will not be available for use during the first grant program cycle. Therefore, the regulation specifies the use of the simple payback methodology, but encourages institutions to obtain a life-cycle cost analysis for use in their decision-making process for the first grant program cycle.

Several comments were also received regarding the 15-year simple payback period limitation on energy conservation measures, including solar and other renewable resource measures. Comments were approximately balanced between those favoring a shorter payback period limitation and those favoring a longer payback period limitation. Other comments suggested that States be responsible for determining the limitation. No change has been made to the final regulation. The 15-year simple payback limitation on eligible measures approximates the limit that would result if measures were determined to be cost-effective by a life-cycle cost analysis (assuming a 10-percent real discount rate, current fuel price forecasts and a 25-year useful life of the measure or building). Since DOE intends to amend this regulation to substitute life-cycle cost analysis for simple payback, this provision may be deleted at that time.

State Forwarding of Grant Applications

A number of comments suggested changes to the requirement of § 455.72 that States forward grant applications to DOE only once each grant program cycle. Some comments proposed to permit States to forward applications for financial assistance continuously or at several times during the grant program cycle to reduce administrative burdens which might delay the attainment of energy savings. Since NECPA specifically limits the frequency of application submittals, this provision has not been altered. Further, this single submittal is likely to result in a more equitable allocation of the available funds by requiring the simultaneous evaluation of all applications received during a single grant program cycle.

Grant Awards

Several comments requested that the regulations clarify whether additional funding will be available to an applicant in the same or a subsequent grant program cycle to complete a technical assistance program or energy conservation measure that has already been funded by a grant. Section 455.80 has been amended to specify that no additional assistance will be available to fund cost overruns. In order to promote accurate cost calculation and thereby assure that only cost-effective technical assistance programs and energy conservation measures, including solar or other renewable resource measures, receive Federal assistance, DOE shall award only one grant for any technical assistance program or energy conservation measure for any building.

State Administrative Costs

The subject of grant awards to defray State expenses incurred in administration of this program elicited numerous comments from States and institutions. Several comments favored the proposed provision allowing 50 percent matching grants to States in amounts not exceeding 5 percent of all grants awarded to institutions within a State. Some comments, however, suggested awarding such grants as early as possible in the grant program cycle to help cover the significant expenditures required for a State to develop a State Plan and to establish its system for accepting and reviewing grant applications before they are submitted to DOE. It was also suggested that DOE raise the allowable percentage of funding for the States.

DOE still anticipates that 5 percent of the grants awarded within a State will provide the State with adequate funding, when coupled with State matching funds, to administer effectively this phase of the program. However, §§ 455.62 and 455.83 have been revised to permit earlier grant awards for this purpose. As revised, a State may apply for an administrative expense grant concurrently with submission of its State Plan. For subsequent grant program cycles, a State may apply for an administrative expense grant immediately upon publication by DOE of the amounts allocated for among the States for that grant program cycle. Up to 2 percent of the amounts allocated to the State for grants for technical assistance programs and energy conservation measures will be available for administrative expense grants. For the first grant program cycle, DOE plans to award these 2 percent grants for State administrative costs at the time the State Plan is approved.

Subsequent to this initial application for administrative costs, States may forward a second application to DOE during each grant program cycle at the time the State forwards all the grant applications eligible for technical assistance programs and energy conservation measures. At that time, States may apply for an administrative expense grant up to an amount equal to the difference between the initial amount awarded for an administrative expense grant for that grant program cycle and 5 percent of the total of all grants recommended for institutions in that State in the same grant program cycle. All grants for State administrative expenses are subject to the 50 percent matching requirements. The total of all amounts requested to defray State administrative expenses plus the total of all amounts recommended to fund technical assistance programs and energy conservation measures must be less than or equal to the total amount allocated for the State.

The limitations on State administrative expenses set forth in § 455.83 were also revised pursuant to comments received. States' expenses may now include the acquisition of services, such as computer, printing or other services, directly supporting the State's administration of the grant program. In addition, the cost limit on any single item of equipment acquired was raised from $200 to $300. Items costing in excess of $300 may only be purchased with the express consent of the Secretary.

Allocation Formula

The formula established for allocating funds among the States for schools and hospitals and for units of local government and public care institutions is designed to reflect the relative need for financial assistance of each State. The population and climate of each State is considered to be the best indicator of need, because these two factors tend to reflect the number of buildings eligible for assistance and the level of energy use within such buildings, respectively. Total energy use of the eligible institutions within any State is expected to be approximately in direct proportion to the product of these factors. Bureau of Census estimates were used as the basis for all population data. Population-weighted State averages for heating and cooling degree days, as determined by the National Oceanic and Atmospheric Administration, were used to indicate climate. Although heating and cooling degree days do not precisely reflect the different energy requirements of buildings, they are the only indicators of climate currently available on a population-weighted basis for all States. DOE is examining possible alternatives to the use of heating and cooling degree days in response to comments concerning the formula. These alternatives will not be available for use in computing State allocations during the first grant program cycle. If an alternative measure of climate is developed which more precisely reflects actual energy use and the potential for energy conservation, the allocation formula established by these rules will be appropriately amended at that time.

Fuel cost is used in the allocation formula to reflect the special needs of those regions where the price of energy is somewhat higher than the national average. And, finally, a portion of the available funds is allocated equally among all States in order to reflect the minimum requirements necessary to participate in the program and to assure that no State (except the District of Columbia and the eligible territories) receive less than 0.5 percent of the total amounts appropriated, as required by section 398 of EPCA.

A number of comments stated that the formula for allocating funds among States was incorrect and that the allocation factors given in Table 4 of the proposed regulation could not be derived with the data and formula given. The regulations have been changed to clarify the factors in the allocation formula. The denominator of the fuel cost factor is the summation of the fuel cost numerators of all States. The denominator of the population-climate factor is the summation of the population-climate numerators of all States. In addition, there were several errors in the climate data given in Table 3 of the proposed regulation. The correct data for fuel cost, population and climate are set forth below in Tables 1, 2 and 3, respectively. New allocation factors appear in Table 4, and the allocation of funds among States for local government and public care buildings and for schools and hospitals for the first grant program cycle are given in Table 5.

Table 1.—*Oil Import Price: 15.32*

[Demand Region Average Retail Price Summary in 1978 $/Million Btu's]

Sector (fuel)	Demand regions										
	Nw.-Eng.	N.Y./N.J.	Mid-Atl.	S.-Atl.	Midwest	S.-West	Central	N.-Cntrl.	West	N.-West	Total
Residential	5.11	5.66	6.14	7.87	4.56	5.20	4.41	4.10	5.59	4.82	5.39
(Elect.)	13.31	15.91	13.89	11.05	12.00	11.87	12.70	9.65	12.66	5.83	11.71
(Dist.)	3.89	3.97	4.16	4.23	3.78	3.90	3.69	3.87	3.85	3.85	3.93
(LG)	3.90	4.01	4.32	4.32	3.99	3.92	3.91	4.07	3.94	3.94	4.04
(Coal)	2.07	1.95	1.84	1.97	1.75	1.63	1.68	1.37	1.75	1.78	1.82
(NG)	4.53	4.13	3.58	3.15	3.11	2.39	2.11	2.26	3.35	3.65	3.09
Commercial	4.78	6.45	6.45	6.65	5.15	6.02	6.05	5.26	6.85	4.22	5.85
(Elect.)	13.22	17.69	13.31	11.18	11.98	11.26	12.43	8.80	11.71	5.81	12.01
(Dist.)	3.64	3.71	3.76	3.76	3.60	3.64	3.51	3.64	3.56	3.56	3.66
(Resid.)	2.67	2.96	3.27	2.90	3.12	2.97	3.10	3.01	2.92	2.85	2.99
(LG)	3.27	3.27	3.27	3.27	3.49	3.27	3.46	3.47	3.27	3.27	3.30
((Coal)	2.07	1.95	1.84	1.97	1.75	1.63	1.68	1.37	1.75	1.76	1.82
(Asphalt)	3.18	3.18	3.18	3.17	3.20	3.13	3.15	3.19	3.07	3.07	3.15
(NG)	3.86	3.53	3.11	2.63	2.78	2.46	3.46	3.13	2.83	3.05	2.94
Raw material [1]	3.43	3.35	3.18	2.92	3.25	3.27	3.28	3.20	3.08	2.92	3.22
(LG)	3.61	3.61	3.61	3.58	3.59	3.54	3.52	3.56	3.44	3.44	3.54
(Oil)	3.18	3.18	3.18	3.17	3.20	3.13	3.15	3.19	3.07	3.07	3.15
(NG)	3.29	2.83	2.69	2.19	2.44	2.16	3.10	2.65	2.44	2.37	2.33
Industrial [3]	4.86	4.54	3.92	4.98	3.86	2.98	4.79	3.16	3.85	3.28	3.79
(Elect.)	10.97	9.47	10.97	9.40	9.37	9.57	10.55	7.30	9.96	3.86	9.29
(Dist.)	3.64	3.69	3.86	3.85	3.60	3.63	3.50	3.68	3.56	3.56	3.67
(Resid.)	2.92	3.06	3.19	2.87	3.10	2.96	3.07	2.98	2.92	2.97	2.99
(LG)	3.66	3.74	3.95	3.96	3.82	3.70	3.76	3.85	3.69	3.69	3.79
(Coal)	2.07	1.95	1.84	1.97	1.75	1.63	1.68	1.37	1.75	1.78	1.76
(Met Coal [2])	2.18	2.08	1.97	2.10	2.02	2.12	1.95	2.21	2.59	2.70	2.03
(Naphtha)	3.61	3.61	3.61	3.58	3.59	3.54	3.52	3.56	3.44	3.44	3.56
(NG)	3.29	2.83	2.69	2.24	2.44	2.16	3.10	2.65	2.44	2.37	2.31
Transportation	5.74	5.79	5.67	5.63	5.67	5.22	5.52	5.49	5.38	5.42	5.55
(Elect.)	12.44	14.25	12.35	10.33	10.61	10.64	11.74	8.59	11.37	4.96	13.22
(Dist.)	4.79	4.84	5.00	4.99	4.75	4.77	4.65	4.82	4.71	4.71	4.82
(Resid.)	2.92	3.06	3.19	2.87	3.10	2.96	3.07	2.96	2.92	2.97	2.99
(LG)	3.27	3.27	3.27	3.27	3.49	3.27	3.46	3.47	3.27	3.27	3.31
(Gasoline)	6.05	6.27	6.03	5.94	5.96	5.73	5.83	5.87	6.01	6.02	5.96
(Jet Fuel)	4.12	4.23	4.49	4.54	4.05	4.16	3.93	4.16	4.10	4.10	4.22
Average price	5.16	5.62	5.08	5.76	4.67	3.83	5.01	4.40	5.11	4.42	4.82

[1] Liquid gas in the raw material sector includes liquid gas feedstock.
[2] Met Coal includes 70% premium coal and 30% bituminous low sulfur coal.
[3] Industrial sector here does not include refineries.

Source: Energy Information Administration. Prepared for the Administrator's Annual Report, 1977 (1985 Series C projections).

Table 2

State	Population (in thousands)
Alabama	3,665
Alaska	382
Arizona	2,270
Arkansas	2,109
California	21,520
Colorado	2,583
Connecticut	3,117
Delaware	582
Dist. of Columbia	702
Florida	8,421
Georgia	4,970
Hawaii	887
Idaho	831
Illinois	11,229
Indiana	5,302
Iowa	2,870
Kansas	2,310
Kentucky	3,428
Louisiana	3,841
Maine	1,070
Maryland	4,144
Massachusetts	5,809
Michigan	9,104
Minnesota	3,965
Mississippi	2,354
Missouri	4,778
Montana	753
Nebraska	1,553
Nevada	610
New Hampshire	822
New Jersey	7,336
New Mexico	1,168
New York	18,084
North Carolina	5,469
North Dakota	643
Ohio	10,690
Oklahoma	2,766
Oregon	2,329
Pennsylvania	11,862
Rhode Island	927
South Carolina	2,848
South Dakota	686
Tennessee	4,214
Texas	12,487
Utah	1,228
Vermont	478
Virginia	5,032
Washington	3,612
West Virginia	1,821
Wisconsin	4,609
Wyoming	390
American Samoa	28
Guam	100
Puerto Rico	2,951
Virgin Islands	83
U.S. total	217,820

Table 3

State	Heating degree days	Cooling degree days
Alabama	2,695	1,999
Alaska	12,012	8
Arizona	2,298	2,624
Arkansas	3,214	1,892
California	2,728	669
Colorado	7,004	336
Connecticut	6,130	507
Delaware	4,780	1,021
Dist. of Columbia	4,750	1,415
Florida	704	3,368
Georgia	2,684	1,859
Hawaii	0	3,528
Idaho	6,917	415
Illinois	6,058	950
Indiana	5,713	952
Iowa	6,834	876
Kansas	4,900	1,543
Kentucky	4,414	1,254
Louisiana	1,701	2,638
Maine	8,002	222
Maryland	4,782	1,015
Massachusetts	6,232	487
Michigan	6,739	593

Table 3—Continued

State	Heating degree days	Cooling degree days
Minnesota	8,729	473
Mississippi	2,411	2,223
Missouri	5,024	1,332
Montana	8,292	239
Nebraska	6,347	1,099
Nevada	4,370	1,500
New Hampshire	7,535	297
New Jersey	5,470	877
New Mexico	4,768	972
New York	5,899	677
North Carolina	3,392	1,454
North Dakota	9,484	421
Ohio	5,779	797
Oklahoma	3,508	2,003
Oregon	5,254	193
Pennsylvania	5,755	723
Rhode Island	5,924	445
South Carolina	2,697	1,885
South Dakota	7,681	801

Table 3—Continued

State	Heating degree days	Cooling degree days
Tennessee	3,801	1,455
Texas	2,015	2,880
Utah	6,580	630
Vermont	7,873	293
Virginia	4,286	1,113
Washington	5,752	171
West Virginia	5,108	840
Wisconsin	7,531	541
Wyoming	7,895	328
American Samoa	0	5,325
Guam	0	5,011
Puerto Rico	0	4,807
Virgin Islands	0	
		5,427
U.S. Total	270,449	77,280

Table 4

State	0.07/n+0.1(Sfc)/Nfc+0.83(SP)(SC)/(NPC)=Allocation Factor			
Alabama	.0013	.0021	.0112	.0146
Alaska	.0013	.0016	.0030	.0059
Arizona	.0013	.0019	.0073	.0104
Arkansas	.0013	.0014	.0070	.0097
California	.0013	.0019	.0476	.0507
Colorado	.0013	.0016	.0123	.0152
Connecticut	.0013	.0019	.0135	.0166
Delaware	.0013	.0019	.0022	.0053
Dist. of Columbia	.0013	.0019	.0028	.0060
Florida	.0013	.0021	.0223	.0257
Georgia	.0013	.0021	.0147	.0181
Hawaii	.0013	.0019	.0020	.0052
Idaho	.0013	.0016	.0040	.0069
Illinois	.0013	.0017	.0512	.0542
Indiana	.0013	.0017	.0230	.0260
Iowa	.0013	.0018	.0144	.0175
Kansas	.0013	.0018	.0097	.0128
Kentucky	.0013	.0021	.0126	.0160
Louisiana	.0013	.0014	.0108	.0135
Maine	.0013	.0019	.0057	.0089
Maryland	.0013	.0019	.0156	.0188
Massachusetts	.0013	.0019	.0253	.0285
Michigan	.0013	.0017	.0434	.0464
Minnesota	.0013	.0017	.0237	.0267
Mississippi	.0013	.0021	.0071	.0105
Missouri	.0013	.0018	.0198	.0229
Montana	.0013	.0016	.0042	.0071
Nebraska	.0013	.0018	.0075	.0106
Nevada	.0013	.0019	.0023	.0055
New Hampshire	.0013	.0019	.0042	.0074
New Jersey	.0013	.0021	.0303	.0336
New Mexico	.0013	.0014	.0044	.0070
New York	.0013	.0021	.0774	.0807
North Carolina	.0013	.0021	.0172	.0206
North Dakota	.0013	.0016	.0041	.0070
Ohio	.0013	.0017	.0457	.0487
Oklahoma	.0013	.0014	.0099	.0126
Oregon	.0013	.0016	.0083	.0112
Pennsylvania	.0013	.0019	.0500	.0531
Rhode Island	.0013	.0019	.0038	.0070
South Carolina	.0013	.0021	.0085	.0119
South Dakota	.0013	.0016	.0038	.0067
Tennessee	.0013	.0021	.0144	.0178
Texas	.0013	.0014	.0381	.0407
Utah	.0013	.0016	.0058	.0087
Vermont	.0013	.0019	.0025	.0057
Virginia	.0013	.0019	.0177	.0208
Washington	.0013	.0016	.0139	.0168
West Virginia	.0013	.0019	.0071	.0102
Wisconsin	.0013	.0017	.0242	.0272
Wyoming	.0013	.0016	.0021	.0050
American Samoa	.0013	.0019	.0001	.0032
Guam	.0013	.0019	.0003	.0035
Puerto Rico	.0013	.0021	.0094	.0128
Virgin Islands	.0013	.0021	.0003	.0038
U.S. Total	.0700	.1000	.8300	1.0000

Table 5

State	Allocation Factor	Schools & [1] Hospitals	Units of Local [1] Government & Public Care Institutions
Alabama	.0146	$2,625,625	$255,269
Alaska	.0059	1,059,528	103,010
Arizona	.0104	1,876,158	182,404
Arkansas	.0097	1,744,065	169,562
California	.0507	9,130,947	887,731
Colorado	.0152	2,741,280	266,513
Connecticut	.0166	2,994,044	291,088
Delaware	.0053	960,830	93,414
Dist. of Columbia	.0060	1,072,309	104,252
Florida	.0257	4,627,242	449,871
Georgia	.0181	3,255,298	316,487
Hawaii	.0052	933,898	90,796
Idaho	.0069	1,235,391	120,107
Illinois	.0542	9,756,588	948,557
Indiana	.0260	4,677,807	454,787
Iowa	.0175	3,152,824	306,525
Kansas	.0128	2,304,189	224,018
Kentucky	.0160	2,886,435	280,628
Louisiana	.0135	2,434,027	236,642
Maine	.0089	1,601,455	155,697
Maryland	.0188	3,379,453	328,558
Massachusetts	.0285	5,129,224	498,675
Michigan	.0464	8,357,619	812,546
Minnesota	.0267	4,812,300	467,863
Mississippi	.0105	1,888,195	183,575
Missouri	.0220	4,118,238	400,384
Montana	.0071	1,272,836	123,748
Nebraska	.0106	1,915,307	186,210
Nevada	.0055	986,773	95,936
New Hampshire	.0074	1,324,786	128,799
New Jersey	.0336	6,055,483	588,728
New Mexico	.0070	1,267,691	123,248
New York	.0807	14,531,860	1,412,820
North Carolina	.0206	3,714,978	361,178
North Dakota	.0070	1,266,401	123,122
Ohio	.0487	8,773,116	852,942
Oklahoma	.0126	2,268,269	220,526
Oregon	.0112	2,007,741	195,197
Pennsylvania	.0531	9,568,916	930,117
Rhode Island	.0070	1,262,250	122,719
South Carolina	.0119	2,139,013	207,960
South Dakota	.0067	1,201,941	116,855
Tennessee	.0178	3,206,416	311,735
Texas	.0407	7,334,243	713,051
Utah	.0087	1,557,500	151,424
Vermont	.0057	1,025,966	99,747
Virginia	.0208	3,747,870	364,378
Washington	.0168	3,027,809	294,370
West Virginia	.0102	1,836,072	178,507
Wisconsin	.0272	4,896,400	476,039
Wyoming	.0050	895,907	87,102
American Samoa	.0032	584,782	56,854
Guam	.0035	626,017	60,863
Puerto Rico	.0128	2,297,382	223,357
Virgin Islands	.0036	653,839	63,568
U.S. Total	1.0000	180,000,100	17,499,950

[1] Allocations are subject to availability of funds.

Several comments expressed doubt as to whether the formula set forth in § 455.101, allocating appropriations among the States, conformed to the requirements of sections 398 and 400H of EPCA. The formula fully complies with the requirements of the law. Pursuant to section 400H of EPCA, the Secretary must allocate grants for units of local government and public care institutions among the States based upon the population and climate of each State and such other factors as the Secretary deems appropriate. The Secretary must also assure that the funds appropriated for grants to schools and hospitals are allocated among the States on the basis of a formula to be prescribed by rule in accordance with the provisions of section 398 of EPCA. Since population and climate factors are to be the principal basis for allocating funds for schools and hospitals, as well as for units of local government and public care institutions, DOE has determined that it is equitable and appropriate to use the same formula for allocating among the States all funds appropriated under Title III for technical assistance programs and energy conservation measures. In conformity with the requirements of section 398 of EPCA, 10 percent of the amounts available will be allocated taking into account energy costs. Another 80 percent of the amounts available will be allocated taking into account the population and climate of each State. DOE has decided to allocate the remaining 10 percent of the available funds so that 7 percent will be divided equally among all States and the remaining 3 percent will be allocated on the basis of population and climate, bringing the total percentage allocated on the basis of population and climate to the 83 percent figure set forth in § 455.101. This formula is used to assure that no eligible State receives less than 0.5 percent of the funds allocated among the States.

The additional requirement to allocate 10 percent of the total available for schools and hospitals determined to be in a class of severe hardship (for additional financial assistance in excess of the 50 percent Federal share, up to 90 percent of the costs of technical assistance programs and energy conservation measures) is satisfied by the requirement that each State reserve 10 percent of its allocation for schools and hospitals each year to provide this additional financial assistance.

State and Grantee Reporting Requirements

Sections 455.63 and 455.73 have been revised in the final regulation to include the requirement that States and grantees which have received financial assistance for energy conservation measures submit regular reports on energy use. These reports are intended to indicate the energy use reductions that have been realized as a result of energy conservation maintenance and operating procedures and energy conservation measures. This requirement was added to insure that the States and DOE have available accurate information on the actual energy savings resulting from these programs. Further, these reports will encourage participating institutions to establish sound, ongoing energy management practices. An essential ingredient of any effective energy management program is the monitoring of actual energy use levels. These practices are expected to provide significant long-term benefits to institutions in maintaining efficient operations. Grantees will submit reports annually to the States. The States will summarize the reports submitted by the grantees and report the results to DOE in an annual report. Data and information contained in the reports prepared by the grantees will be collected and maintained on a monthly basis or for a period consistent with the billing cycle associated with the relevant fuel type. This reporting requirement will apply for three years or for the life of these programs, whichever is shorter.

Comments DOE Could Not Incorporate

DOE received many comments in response to the notice of proposed rulemaking which suggested revisions to the regulation which the Department was unable to incorporate in the final regulation. These comments included suggestions to: eliminate the matching funds requirement; fund energy conservation measures for units of local government and public care institutions; permit the funding of administrative buildings owned by local education agencies; alter or eliminate the requirement for conformity with the provisions of the Davis-Bacon Act; fund technical assistance programs and energy conservation measures commenced prior to November 9, 1978; eliminate the requirement that funds not obligated be reallocated in the next grant program cycle; and permit units of local government and public care institutions to qualify for hardship funding. Each of these comments proposes a revision to a specific requirement of NECPA. Thus, DOE could not and did not incorporate these comments in this regulation.

V. Additional Information

Environmental Assessment

DOE prepared an environmental assessment of the entire Title III NECPA programs. Notice of the public availability of that environmental assessment, together with the negative determination of environmental impact reached pursuant to an evaluation of the environmental assessment, was published in the Federal Register on March 12, 1979 (44 FR 13554). The negative determination concluded that the programs established by Title III of NECPA did not constitute major Federal actions significantly affecting the quality of the human environment pursuant to Section 102(2)(C) of the National Environmental Policy Act of 1969 (NEPA), as amended (42 U.S.C. 4321 *et seq.*). No material comments were received during the public comment period. Consequently, DOE has finalized, and will act in accordance with, that negative determination.

Regulatory Analysis and Effective Date

The proposed regulation was reviewed in accordance with Executive Order 12044, 43 FR 12661, and was determined to be a "significant regulation" likely to have a "major impact." The proposed regulation was also reviewed in accordance with OMB Circular A-116 and was determined to be a major policy and program initiative.

In consideration of the rapid depletion of the Nation's nonrenewable energy resources and the short-term statutory deadline for issuance of regulations implementing NECPA Title III programs, the Under Secretary of DOE has determined that it is contrary to the public interest to delay issuance of this regulation for preparation of a regulatory analysis and an urban and community impact analysis. However, DOE is in the process of preparing such analyses which will be made available for public review and comment within 90 days of the publication of this regulation. Based on the findings of these analyses and any comments received following public review, DOE may propose appropriate amendments to this regulation.

Also, for the reasons just noted, good cause exists to make this regulation effective upon publication, rather than 30 days thereafter as would otherwise be required under the Administrative Procedure Act. In consideration of the foregoing, Part 455 of Chapter II, Title 10 of the Code of Federal Regulations is amended by adding new Subparts C through I, as set forth below. This amendment shall be effective April 17, 1979.

Issued in Washington, D.C., April 6, 1979.

Omi G. Walden,

Assistant Secretary, Conservation and Solar Applications, Department of Energy.

10 CFR Part 455 is amended by establishing new Subparts C, D, E, F, G, H and I as follows:

Subpart C—Technical Assistance Programs for Schools, Hospitals, Units of Local Government, and Public Care Institutions

Subpart D—Energy Conservation Measures for Schools and Hospitals

Subpart E—Applicant Responsibilities

Subpart F—State Responsibilities

Subpart G—Grant Awards

Subpart H—State Plan Development and Approval

Subpart I—Allocation of Appropriations Among the States

Authority: Title III of the National Energy Conservation Policy Act, Pub. L. 95-619, 92 Stat. 3206 et seq., which establishes Parts G and H of Title III of the Energy Policy and Conservation Act, Pub. L. 94-163, 42 U.S.C. 6321 et seq.; Section 365(e)(2), 42 U.S.C. 6325(e)(2), of the Energy Conservation and Production Act, Pub. L. 94-385, 42 U.S.C. 3801 et seq.; Department of Energy Organization Act, Pub. L. 95-91, 42 U.S.C. 7101 et seq.

Subpart C—Technical Assistance Programs for Schools, Hospitals, Units of Local Government, and Public Care Institutions

§ 455.40 Purpose and scope.

This subpart specifies what constitutes a technical assistance program eligible for financial assistance under this part, and sets forth the eligibility criteria for schools, hospitals, units of local government and public care institutions to receive grants for technical assistance to be performed in buildings owned by such institutions.

§ 455.41 Eligibility.

To be eligible to receive financial assistance for a technical assistance program, an applicant must—

(a) Be a school, hospital, unit of local government or public care institution, all as defined in § 455.2, or a coordinating agency representing a group of eligible institutions and which has been granted authority by the institutions to act in their behalf;

(b) Be located in a State which has an approved State Plan as described in Subpart H of this part;

(c) Have conducted an energy audit or its equivalent, as determined by the State in accordance with the State Plan, for the building for which financial assistance is to be requested, subsequent to the most recent construction, reconfiguration or utilization change which significantly modified energy use within the building;

(d) Give assurance that it has implemented all energy conservation maintenance and operating procedures identified as a result of the energy audit, or provide a satisfactory written justification for not implementing any specific maintenance and operating procedures so identified; and,

(e) Submit an application in accordance with the provisions of this part and the approved State Plan.

§ 455.42 Contents of program.

(a) A technical assistance program shall be conducted by a qualified technical assistance analyst, who shall consider all possible energy conservation measures for a building, including solar or other renewable resource measures. A technical assistance program shall include a detailed engineering analysis to identify the estimated costs of, and the energy and cost savings likely to be realized from, implementing each identified energy conservation maintenance and operating procedure. A technical assistance program shall also identify the estimated cost of, and the energy and cost savings likely to be realized from, acquiring and installing each energy conservation measure, including solar and other renewable resource measures, that indicate a significant potential for saving energy based upon the technical assistance analyst's initial consideration.

(b) At the conclusion of a technical assistance program, the technical assistance analyst shall prepare a final report which shall include—

(1) A description of building characteristics and energy data including—

(i) The results of the preliminary energy audit and energy audit (or its equivalent) of the building;

(ii) The operating characteristics of energy using systems; and

(iii) The estimated remaining useful life of the building;

(2) An analysis of the estimated energy consumption of the building, by fuel type (in total Btu's and Btu/sq. ft./yr), at optimum efficiency (assuming implementation of all energy conservation maintenance and operating procedures);

(3) An evaluation of the building's potential for solar conversion, particularly for water heating systems;

(4) A listing of any known local zoning ordinances and building codes which may restrict the installation of solar systems;

(5) A description and analysis of all recommendations, if any, for acquisition and installation of energy conservation measures, including solar and other renewable resource measures, setting forth—

(i) A description of each recommended energy conservation measure;

(ii) An estimate of the cost of design, acquisition and installation of each energy conservation measure;

(iii) An estimate of the useful life of each energy conservation measure;

(iv) An estimate of increases or decreases in maintenance and operating costs that would result from each energy conservation measure, if any;

(v) An estimate of the salvage value or disposal cost of each energy conservation measure at the end of its useful life, if any;

(vi) An estimate of the annual energy and energy cost savings (using current energy prices) expected from the acquisition and installation of each energy conservation measure. In calculating the potential energy cost savings of each recommended energy conservation measure, including solar or other renewable resource measure, technical assistance analysts shall—

(A) Assume that all energy savings obtained from energy conservation maintenance and operating procedures have been realized;

(B) Calculate the total energy and energy cost savings, by fuel type, expected to result from the acquisition and installation of all recommended energy conservation measures, taking into account the interaction among the various measures; and,

(C) Calculate that portion of the total energy and energy cost savings, as determined in (B) above, attributable to each individual energy conservation measure.

(vii) The simple payback period of each recommended energy conservation measure, taking into account the interactions among the various measures. The simple payback period is calculated by dividing the estimated total cost of the measure, as determined pursuant to § 455.42(b)(5)(ii), by the estimated annual cost saving accruing from the measure, as determined pursuant to § 455.42(b)(5)(vi). For the purposes of ranking applications, the simple payback period shall be calculated using the cost savings resulting from energy savings only, determined on the basis of current energy prices. The estimated cost of the measure shall be the total cost for design and other professional services (excluding costs of a technical assistance program), if any, and acquisition and installation costs. Other economic analyses, such as life-cycle costing, which consider all costs and cost savings, such as maintenance costs and/or savings, resulting from an energy conservation measure, are recommended, but not required, for use by the institution in its decision-making process;

(6) A listing of energy use and cost data for each fuel type used for the prior 12-month period.

(7) A signed and dated certification that the technical assistance program has been conducted in accordance with the requirements of this section and the grant application and that the data presented is accurate to the best of the technical assistance analyst's knowledge.

Subpart D—Energy Conservation Measures for Schools and Hospitals

§ 455.50 Purpose and scope.

This subpart specifies what constitutes an energy conservation measure that may receive financial assistance under this part and sets forth the eligibility criteria for schools and hospitals to receive grants for energy conservation measures, including solar and other renewable resource measures.

§ 455.51 Eligibility.

(a) To be eligible to receive financial assistance for an energy conservation measure, including solar or other renewable resource measure, an applicant must—

(1) Be a school or hospital, or both as defined in § 455.2, or a coordinating agency which represents groups of eligible institutions and which has been granted authority by the institutions to act in their behalf;

(2) Be located in a State which has an approved State Plan as described in Subpart H of this part;

(3) Have completed a technical assistance program or its equivalent, as determined by the State in accordance with the State Plan, for the building for which financial assistance is to be requested, subsequent to the most recent construction, reconfiguration or utilization change to the building which significantly modified energy use within the building;

(4) Have implemented all energy conservation maintenance and operating procedures which are identified as the result of an energy audit and a technical assistance program, or have provided a satisfactory written justification for not implementing any specific maintenance and operating procedures so identified;

(5) Have no plan or intention at the time of application to close or otherwise dispose of the building for which financial assistance is to be requested within the simple payback period of any energy conservation measure recommended for that building; and

(6) Submit an application in accordance with the provisions of this part and the approved State Plan.

(b) To be eligible for financial assistance, the simple payback period of each energy conservation measure for which financial assistance is requested shall not be less than 1 year nor greater than 15 years, and the estimated useful life of the measure shall be greater than its simple payback period.

§ 455.52 Contents of program.

The programs to be funded under this part will be for the design, acquisition and installation of energy conservation measures to reduce energy consumption or measures to allow the use of solar or other alternative energy resources for schools and hospitals. Such measures include, but are not necessarily limited to—

(a) Insulation, which resists heat transfer from the mechanical systems to the surrounding space, for bare pipes, water heaters, hot water storage tanks, chilled water piping, ductwork and other uninsulated mechanical equipment carrying an above or below ambient temperature fluid;

(b) Roof insulation, which resists heat transfer through the roof;

(c) Ceiling insulation, installed either above or below the ceiling, which resists heat transfer through the ceiling;

(d) Wall insulation, which resists heat transfer through the wall;

(e) Floor insulation, which resists heat transfer through the floor;

(f) Storm windows, which are an additional window, normally installed to the exterior, but which may be installed to the interior of the primary or ordinary window, to increase resistance to heat transfer, and to decrease air infiltration through the window assembly;

(g) Storm doors, which are an extra door installed to the exterior of an exterior door, but also may be installed as part of the entrance vestibule, to decrease heat transfer and air infiltration through the building entrance ways;

(h) Multiglazed window or door systems, which are a single glass unit consisting of multiple layers of glass separated by a hermetically sealed air space, which provide greater resistance to heat transfer;

(i) Reduction in glass area (in other than south-facing glazing systems) through use of methods such as bricking and insulated paneling which decreases heat transfer and air infiltration;

(j) Heat absorbing or heat reflective glazed and coated window and door systems, which are specially treated, coated or laminated glazing systems to absorb or reflect solar heat;

(k) Caulking, which is placed in joints of buildings or window or door systems to prevent the passage of air and moisture through the building envelope;

(l) Weatherstripping, which consists of strips of flexible material placed over, under, or in movable joints of windows and doors to reduce the passage of air and moisture;

(m) Automatic energy control systems, such as mixed air temperature reset devices; cooling coil discharge temperature reset devices; hot deck temperature reset devices; economizer controls; enthalpy controls; night setback thermostats; time clocks to start/stop selected heating, ventilating and air conditioning systems, refrigeration equipment, hot water generators, and associated pumps and fans; thermostatic radiator valves, and central computer control systems, which adjust the supply of heating, cooling, and ventilation to meet space conditioning requirements;

(n) Equipment required to operate or convert to variable energy supply, including—

(1) Automatic ventilating systems to turnoff or vary the consumption of energy systems to deliver no more energy than required at any operating point;

(2) Constant volume air distribution systems altered to variable air flow systems by the addition of variable air flow boxes, fan volume control dampers and related climatic controls; or

(3) Water spray coils for adiabatic cooling during appropriate weather conditions;

(o) Passive solar systems, such as direct gain glazing systems, mass (trombe) wall systems, thermal pond systems, and thermosyphon systems, which utilize elements of the building to collect, store and distribute solar energy for heating and/or cooling, and in which heat flow is by natural means (conduction, convection, radiation or evaporation);

(p) Solar space heating or cooling systems, which consist of solar collectors, and associated thermal storage, heat exchangers, pumps, fans, controls, piping and ducting;

(q) solar electric generating systems, which consist of photovoltaic solar collectors and associated electric storage and controls, or concentrating solar collectors and generating equipment, or wind energy conversion systems;

(r) Solar domestic hot water heating systems, which consist of solar collectors, and associated thermal storage, heat exchangers, pumps, controls and piping, for systems such as domestic hot water, laundry, kitchen, and boiler water makeup;

(s) Furnace or utility plant modifications, which consist of the installation of equipment to achieve reduction in fuel consumption, or to convert to renewable energy sources or coal, including—

(1) Replacement burners, furnaces, boilers, or any combination thereof, which are designed to substantially reduce the amount of fuel consumed as a result of increased combustion efficiency;

(2) Electrical or mechanical furnace ignition systems which eliminate continuous energy use;

(3) Devices for modifying flue openings, such as dampers and heat exchangers, which increase the efficiency of the total heating systems;

(4) Automatic combustion control systems, which improve burner operating performance to reduce consumption of fuel during full- and part-load operation;

(5) Devices, such as turbulators and flow restrictors, for modifying the capacity of boilers or hot water units to reduce oversized equipment to a proper size (after the other building modifications) and to increase the full and part-load efficiency of the primary equipment; and

(6) Equipment required to convert oil-fired and gas-fired units to alternative energy sources, including coal;

(t) Lighting fixture modifications and associated rewiring, which reduce the watts per square foot required for illumination through use of such measures as lamp sources of higher efficiency, or use of non-uniform task lighting design. Lighting fixture modifications that increase the general illumination level of a facility shall not be eligible for funding unless the increase is necessary to conform to any applicable State or local building code;

(u) Energy recovery systems which reduce energy used in heating and cooling systems by—

(1) Direct recycling of uncontaminated air, which has been conditioned, to an adjacent area for heating, cooling or ventilation makeup air;

(2) Exhaust air heat recovery to preheat outside air supply with heat recovery devices such as rotary air wheels, plate heat exchangers, non-regenerative heat-pipe devices, and run-around loop systems; or

(3) Purifying with charcoal or other mediums and recycling exhaust air from toilet areas, dining rooms, and lounges, and other building areas;

(v) Cogeneration systems which produce steam, heat, or other forms of energy as well as electricity for use primarily within a building or complex of buildings and which meet such fuel efficiency requirements as may be prescribed or approved by DOE and which may be new heat recovery equipment added to existing electrical generation systems;

(w) Any otherwise eligible energy conservation measure that involves leased equipment, which will save a substantial amount of energy. Only the costs of installation and connection of such leased equipment are eligible for financial assistance under this program. For purposes of ranking, pursuant to § 455.71(b)(1), a building for which a leased measure has been proposed, the simple payback period shall be determined by dividing the total installation and connection costs by the result of subtracting the average annual recurring lease costs from the projected average annual energy cost saving;

(x) Any other measures an energy audit or a technical assistance report shows, to the satisfaction of the Secretary, will save a substantial amount of energy. Such measures must be specifically identified in the grant application, and a complete description of the measure, together with calculations and other technical data supporting the projected cost and energy savings must be included in the application.

Subpart E—Applicant Responsibilities

§ 455.60 Grant application submittals.

(a) Each eligible applicant desiring to receive financed assistance shall file an applicant in accordance with the provisions of this subpart and the approved State Plan of the State in which such building is located. The application, which may be amended in accordance with applicable State procedures at any time prior to the State's final determination thereon, shall be filed with the State energy agency designated in the State Plan.

(b) Applications from schools, hospitals, units of local government, public care institutions and coordinating agencies for financial assistance for technical assistance programs shall include—

(1) The applicant's name and mailing address;

(2) A written statement certifying that the applicant is eligible under § 455.41;

(3) The results of the preliminary energy audit and energy audit (or its equivalent) for each building for which financial assistance is requested;

(4) A project budget, by building, which stipulates the intended use of all Federal and non-Federal funds, and identifies the sources and amounts of non-Federal funds, including in-kind contributions (limited to the goods and services described in OMB Circular A-102, "Uniform Administrative Requirements for Grants-in-Aid to State and Local Governments", which are directly related to the project and do not include funds derived from revenue sharing or other Federal sources), to be used to meet the cost-sharing requirements described in Subpart G of this part;

(5) A brief description, by building, of the proposed technical assistance program, including a schedule, with appropriate milestone dates, for completing the technical assistance program; and

(6) Additional information required by the applicable State Plan, and any other information which the applicant desires to have considered, such as information to support an application from a school or hospital for financial assistance in excess of the 50 percent Federal share on the basis of severe hardship.

(c) Applications from schools or hospitals and coordinating agencies for financial assistance for energy conservation measures, including solar and other renewable resource measures, shall include—

(1) The applicant's name and mailing address;

(2) A written statement certifying that the applicant is eligible under § 455.51;

(3) Identification of each building pursuant to 10 CFR 450.42(a) (1) through (5) for which financial assistance is requested, including—

(i) Name or other identification of each building and its address;

(ii) Building category;

(iii) Description of functional use;

(iv) Ownership; and

(v) Size of building expressed in gross square feet.

(4) A project budget, by building, which stipulates the intended use of all Federal and non-Federal funds, and identifies the sources and amounts of non-Federal funds, including in-kind contributions (limited to the goods and services described in OMB Circular A-102, "Uniform Requirements for Grants-in-Aid to State and Local Governments", which are directly related to the project and do not include funds derived from revenue sharing or other Federal sources), to be used to meet the cost-sharing requirements described in Subpart G of this part;

(5) A schedule, including appropriate milestone dates, for the completion of the design, acquisition and installation of the proposed energy conservation measures for each building;

(6) A list, by building, of the specific energy conservation measures proposed for funding, indicating the cost of each measure, the estimated energy and energy cost savings of each measure, the projected simple payback period for each measure, computed in accordance with the methodology described in § 455.42(b)(5)(vii) or § 455.52(w), as the case may be, and the average simple payback period for all measures proposed for the building. The average simple payback period of all measures proposed shall be determined by dividing the total estimated cost by the total projected annual cost saving (from energy savings only);

(7) A technical assistance report, completed since the most recent

construction, reconfiguration or utilization change to the building which significantly modified energy use, for each building;

(8) If the applicant is aware of any adverse environmental impact which may arise from adoption of any energy conservation measure, an analysis of that impact and the applicant's plan to minimize or avoid such impact; and

(9) Additional information required by the applicable State Plan, and any additional information which the applicant desires to have considered, such as information to support an application for financial assistance in excess of the 50 percent Federal share on the basis of severe hardship.

(d) Financial assistance for units of local government and public care institutions will be provided only for buildings which are owned and primarily occupied by offices or agencies of a unit of local government or public care institution and which are not intended for seasonal use and not utilized primarily as a school or hospital eligible for assistance under this program.

(e) Financial assistance provided to a school which is a local education agency as defined in § 455.2 must not be used for a technical assistance program or acquisition or installation of any energy conservation measure in any building of such agency which is used principally for administration.

§ 455.61 Applicant Certifications.

Applications for financial assistance for technical assistance programs and energy conservation measures, including solar and other renewable resource measures, shall include a signed statement that the applicant—

(a) Has satisfied the requirements set forth in § 455.60;

(b) Will expend granted funds for the purpose stated in the application and in compliance with the requirements of this part and the applicable approved State Plan;

(c) Has implemented all energy conservation maintenance and operating procedures recommended as a result of the energy audit and, for applications for energy conservation measures, those recommended in the report obtained under a technical assistance program. If any such procedure has not been implemented, the application shall contain a satisfactory written justification for not implementing that procedure;

(d) Will obtain from the technical assistance analyst, before the analyst performs any work in connection with a technical assistance program or energy conservation measure, a signed statement certifying that the technical assistance analyst has no conflicting financial interests and is otherwise qualifed to perform the duties of a technical assistance analyst in accordance with the standards and criteria established in the approved State Plan;

(e) Will not enter into any contract relating to an energy conservation measure, which requires or may require expenditure of more than $5,000 (excluding technical assistance costs), that does not conform to the provisions of the Davis-Bacon Act (40 U.S.C. section 276a to 276a–5) pertaining to minimum wages for construction in the applicant's locality; and

(f) Will comply with all reporting requirements contained in § 455.63.

§ 455.62 Grant Applications For State Administrative Expenses.

(a) Each State desiring to receive grants to help defray State administrative expenses shall file applications therefor in accordance with the provisions of this section. Each State may apply for an amount not exceeding 2 percent of its total allocation for technical assistance and energy conservation measures during the initial grant program cycle to the Secretary at any time after the State forwards its State Plan to the Secretary for approval; or, for subsequent grant program cycles, any time after notice by DOE of the amounts allocated to each State for that grant program cycle. In addition, each State after it makes the submittal to DOE required under § 455.72 may apply for a further grant not exceeding 5 percent of the total of all grant awards for technical assistance and energy conservation measures within that State in that grant program cycle, less any amounts previously awarded the State for administrative expenses in the same grant program cycle.

(b) Applications for financial assistance to defray State administrative expenses shall include—

(1) The name and address of the person designated by the State to be responsible for the State's functions under this part; and

(2) An itemized budget, which stipulates the intended use of all Federal and non-Federal funds, for only those State administrative expenses listed in § 455.83(b), and which identifies the sources and amounts of the required matching non-Federal funds, including in-kind contributions (limited to the goods and services described in OMB Circular A–102, "Uniform Requirements for Grants-in-aid to State and Local Governments", which are directly related to the project and do not include funds derived from revenue sharing or other Federal sources), to be used to meet the cost-sharing requirements described in Subpart G of this part.

§ 455.63 Grantee Records and Reports.

(a) Each State, school, hospital, unit of local government, public care institution and coordinating agency which receives a grant for a technical assistance program, energy conservation measure, including solar and other renewable resource measure, or State administrative expenses shall keep all the records required by § 455.4.

(b) By the end of January and July of each year each grantee shall, until the grantee's program has been concluded, submit a report to the State which shall detail and discuss—

(1) Milestones accomplished, those not accomplished, status of in-progress activities, problems encountered, and remedial actions, if any, planned; and

(2) Financial status reports completed in accordance with the documents listed in § 455.3. Financial status reports must be submitted simultaneously to both the State and the Secretary.

(c) Within 90 days of concluding a technical assistance program or installation of funded energy conservation measures, including solar and other renewable resource measures, the grantee shall submit a final report to the State and a summary thereof to the Secretary which shall detail and discuss, as applicable—

(1) A summary of all work accomplished;

(2) Problems encountered;

(3) Final financial reports completed in accordance with the documents listed in § 455.3;

(4) For a completed technical assistance program—

(i) The technical assistance report; and

(ii) A recommended plan to implement energy conservation maintenance and operating procedures, and plans to acquire and install energy conservation measures, including solar and other renewable resource measures;

(5) For completed energy conservation measures including solar and other renewable resource measures—

(i) A listing and description of energy conservation measures acquired and installed;

(ii) A final projected simple payback period, computed in accordance with § 455.42, for each building specifying and utilizing the actual costs for each measure and all the measures, taken as a whole; and

(iii) A statement that the completed modifications (material, equipment and installation) conform to the report on the technical assistance program and the approved grant application.

(d) Grantees shall keep all records required by this section for a minimum of three years after completion of the technical assistance program or energy conservation measure for which the grant was awarded.

(e) Grantees shall submit annual reports to the State covering each year of the three-year period following installation of an energy conservation measure or measures, or for the life of the program, whichever is shorter. Such annual reports shall identify each building and shall provide data on the actual energy use of that building for the preceeding 12-month period. Energy use shall be presented on a monthly or quarterly, as well as an annual basis, consistent with the energy billing cycle for the building. Annual reports shall be submitted within 60 days of the close of each 12-month period.

Subpart F—State Responsibilities

§ 455.70 State Evaluation of Grant Applications.

(a) If an application received by a State is reviewed and evaluated by that State and determined to be in compliance with Subparts C, D and E of this part, § 455.70(b), any additional requirements of the approved State Plan, State environmental laws, and other applicable laws and regulations, then such application will be eligible for financial assistance.

(b) Concurrently with its evaluation and ranking of grant applications pursuant to § 455.71, the State will forward each application for a school or hospital to the State school facilities agency or the State hospital facilities agency, as the case may be, for review and certification that each school application is consistent with related State programs for educational facilities, and each hospital application is consistent with State health plans under sections 1524(c)(2) and 1603 of the Public Health Service Act (42 U.S.C. 300m–3 and 300o–2, respectively), and that each has been coordinated through the review mechanisms under section 1523 of the Public Health Service Act (42 U.S.C. 300m–2) and section 1122 of the Social Security Act. No application from a school or hospital shall be eligible for funding until such certification has been issued.

§ 455.71 State Ranking of Grant Applications.

All eligible applications received by the State will be ranked by the State on an individual building-by-building basis.

(a) For technical assistance programs, buildings shall be ranked in descending priority based upon the energy conservation potential of the building as determined from an energy audit (or its equivalent) in accordance with the procedures established in the State Plan and one or more of the methods indicated in 10 CFR 450.43(c). In the case of buildings having equivalent energy conservation potential, preference shall be given to those buildings which have completed an energy audit without the use of Federal funds.

(1) Each State shall develop separate rankings for all buildings covered by eligible applications for—

(i) Technical assistance programs for units of local governments and public care institutions, and

(ii) Technical assistance programs for schools and hospitals.

(2) Within each ranking for technical assistance, a State shall indicate the amount of financial assistance requested by the applicant for each eligible building and, for those buildings with the highest ranking within the limits of the State's allocation, the amount recommended for funding. If the amount recommended is less than the amount requested by the applicant, the list shall also indicate the reason for that recommendation.

(b) For energy conservation measures, including solar or other renewable energy resource, buildings shall be ranked in descending priority. Several buildings may be ranked as a single building if the application proposes a single energy conservation measure which directly involves all of the buildings. States shall indicate the amount of financial assistance requested by the applicant for each eligible building and, for those buildings with the highest ranking within the limits of the State's allocation, the amount recommended for funding. If the amount recommended is less than the amount requested by the applicant, the list shall also indicate the reason for that recommendation. Buildings shall be ranked in accordance with the procedures established by the State Plan, on the basis of the information developed during a technical assistance program (or its equivalent) for the building and the criteria for ranking applications, which are listed below in the descending order in which weights for each criterion are to be applied by the State—

(1) The average simple payback period of all energy conservation measures proposed for the building, determined by dividing the total estimated cost by the total projected annual energy cost savings;

(2) The type(s) of energy source(s) to which conversion is proposed (with weighting adjustments directly proportional to the ratio of the annual energy cost savings of the conversion measure to the total annual energy cost savings of all measures proposed for a given building), including in descending priority—

(i) Renewable; and

(ii) Coal;

(3) The type(s) and quantity(s) of energy to be saved (with weighting adjustments directly proportional to the ratio of the annual energy savings of each measure to the total annual energy savings of all measures proposed for a given building), including, in descending priority—

(i) Oil;

(ii) Natural gas; and

(iii) Electricity;

(4) Climate within the State; and

(5) Other factors as determined by the State.

(c) Within the rankings of school and hospital buildings for technical assistance and energy conservation measures, including solar or other renewable resource measures, a State shall assure that—

(1) Schools receive not more than 70 percent of the total funds allocated for schools and hospitals to the State in any grant program cycle; and

(2) Hospitals receive not more than 70 percent of the total funds allocated for schools and hospitals to the State in any grant program cycle.

(d) To the extent provided in § 455.82(c), additional financial assistance will be available for schools and hospitals experiencing severe hardship based upon an applicant's long-term need or inability to provide the 50 percent non-Federal share. This additional financial assistance will be available only to the extent necessary to enable such institutions to participate in the program.

(1) Funding for this additional financial assistance will be taken from the funds reserved for grants in excess of 50 percent of the total costs of the technical assistance programs and energy conservation measures.

(2) Applications for Federal funding in excess of 50 percent based on claims of severe hardship shall be given an additional evaluation by the State to assess on a quantifiable basis, to the maximum extent practicable, the

relative need among eligible institutions. The minimum amount of additional Federal funding necessary for the applicant to participate in the program will be determined by the State in accordance with the procedures established in the State Plan and will be based upon one or more of the following—

(i) The ratio of the cost of the proposed technical assistance programs or energy conservation measures to the institution's total annual budget;

(ii) The borrowing capacity of the institution;

(iii) The average unemployment rate for the institution's locality at the time the application is submitted;

(iv) The ratio of the amount expended annually by the institution for energy to the institution's total annual operating budget;

(v) The median annual family income of the institution's locality; and

(vi) Other special conditions of the institution or its locality as determined by the State.

(3) A State shall indicate, for those schools and hospitals with the highest rankings, determined pursuant to paragraphs (a) and (b) of this section—

(i) The amount of additional hardship funding requested by each eligible applicant for each building determined to be in a class of severe hardship, and

(ii) The amount of hardship funding recommended by the State based upon relative need as determined in accordance with the State Plan, to the limit of the hardship funds available.

(e) A State is exempt from the ranking requirements of this section when—

(1) The total amount requested by all applications for schools and hospitals for technical assistance and energy conservation measures in a given grant program cycle for grants up to 50 percent is less than or equal to the funds available to the State for such grants and the total amount recommended for hardship funding is less than or equal to the amounts available to the State for such grants.

(2) The total amount requested by all applications for buildings owned by units of local government and public care institutions in a given grant program cycle is less than or equal to the total amount allocated to the State for technical assistance program grants in the State.

§ 455.72 Forwarding of Applications.

Each State shall forward to the Secretary once each grant program cycle each listing of buildings covered by eligible applications for schools and hospitals or for units of local government and public care institutions, and ranked by the State pursuant to the provisions of § 455.71.

§ 455.73 State Duties.

(a) Each State shall be responsible for—

(1) Consulting with eligible institutions and coordinating agencies representing such institutions in the development of its State Plan;

(2) Notifying eligible institutions and coordinating agencies of the content of the approved State Plan;

(3) Notifying each applicant, prior to submittal of applications to the Secretary, how the applicant's building ranked among other similar buildings, and whether and to what extent its application will be recommended for funding or, if not to be recommended for funding, the reason therefore;

(4) Certifying that each institution that has submitted an application to be recommended for funding has given its assurance that it is willing and able to participate on the basis of the amounts recommended for that institution in the State ranking pursuant to § 455.71; and

(5) Direct program oversight, monitoring and financial auditing of the activities for which grants are awarded to its institutions to insure compliance with all legal requirements. States shall immediately notify the Secretary of any non-compliance or indication thereof.

(b) Each State shall submit a report to the Secretary, by the close of each February and August following State Plan approval for the duration of the grant program, providing—

(1) A narrative of the program, including objectives accomplished, problems encountered and recommended solutions;

(2) A detailed report on program related financial expenditures by all grantees and by the State;

(3) A summary of the most recent reports received by the State pursuant to § 455.63; and

(4) Such other information as the Secretary may, from time to time, request.

(c) Each State shall include in the August report required by paragraph (b) of this section, an estimate of annual energy use reductions in the State, by energy source, attributable to implementation of energy conservation maintenance and operating procedures and installation of energy conservation measures under this program. Such estimates shall be based upon a sampling of institutions participating in the technical assistance phase of this program and upon the reports submitted to the State pursuant to § 455.63(e).

Subpart G—Grant Awards

§ 455.80 Approval of Grant Applications.

(a) The Secretary shall review and approve applications submitted by a State in accordance with § 455.72 if the Secretary determines that the applications meet the objectives of the Act, and comply with the applicable State Plan and the requirements of this part. The Secretary may disapprove all or any portion of an application to the extent that funds are not available to carry out a program or measure (or portion thereof) contained in the application, or for such other reason as the Secretary may deem appropriate.

(b) The Secretary shall notify a State and the applicant of the final approval or disapproval of an application at the earliest practicable date after the Secretary's receipt of the application, and, in the event of disapproval, shall include a statement of the reasons therefor. An application which has been disapproved may be amended and resubmitted in the same manner as the original application at any time within a grant program cycle.

(c) The Secretary shall award only one grant to an applicant for any single technical assistance program or energy conservation measure for any one building. Financial assistance under this part for any single technical assistance program or energy conservation measure shall not exceed the amount of the initial grant award.

§ 455.81 Grant Awards For Units of Local Government and Public Care Institutions.

(a) The Secretary may make grants to units of local governments, public care institutions and coordinating agencies for up to 50 percent of the costs of performing technical assistance programs for buildings covered by an application approved in accordance with § 455.80.

(b) Total grant awards within any State to units of local government and public care institutions are limited to the funds allocated to each State in accordance with Subpart I of this part.

(c) No grant awarded under this section for a technical assistance program shall include funding for the purchase of any single item of equipment or personal property having an acquisition cost in excess of $500.

§ 455.82 Grant Awards For Schools and Hospitals.

(a) The Secretary may make grants to schools, hospitals and coordinating agencies for up to 50 percent of the cost of performing technical assistance programs for buildings covered by an application approved in accordance with § 455.80. Grant awards for technical assistance programs in any State within any grant program cycle shall not exceed—

(1) 30 percent of the amount allocated to a given State from the 1978 fiscal year appropriation for technical assistance programs and energy conservation measures for schools and hospitals;

(2) 15 percent of the amount allocated to a given State from the 1979 fiscal year appropriation for technical assistance programs and energy conservation measures for schools and hospitals;

(3) 5 percent of the 1980 fiscal year appropriation for technical assistance programs and energy conservation measures for schools and hospitals.

(b) The Secretary may make grants to schools, hospitals and coordinating agencies for up to 50 percent of the costs of acquiring and installing energy conservation measures, including solar and other renewable resource measures, for buildings covered by an application approved in accordance with § 455.80.

(c) The Secretary may award 10 percent of the total amount allocated to a State for schools and hospitals for technical assistance programs and energy conservation measures in a given grant program cycle to cover more than 50 percent, but not to exceed 90 percent, of the cost of a technical assistance program or an energy conservation measure. These additional amounts may be awarded to applicants in a class of severe hardship, ascertained by the State in accordance with the State Plan, for buildings recommended by the State pursuant to § 455.71(d)(3), and in amounts determined pursuant to § 455.71(d)(2).

(d) The Secretary shall not award more than 70 percent of the total amount allocated to a State for technical assistance programs and energy conservation measures in a given grant program cycle to either schools or hospitals in that State.

(e) No grant awarded under this section for a technical assistance program shall include funding for the purchase of any single item of equipment or other personal property having an acquisition cost in excess of $500.

(f) Applicant expenditures for a technical assistance program commenced after November 8, 1978 for a building may be wholly or partially classified in the discretion of the Secretary as matching non-Federal funds for the purposes of matching grants awarded for energy conservation measures.

§ 455.83 Grant Awards For State Administrative Expenses.

(a) For the purpose of defraying State expenses in the administration of technical assistance programs and energy conservation measures, the Secretary may make grant awards to a State—

(1) Immediately following approval of the State Plan, or for subsequent grant program cycles, immediately following public notice of the amounts allocated to a State for the grant program cycle, and upon approval of the grant application for administrative costs, in an amount not exceeding 2 percent of that State's total allocation for a given grant program cycle for technical assistance and energy conservation measures. Grants for such purposes may be made for up to 50 percent of a State's projected administrative expenses, as approved by the Secretary; and

(2) Concurrently with grant awards for approved applications for technical assistance or energy conservation measures for institutions in that State, and upon approval of an application for administrative costs, in an amount not exceeding the difference between the amount granted pursuant to subparagraph (1) of this paragraph and 5 percent of the total amount of grants awarded within the State for technical assistance programs and energy conservation measures in the applicable grant program cycle. Grants for such purposes may be made for up to 50 percent of a State's projected administrative expenses, as approved by the Secretary. The total of all grants for State administrative costs, technical assistance programs and energy conservation measures in that State shall not exceed the total amount allocated for that State for any grant program cycle.

(b) A State's administrative expenses shall be limited to those directly related to administration of technical assistance programs and energy conservation measures including costs associated with—

(1) Personnel, whose time is expended directly in support of such administration;

(2) Supplies, and services, expended directly in support of such administration;

(3) Equipment purchased or acquired solely for, and utilized directly in support of such administration: *Provided*, That no single item of equipment or other personal property costing more than $300 shall be acquired without the express consent of DOE;

(4) Printing, directly in support of such administration; and

(5) Travel, directly related to such administration.

Subpart H—State Plan Development and Approval

§ 455.90 Contents of State Plan.

Each State shall develop a State Plan for technical assistance programs and energy conservation measures, including solar and other renewable resource measures. The State Plan shall be reviewed and approved by State energy agency. The State Plan shall include—

(a) A statement setting forth the procedures by which the views of eligible institutions or coordinating agencies representing such institutions, or both, were solicited and considered during development of the State Plan;

(b) The procedures the State will follow to notify eligible institutions and coordinating agencies of the content of the approved State Plan;

(c) The procedures for submittal of grant applications to the State;

(d) A description and evaluation of the results of preliminary energy audits (described in Subpart B of this part) which have been conducted in the State including, but not limited to—

(1) In the case of a State which has completed preliminary energy audits of all potentially eligible buildings, a summary of the data gathered pursuant to § 450.42 for all such buildings;

(2) In the case of a State which has completed preliminary energy audits of a sample of all potentially eligible buildings within the State—

(i) Reasonably accurate estimates of the preliminary energy audit data required by 10 CFR 450.42 for all potentially eligible buildings within the State; and

(ii) A plan which describes further actions to be taken to complete preliminary energy audits of all potentially eligible buildings;

(e) The procedures to be used by the State for evaluating and ranking technical assistance and energy conservation measure grant applications pursuant to § 455.71, including the weights assigned to each criterion set forth in § 455.71(b);

(f) The procedures that the State will follow to insure that funds will be allocated equitably among eligible applicants within the State, including procedures to insure that funds will not be allocated on the basis of size or type of institution but rather on the basis of relative need taking into account such factors as cost, energy consumption and energy savings, in accordance with § 445.71;

(g) The procedures that the States will follow for identifying schools and hospitals experiencing severe hardship and for apportioning the funds that are available for schools and hospitals in a class of severe hardship. Such policies and procedures shall be in accordance with § 455.71(d);

(h) A statement setting forth the extent to which, and by which methods, the State will encourage utilization of solar space heating, cooling and electric systems and solar water heating systems;

(i) The procedures to assure that all financial assistance under this part will be expended in compliance with the requirements of the State Plan, in compliance with the requirements of this part, and in coordination with other State and Federal energy conservation programs;

(j) The procedures to insure implementation and continued use of energy conservation maintenance and operating procedures in those buildings for which financial assistance is awarded under this part;

(k) The procedures designed to insure that financial assistance under this part will be used to supplement, and not to supplant, State, local or other funds;

(l) The procedures for determining that energy audits performed without the use of Federal funds have been performed in substantial compliance with the requirements of 10 CFR Part 450 for the purposes of satisfying the eligibility requirements contained in § 455.41(c);

(m) The procedures for establishment of, and adherence to, milestones for accomplishment of technical assistance programs and energy conservation measures receiving financial assistance under this part;

(n) The procedures for determining that technical assistance programs performed without the use of Federal funds have been performed in compliance with the requirements of § 455.42, for the purposes of satisfying the eligibility requirements contained in § 455.51(a)(3).

(o) The procedures for State management, financial audit, monitoring and evaluation of technical assistance programs and energy conservation measures receiving financial assistance under this part;

(p) A description of the State's program for establishing and insuring compliance with qualifications for technical assistance analysts. Such policies shall require that technical assistance analysts—

(1) Have experience in energy conservation and be a registered professional engineer licensed under the regulatory authority of the State;

(2) Be an architect-engineer team, the principal members of which are licensed under the regulatory authority of the State; or

(3) Be otherwise qualified in accordance with such criteria as the State may prescribe in its State Plan to insure that individuals conducting technical assistance programs possess the appropriate training and experience in building energy systems. Such policies shall also require that technical assistance analysts be free from financial interests which may conflict with the proper performance of their duties; and

(q) The procedures for apportionment of funds among eligible institutions within the State. As a minimum, such policies and procedures shall assure a separate priority ranking pursuant to the provisions of § 455.71 for each building covered by an application approved pursuant to the provisions of § 455.70 for—

(1) Technical assistance programs for units of local government and public care institutions;

(2) Technical assistance programs for schools and hospitals; and

(3) Energy conservation measures, including solar and other renewable resource measures, for schools and hospitals.

§ 455.91 Submission and Approval of State Plans.

(a) Proposed State Plans shall be submitted to the Secretary within 120 days of the effective date of this subpart unless the Secretary, upon request and for good cause shown, grants an extension of time.

(b) The Secretary shall, within 60 days of receipt of a proposed State Plan, review each Plan and, if it is found to conform to the requirements of this part, approve the State Plan. If the Secretary does not disapprove a State Plan within the 60-day period, the Secretary will be deemed to have approved the State Plan.

(c) If the Secretary determines that a proposed State Plan fails to comply with the requirements of this part, the Secretary shall return the Plan to the State with a statement setting forth the reasons for disapproval. With the written consent of the Secretary, the State may submit a new or amended Plan at any time.

§ 455.92 State Plans Developed by the Secretary.

(a) If a State Plan has not been approved by February 7, 1981, or within 90 days after completion of the preliminary energy audits, whichever is later, the Secretary may develop and implement a State Plan on behalf of the schools and hospitals in the State.

(b) Subsequent to the development of a State Plan by the Secretary, the State may submit its own State Plan and the Secretary shall approve or disapprove such plan within 60 days after receipt by the Secretary. If the proposed plan meets the requirements of this part, and is not inconsistent with any plan developed and implemented by the Secretary, the Secretary shall approve the State Plan which shall automatically replace the Plan developed by the Secretary.

Subpart I—Allocation of Appropriations Among the States.

§ 455.100 Allocation of Funds.

(a) The Secretary will allocate available funds among the States for the purpose of awarding grants to schools, hospitals, units of local government, and public care institutions and coordinating agencies to implement technical assistance and energy conservation measures grant programs in accordance with this part.

(b) By notice published in the Federal Register, the Secretary shall notify each State of the total amount allocated for grants within the State for any grant program cycle.

(c) By notice published in the Federal Register, the Secretary shall notify each State of the period for which funds allocated for a grant program cycle will be reserved for grants within the State.

(d) Each State shall apportion ten percent of its allocation for schools and hospitals in each grant program cycle to provide additional financial assistance, in excess of the 50 percent Federal share but not to exceed 90 percent, for technical assistance programs and energy conservation measures for schools and hospitals determined to be in a class of severe hardship. Such determinations shall be made in accordance with § 455.71(d).

§ 455.101 Allocation Formulas.

(a) Financial assistance for conducting technical assistance programs for units of local government and public care institutions shall be allocated among the States by multiplying the sum available by the allocation factor set forth in paragraph (c) of this section.

(b) Financial assistance for conducting technical assistance programs and acquiring and installing energy conservation measures, including solar and other renewable resource measures, for schools and hospitals shall be allocated among the States by multiplying the sum available by the allocation factor set forth in paragraph (c) of this section.

(c) The allocation factor (K) shall be determined by the formula—

$$K = \frac{0.07}{n} + 0.1\,\frac{(Sfc)}{(Nfc)} + 0.83\,\frac{(SP)(SC)}{(NPC)}$$

where, as determined by DOE—

(1) Sfc is the average retail cost per million Btu's of energy consumed within the region in which the State is located, as reflected in the 1985, Series C projections prepared for DOE's Energy Information Administration Administrator's Annual Report, 1977;

(2) Nfc is $271.95, the summation of the Sfc numerators for all States;

(3) n is the total number of eligible States;

(4) SP is the population of the State, as determined from 1976 census estimates, "Current Population Reports", Series P-25, number 603;

(5) SC is the sum of the State's heating and cooling degree days, as determined from National Oceanic and Atmospheric Administration data for the thirty year period, 1941 through 1970;

(6) NPC is 1,277,259,000, the summation of the (SP) (SC) numerators for all States.

(d) Except for the District of Columbia, Puerto Rico, Guam, American Samoa and the Virgin Islands, no allocation available to any State may be less than 0.5 percent of all amounts allocated in any grant program cycle. No State will be allocated more than 10 percent of the funds allocated in any grant program cycle.

§ 455.102 Reallocation of Funds

(a) If a State Plan has not been approved and implemented by a State by the close of the period for which allocated funds are available as set forth in the notice issued by the Secretary pursuant to § 455.100(d), funds allocated to that State for technical assistance and energy conservation measures will be reallocated among all States for the next grant program cycle, if available.

(b) If a State Plan has not been approved by February 7, 1981, or within ninety days after completion of the preliminary energy audits, whichever is later, the Secretary may develop and implement a State Plan on behalf of the schools and hospitals within the State. If the Secretary does not develop a State Plan for a State, the funds reserved for that grant program cycle for schools and hospitals in that State will be reallocated for the next grant program cycle among all States for schools and hospitals.

(c) If a State does not forward a sufficient number of grant applications to award all the funds allocated for the State in any grant program cycle, the Secretary shall reallocate the funds which remain available among all States for the next grant program cycle.

(d) If a State does not forward a sufficient number of grant applications under the severe hardship provisions set forth in § 455.71(d) to award 10 percent of all of the funds allocated to the State for schools and hospitals in that grant program cycle, the Secretary shall reallocate the remaining hardship funds among all States for the next grant program cycle.

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PROGRAM SUMMARY

Background

The National Energy Conservation Policy Act of 1978 (P.L. 95-619), contains major grants programs to promote energy conservation in four sectors of public and private non-profit buildings constructed prior to April 20, 1977. The Grants Programs for Schools and Hospitals and for Buildings Owned by Units of Local Government and Public Care Institutions (Title III, Parts 1 and 2 of the law) are voluntary activities which provide 50% matching Federal grant funds, or up to 90% federal funding in cases of severe hardship, for programs to be administered by energy offices in each of the 50 states, Puerto Rico, the Virgin Islands, the District of Columbia, Guam and American Samoa.

Program Objectives and Activities

The objectives of the program are to provide financial assistance to the eligible institutions for the energy use analyses of buildings and energy saving measures. In order to assist the institutions in accomplishing these objectives, the grants program has been structured around four steps which comprise the two major phases of these programs.

The first step of Phase I is the Preliminary Energy Audit (PEA). The purpose of the Preliminary Energy Audit (PEA) is to determine the energy savings potential of buildings by identifying the physical and energy-using characteristics of the buildings. The major components of the PEA include major energy using systems identified in terms of fuel source and physical characteristics, prior building energy conservation efforts, renewable energy resource potential, and energy savings potential. The PEA is to provide basic building information which will identify those large energy using buildings and systems which will become candidates for subsequent Energy Audits (EA), Technical Assistance (TA), and Energy Conservation Measures (ECM).

Source: Energy Conservation Grants Program Training Manual, pages 2 - 4 (revised); GOER; May, 1979.

The second step, the Energy Audit, is to provide a survey of the buildings identified as targets by the PEA. The Energy Audit includes reporting the type, size, energy use level and major energy using systems of buildings; maintenance and operating procedures which may be implemented to conserve energy; and data which may identify the need or potential for acquisition and installation of energy conservation measures.

The first step of Phase II is the Technical Assistance (TA) analysis. Technical Assistance consists of a detailed engineering analysis performed by a registered professional; and it includes data relating to specific costs, payback periods, and projected energy savings resulting from the purchase and installation of various energy saving devices or systems. The TA report will include recommendations and analyses for such energy savings measures as storm windows, insulation, solar energy systems, and automatic setback devices to name a few. The TA is the last step for which local government and public care buildings are currently eligible under the program.

The final step, Energy Conservation Measures (ECM) provides for the purchase and installation of energy measures including material, equipment, and the physical modification of the building recommended as a result of the TA audit.

Funding

The authorized funding for these programs provides a total of $900 million for schools and hospitals, and $65 million for local government and public care buildings.

In Phase I, the Department of Energy (DOE) will make grants available to each State to conduct a statewide program of PEA's in all four categories of eligible buildings, and to states or units of local government and public care institutions or both for conducting EA's. In both phases the state will be responsible for the overall planning and administration of the grants.

In Phase II, grants will be awarded to eligible institutions in accordance with statewide plans developed by each state energy office and approved by DOE. Grant applications will be submitted annually to DOE through the Texas Energy and Natural

Resources Advisory Council which will approve and rank them for funding and then forward the applications to DOE for final approval and grant award.

Institutions will be able to use in-kind contributions (such as salaries of personnel and building materials on hand, etc.) to make up part of their 50% matching funds. New construction is not included in these grant programs.

Some funding considerations for states are as follows:

* Under the law, schools would receive a minimum of 30% of the state allocation and hospitals also would receive at least 30% of the allocated monies. The remaining 40% would be available to schools and hospitals based upon recommendations of the Texas Energy and Natural Resources Advisory Council.

* No state may receive more than 10% of the total federal funds or less than 0.5%.

* Funds granted to a state or individual facility must be matched 50/50 from non-federal funds.

* Funds may not be used to repay money expended for any energy conservation project commenced prior to the application submittal deadline date established by the Texas Energy and Natural Resources Advisory Council.

* For schools and hospitals, in cases of severe financial hardship, 10% of a state's grant allocation will be reserved to pay up to 90% of the federal share.

* In accordance with the authorized funding levels for the program under NECPA and the U.S. Department of Energy's original allocation factors for the first grant program cycle, it can be estimated that Texas could receive approximately $40 million during the duration of the program. However, full receipt of this funding is contingent upon Congress passing appropriations to match the authorized funding levels. Actual federal funding for the Texas program during the first of three program cycles is as follows:

FIRST GRANT PROGRAM CYCLE

	Phase I PEA/EA	Phase II TA/ECM	Total
Schools and Hospitals	$ 892,824	$ 5,704,404	$ 6,597,228
Local Government and Public Care	334,809	713,050	1,047,859
TOTAL	$ 1,227,633	$ 6,417,454	$ 7,645,087

Schedules for subsequent program cycles will be distributed to the eligible institutions at a later date.

EXECUTIVE SUMMARY OF THE STATE PLAN

1. The basic sequence for participation in the program requires that the building owner (a) first conduct a preliminary energy audit (PEA) by completing the PEA form*, (b) complete the energy audit (EA) form*, (c) conduct an on-site energy audit of the building listing all maintenance and operating procedures identified to save energy, (d) initiate (implement) all the maintenance and operating procedures identified by the energy audit, (3) submit an application to the Texas Energy and Natural Resources Advisory Council (TENRAC) for federal funding to conduct technical assistance (detailed engineering analysis of the building), if desired**, (f) technical assistance (TA) analyst conducts the technical assistance analysis, (g) technical assistance analyst writes report (see Technical Assistance Report Format) identifying further maintenance and operating procedures and the energy conservation measures, (h) initiate (implement) the maintenance and operating procedures identified by the technical assistance analyst, (i) submit an application to TENRAC for federal funding for energy conservation measures (ECM) recommended in the technical assistance report, if desired**, (j) purchase and install the energy conservation measures, (k) monitor energy savings prior to and subsequent to the installation of energy conservation measures (see Section 3.1).
2. Technical Assistance and Energy Conservation Measures applications must be submitted in duplicate with supporting materials. Therefore, institutions must submit one original and one copy of the Energy Conservation Measures application, each accompanied by the Preliminary Energy Audit Report, the Energy Audit Report, and the Technical Assistance Report.
3. See Section 3.4 for application submission dates.

Source: Plan of the State of Texas for Technical Assistance and Energy Conservation Measures Available to Schools, Hospitals, Units of Local Government and Public Care Institutions, Texas Energy and Natural Resources Advisory Council, 1980.

*The preliminary energy audit (PEA) form and the energy audit (EA) form are included in the Energy Auditor Training Manual developed by the Texas Energy and Natural Resources Advisory Council (TENRAC). Also see Appendices A and B.

**See Section 8.3 for schedule for submission of applications to TENRAC.

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4. Funding will be awarded by the following categories: (a) schools and hospitals technical assistance, (b) schools and hospitals energy conservation measures, (c) schools and hospitals technical assistance severe hardship, (d) schools and hospitals energy conservation measures severe hardship, and (e) local government and public care technical assistance.
5. The technical assistance grant ranking criteria include (a) Btu/G.S.F./Annual Operating Hours/Year,* (b) $/G.S.F./Annual Operating Hours/Year, (c) potential energy savings chart, (d) implementation of an institutional energy management plan, (e) cost of the TA per gross square foot, and (f) energy savings resulting from maintenance and operating procedures (see Section 6.1 for weighting factors).
6. The average conservation measure grant ranking criteria weighting factors include (a) average simple payback, 0.24, (b) conversion to renewable and coal, 0.18, (c) quantities of types of energy saved including oil, natural gas, and electricity, 0.17, (d) climate within the state, 0.16, (e) technical review of technical assistance reports, 0.15, and (f) energy management plan implementation, 0.10 (see Section 6.2).
7. All TA and ECM grants will be awarded on a building-by-building basis unless an ECM grant application is for a common measure(s) for a complex of buildings (see Section 7.0).
8. No building which is part of a complex that has received a grant will be awarded a grant on the basis of application as a single building except as provided below:
   (a) If a measure is for a central power plant building which serves a complex, applications may also be submitted for single buildings within the complex.
   (b) If a common measure or measures serving a complex of more than three buildings is not physically installed in any of the buildings in the complex (e.g., pipe system from existing solar energy system to serve more buildings, pipe insulation) and the total cost of the measure(s) is (are) less than $75,000, the applicant may also submit an application for any givern building in the complex. However, such buildings are not eligible as part of a different combination of buildings (complex) within the institution (see Section 7.0).

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*British thermal unit (Btu) per gross square foot (G.S.F.) per annual operating hours per year.

9. The amount of the technical assistance grant shall be the least of (1) the application request, (2) $50,000, or (3) the following limits:
   (a) $0.10 per G.S.F. for primary and secondary buildings,
   (b) $0.15 per G.S.F for post-secondary buildings,
   (c) $0.20 per G.S.F. for hospital buildings,
   (d) $0.15 per G.S.F. for buildings owned by units of local government, and
   (e) $0.10 per G.S.F. for public care buildings (see Section 7.1).

   It should also be noted that those applications with the lowest cost per gross square foot (G.S.F.) by program category will be given the most credit toward TA grant application rankings (see Section 6.1.5).

10. There are graduated limitations on the amount a single building owner may receive for TA and ECM prior to the funding of an established range of the highest ranked applications. Thus, the highest ranked 20 percent of applications will be awarded funding before any single building owner will receive more than 15 percent of the total funding for TA and ECM. The same provision applies to the second 20 percent of grant applications. The bottom 60 percent will be awarded funding in descending order of priority (see Section 7.1).

11. No building owner shall be permitted to apply for grants on a 50 percent federal (or less) and 50 percent institutional matching funds basis for some buildings and also apply for severe hardship funding for other buildings during the same grant program cycle (see Section 8.1).

12. The amount of funding for severe hardship grants will be based on a technical review of severe hardship statements which include financial status information (WF=0.80) and the ratio of the amount expended on energy to the total operating budget (WF=0.20) (see Sections 8.2, 8.2.1 and 8.2.2).

13. TENRAC has developed a required format for the technical assistance reports. This report format will be required for all technical assistance reports submitted to TENRAC with ECM applications after September 30, 1979, as well as all technical assistance funded by federal grants (see Section 15.1 and Appendix F).

14. Applicants should notice state requirements added to the content of the technical assistance report including a description of the interdependence of measures and a description of energy savings calculations and procedures (see Section 15.2).

SUMMARY OF THE MAJOR PROCEDURES AND ACTIVITIES OF THE FEDERAL REGULATIONS AND THE STATE PROGRAM

Phase I: Preliminary Energy Audits (PEA) and Energy Audits (EA)

1. The first year of the program began with date of publication of Phase I rules in the Federal Register, April 2, 1979.
2. The State application for PEA/EA funds was submitted to DOE on April 30, 1979. DOE awarded the PEA/EA funds to TENRAC on June 22, 1979.
3. Energy Audit grant applications for institutions were available November 21, 1979. The deadline for submission of EA grant applications was February 15, 1980.
4. Major components of the PEA include building size, operating schedule, major energy using systems, energy use and cost by month, past energy conservation activities, renewable energy resource potential, and building energy savings potential.
5. The components of the EA include energy auditor certification, descriptive building data including major fuel systems by type, climatic and roof characteristics, maintenance and operating procedures, prior energy savings, and simple retrofit recommendations and assessment. The EA shall include an on-site audit.
6. Eligible buildings (a) must be owned by schools, hospitals, units of local government, and public care institutions; (b) must be heated or cooled and not leased (unless there is documentation of intent to purchase); (c) and constructed on or before April 20, 1977, as identified by date of occupancy permit.
7. Since TA and ECM grants will be awarded on a building-by-building basis, the PEA and EA must be on a building-by-building basis. An ECM application for a complex must also include a PEA and EA report for each building in the complex.
8. Although personnel of the building owner should attend energy auditor training to obtain instruction in conducting an on-site energy audit including the identification of maintenance and operating procedures and potential energy conservation measures as well as instruction on completing the PEA and EA reports, the energy audit grant funds shall be used to employ an engineer,

Source: Plan of the State of Texas for Technical Assistance and Energy Conservation Measures Available to Schools, Hospitals, Units of Local Government and Public Care Institutions, Texas Energy and Natural Resources Advisory Council, 1980.

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architect-engineer team or experienced energy auditor under the supervision of an engineer to conduct an on-site energy audit.

9. There must be a financial interest disclosure by the energy auditor.

10. A copy of the PEA and EA must be maintained by the building owner. One copy of the PEA and EA must be submitted with both the original and the copy of the TA application; and one copy of the PEA, EA, and TA report must be submitted with both the original and the copy of the ECM application. Thus, two complete sets of each application with attached documents must be submitted.

11. The initiation of maintenance and operating procedures recommended in the energy audit is a prerequisite to submitting a technical assistance application unless an exception is granted as provided by 10 CFR 455.41(d).

12. Buildings used primarily for administration (more than 50 percent) are not eligible for energy audit grants with the exception of local education agencies. (Local education agencies are not eligible for TA or ECM grants.) Local governments should interpret this provision to exclude buildings which are used more than 50 percent for internal administrative functions such as payroll processing, personnel recordkeeping, pension system accounting and other sources provided to the employees of the local governmental unit.

13. If it can be shown on the EA report that there have been energy savings of 20% or more between a base year in the past and a subsequent year, as long as there is less than a 10% degree day variance between the two years, then an on-site energy audit is not required. Otherwise, an on-site energy audit is a requirement.

14. Eighteen energy auditor training sessions were conducted in sixteen (16) locations throughout the State during May, 1979. Subsequent EA training will also be conducted by TENRAC. Notice of EA training programs will be sent to all eligible institutions.

15. Energy auditors must attend the TENRAC energy auditor training program or document appropriate skills and experience by attaching educational transcripts and resumes of applicable work experience relating to knowledge of building mechanical, electrical, and energy use systems. An engineer who conducts the energy audit may affix his/her professional seal to the energy auditor certification statement in lieu of attaching applicable work experience and educational materials.

16. TENRAC will conduct follow-up reviews of energy audits conducted at institutions as required by federal regulations.

17. An institution will not be reimbursed for PEA and EA costs committed or

expended by the institution prior to the awarding of energy audit grants by TENRAC.

18. The costs of conducting preliminary energy audits and energy audits shall not be used as in-kind match for technical assistance or energy conservation measures.

19. Costs related to the institutional administration of the PEA and EA programs, including the costs of completing energy audit applications, shall not be claimed as in-kind match credited toward the energy audit project cost as identified in the application.

Phase II Technical Assistance (TA) and Energy Conservation Measures (ECM)

1. Technical assistance is a detailed engineering energy analysis of the building resulting in a final report with recommendations for maintenance and operating procedures and energy conservation measures. Energy conservation measures involve the installation of materials and equipment and the physical modification of the building to save energy and related costs.

2. For both TA and ECM, buildings must be owned by public or private non-profit schools, hospitals, units of local government, and public care institutions.

3. Eligibility for TA requires that an energy audit must have been conducted (the EA includes the PEA) and the recommended maintenance and operating procedures initiated (implemented), unless the building owner justifies the reasons for not implementing the maintenance and operating procedures, prior to submitting the grant application. The application would then be submitted in accordance with federal regulations and the State Plan.

4. In accordance with federal regulations and the State Plan, a qualified technical assistance analyst must be a registered professional engineer certified by the State or an architect-engineer team with chief members licensed by the State. The analyst must also have had appropriate training and experience in electrical and mechanical systems and energy using systems of buildings as well as experience in conducting most aspects of the detailed engineering analyses described in Section 15.2 of the Plan including energy savings, energy cost savings and payback period analyses.

5. The technical assistance analyst must have no financial interest in supplying materials and equipment for ECM. However, he/she may be involved in the design and supervision of the ECM provided the institution follows competitive procurement procedures for project design and supervision.

6. Eligibility for ECM requires that a technical assistance (detailed engineering analysis) must have been conducted according to 10 CFR 455.42 and the State Plan, and the recommended maintenance and operating procedures of the EA and TA report initiated (implemented) prior to the submission of the ECM application unless the building owner justifies the reasons for not implementing the maintenance and operating procedures. The application would then be submitted in accordance with federal regulations and the State Plan. Each ECM must have a simple payback period of not less than 1 year nor greater than 15 years, and the estimated useful life of the measure must be greater than its simple payback period and the remaining useful life of the building.*

7. The TA report shall be evaluated as part of the grant ranking for each ECM application.

8. There are cost limits established on the amount of the TA grants as well as graduated limits on the amount any given building owner may receive.

9. The amount of federal funding for TA and ECM will be an amount up to 50% or up to 90% in cases of severe hardship. The institution must provide the balance of the project cost.

10. One copy of the TA report, TA application, and ECM application should be maintained by the building owner. One original and one copy of the TA application and the ECM application should be submitted to TENRAC with the PEA report and the EA report attached to each application. Each ECM application must also be accompanied by a TA report.

11. Technical assistance applications will be ranked on the basis of the potential for saving energy as well as various program incentives.

12. TA expense (not claimed as match for the TA grant) incurred on or after November 9, 1978 may count as in-kind match on the ECM application upon approval of the Secretary of Energy.

13. Only one TA grant and one ECM grant will be provided for any given building or complex (a complex is a group of two or more buildings at the same location for which one or more common measures are requested).

14. Buildings used primarily (more than 50%) for administration are not eligible for technical assistance and energy conservation measures. Local governments should interpret this provision to exclude buildings which are used more than 50

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*All references to simple payback periods may be modified as a result of the life cycle costing methodology adopted subsequent to the printing of the State Plan.

percent for internal administrative functions such as payroll processing, personnel recordkeeping, pension system accounting and other services provided to the employees of the local governmental units.

15. The institutions shall keep records and reports including (a) a report submitted each January and July on the progress and financial status of the project (b) a final report on TA and ECM projects submitted within 90 days of project completion - the TA final report shall include the TA analyst report and plan for implementing maintenance and operating procedures and acquiring and installing energy conservation measures; the ECM final report shall include a list of energy conservation measures acquired and installed with final projected payback periods and a statement that the ECMs conform with the TA report and ECM application and (c) annual reports for three years or for the life of the program, whichever is shorter. All the above records are to be maintained by the building owner for three years. TENRAC will provide a required format for all reports in order that such information may easily be analyzed and reported to DOE by TENRAC in a consistent manner.

16. The costs of conducting preliminary energy audits and energy audits shall not be used as applicant match for technical assistance or energy conservation measures.

17. Costs related to the institutional administration of the TA and ECM programs, including the costs of completing TA and ECM applications, shall not be claimed as applicant match credited toward the TA or ECM costs as identified in the application.

18. Because of the need to implement some energy conservation measures during the summer months prior to the notice of grant award, an institution may implement measures identified on the ECM application and the TA report up to an amount which is equal to the non-federal match. Such ECMs must be completed with non-federal match only and initiated after the application deadline date established by TENRAC. Such ECMs must be identified fully in the TA report and the ECM application; and the ECMs must meet all eligibility requirements identified in the federal regulations and the State Plan. Such ECMs will also be included in the data used for grant ranking.

19. Institutions must use competitive procurement procedures in securing the services of the technical assistance analyst(s) and in all costs relating to energy conservation measures including project supervision, design, installation, and purchase of equipment and materials. The selection should be based upon the appropriateness of services and items for the project.

TOTAL ENERGY MANAGEMENT: UNDERSTANDING ENERGY USE AND SYSTEMS

Buildings have three fundamental systems which affect energy use. These are energized systems, nonenergized systems and human systems.

Energized systems are those which consume energy directly. Typical energized systems include those used to provide heating, ventilation, cooling, humidification, dehumidification, lighting, hot water heating, interior conveyance, waste handling and cooking, as well as various pieces of equipment such as typewriters and computers.

Nonenergized systems are those which do not consume energy directly, but which do affect the amount of energy which an energized system must expend to get its job done. Typical nonenergized systems include walls, windows, floors, roof, ceiling, doors, etc., as well as weather, landscaping, siting, and similar factors.

Human systems comprise those persons who somehow have an impact on when and in what quantity energy is consumed. These persons include staff and visitors.

If each component of each system functioned as efficiently as possible, the absolute minimum amount of energy required to get the job done would be expended. Although this absolute minimum is an ideal seldom achieved in fact, it nonetheless stands as the ultimate goal of any energy management program.

Using a common example of the interaction of energy systems may help. The example is the automobile. Three methods can be used to reduce the energy consumption of a typical car.

The first method is to drive the car less, an end use restriction. It is a completely acceptable approach, providing that the car is not used less than it is needed.

The second method considers driving habits. This would mean driving the car at 50 MPH, avoiding panic stops, pressing the accelerator as if there were an egg between it and your foot, and so on. This relates primarily to human systems and habits, and would be similar to turning out lights when not needed, closing exterior doors and windows when air conditioning is on, etc.

The third method ensures that all systems in the car which affect energy consumption are operating as efficiently as possible. This requires consideration of applicable end use restrictions and driving habits covered in the first two methods, as well as close-up analysis of other factors which affect energy consumption. The most obvious "other factor" is the engine. If it is in tune, it will run efficiently. But other systems also are affected. Radial tires generally give better gas mileage than nonradials. Any set of tires inflated to the correct pressure gives better mileage than those which are underinflated. Tinted glass reduces interior heat gain which means the air conditioner runs less and so consumes less energy. The exterior finish of the car, when waxed and smooth, has less wind resistance than one which is comparatively rough. Less wind resistance means the engine has to work less which means more efficiency.

Obviously, the third method is the one which is most desirable. It exposes all the different ways in which energy consumption is affected and so creates numerous options -- some more effective than others -- which can be implemented to reduce energy consumption. This not only means more potential energy savings, but also the ability to pick and choose among those options available to reduce consumption in a manner most compatible with time and budget available. And that is essentially what the Energy Audit is intended to do.

Although a building is obviously far more complicated than a car, the basic principles remain the same. Maximum energy savings are achieved by considering all the options, the way in which different options impact upon one another, the potential benefit versus cost, and numerous other factors. It should be stressed, however, that maximum benefit comes from maximum efficiency. Using an untuned car less does not make it more efficient. However, if the car is driven less, driven well, and kept in tune, etc., the least amount of energy is consumed everytime it is used.

With the above in mind, consider how a building's heating and cooling system is affected by other elements of the three energy systems.

The factors which influence heat loss and heat gain, and a few of the many steps which can be taken to reduce their impact, are as follows:

Infiltration: Infiltration refers to the passage of outside air into a building through apertures such as cracks around windows and door jambs, doors and windows left open, outside air dampers which do not close tightly, etc. In winter, infiltration causes heat loss. The cool, outside air which enters the building must be heated to meet desired conditions. During summer, infiltration causes heat gain. The warm outside air which enters the building must be cooled to meet desired conditions. In many cases additional energy must be expended to humidify, dehumidify, or filter the outside air.

Energized, nonenergized and human systems all affect infiltration. If a building's air handling system maintains a positive air pressure in the building so that interior air pressure slightly exceeds exterior pressure, then infiltration is largely eliminated. Nonenergized systems are involved because the condition of the building's exterior envelope, doors, windows, etc., determines the number, size and location of infiltration access points. Human systems are involved because people are responsible for leaving windows and doors open, as well as for observing, reporting and correcting deficiencies which cause excessive infiltration.

Transmission: Heat transmission refers to the amount of heat transmitted into or from a building through the various components of the building envelope, primarily exterior walls, windows, doors, skylights, roof and floor. The amount of heat loss or gain effected by transmission depends on the difference between indoor and outdoor temperatures in accord with the basic principle of heat flow. This principle states that heat always is transmitted from an area of higher temperature to an area of lower temperature. Accordingly, during winter, heat flows from the interior through the building envelope to the exterior. During summer the process reverses and heat is transmitted from outside to inside.

The rate of transmission depends on the composition of the various materials utilized in construction of the building envelope. This rate can be affected by, among other things, additional insulation or storm windows, especially on those portions of the building most affected.

Ventilation: Ventilation is the term used to describe the function of the mechanical ventilation system which draws in fresh outside air. Ventilation impacts on a heating and cooling system in the same way that infiltration does, but in much greater quantities. The rate of ventilation is referred to in terms of cubic feet per minute, or CFM. The greater the CFM, the more heating or cooling is required to offset the heat loss or heat gain caused by the unconditioned air that is brought into the building. In many instances, the single most dramatic energy conservation measure -- and one achieved with virtually no expense -- involves reduction of the ventilation rate.

Lighting: Lighting contributes to a building's heat gain in direct proportion to the wattage of lamps involved. Heat gain is generally beneficial in winter months because it provides heat which otherwise would have to be provided by mechanical systems. In summer months, of course, the mechanical cooling system must compensate for the heat gain from light sources. There are many techniques available to modify lighting systems while keeping them consistent with the need for proper illumination. Several of the techniques involve human systems; that is, the way people use -- or do not use -- lighting for maximum efficiency.

Solar heat: Solar heat, like the heat of light, contributes to heat gain throughout the year. The specific effect of solar heat depends on the geographical area involved, the intensity and direction of the rays, the materials which comprise the building envelope, color and texture of walls, extent and type of solar controls, and other factors. Numerous nonenergized systems -- such as blinds and drapes -- can be utilized to make maximum use of solar effect. In many cases the effectiveness of human systems (e.g., closing the drapes at the correct time) will determine how well the nonenergized systems work.

Equipment: Virtually all energized devices including business machines, coffee makers, printing presses, television sets, etc., contribute to heat gain. In some unusual cases this heat, or portions of it, can be recovered from one part of a building where heat is not needed and be ducted to another part of a building which requires heat.

Occupants: People contribute to heat gain whenever the room temperature falls below their body temperature. People also affect the moisture content of air through perspiration and exhalation. The way in which different types of spaces are utilized will determine the extent of heat gain involved.

In almost all cases, those factors which contribute negatively to heat loss and heat gain can be modified to a greater or lesser extent. Modification can reduce the load placed on heating and cooling equipment and so the energy required for the equipment's operation.

Any modification must consider the human element. But individual comfort need not be severely affected while substantial savings are attained.

It is not an indictment of operations and maintenance personnel to state that almost all buildings, public and privately owned, are enormous energy wasters. Savings of at least 15% should be easily realized with little or no capital cost. Other improvements will usually provide another 15%-20% or more, depending on many factors, but at greater cost. Improvements that are costly should be selected on the basis of how quickly the energy savings pay for the improvements.

School, hospital, local government and public care buildings serve a variety of purposes. They can include:

* general office buildings
* warehouses
* jails/police facilities
* fire stations
* motor pools
* utility buildings
* special treatment centers
* primary and secondary schools
* colleges and universities
* nursing homes
* others

All of these have different primary purposes and construction. Generally, however, each has energy-using characteristics that can be categorized into four major systems: HVAC, Lighting, Building Envelope and Ancillary systems.

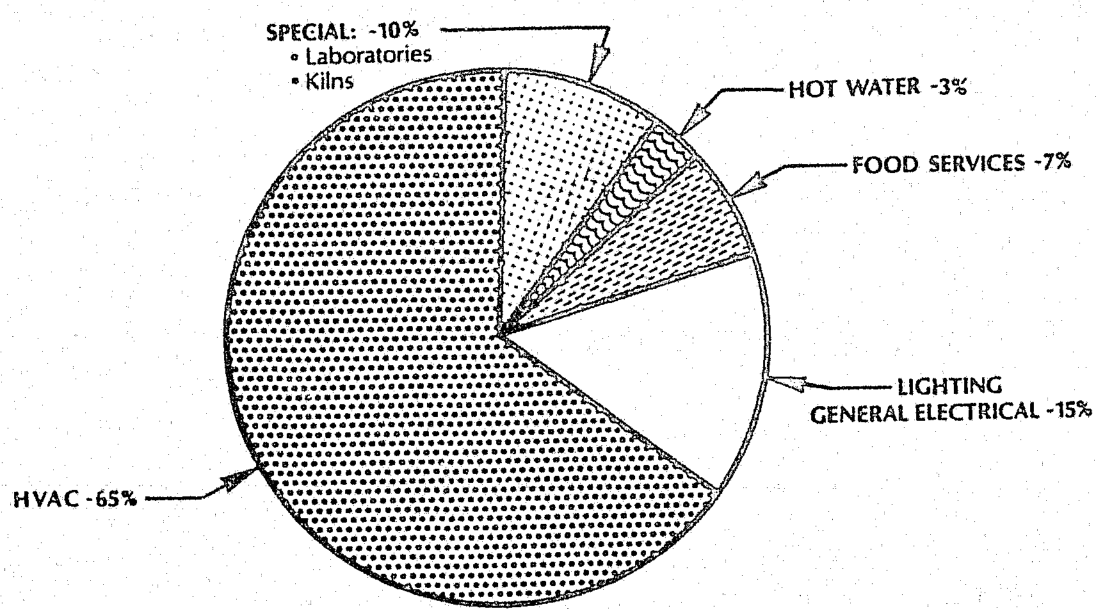
Source: Total Energy Management for Hospitals, Department of Health, Education and Welfare, Publication No. 78-613, Hyattsville, Maryland, 1978, pp. 3-611.

Later tabbed sections describe some important aspects of these systems. These descriptions are helpful in understanding the philosophy behind, and the significance of, the recommendations contained in succeeding sections of this training manual. The relative usage of energy by the various systems varies according to type of agency and building uses:

<u>Schools</u>

In 1977, the nation's educational institutions consumed 1.1 quadrillion BTU's or approximately 1.5% of the total U.S. consumption of energy of all forms. As energy costs continue to erode educational budgets, the importance of a comprehensive energy management program for educational institutions becomes obvious.

As can be seen from the figure below, energy is utilized in a number of ways. Although these percentages will vary, the heating, ventilating, and air conditioning systems (HVAC) usually represent the greatest single usage. Lighting and general electrical represent the second major category.

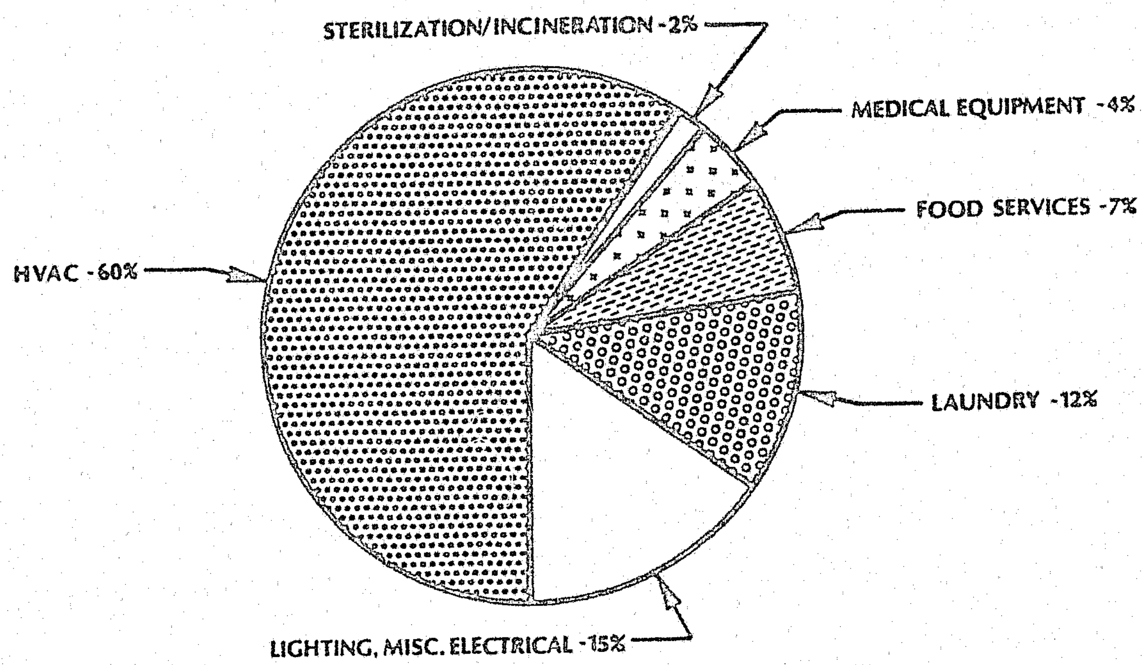


<u>MAJOR ENERGY END USES IN A TYPICAL U.S. EDUCATIONAL INSTITUTION</u>
(Adapted from <u>Energy Audit Workbook for Educational Institutions</u>, Fuel & Energy Consultants, Inc., 1978, Page 2)

Hospitals

Nearly 90% of all U.S. hospitals were designed and constructed before 1974 when the importance of effective energy management was beginning to surface.

Environmental control (heating, ventilating and air conditioning) requires the greatest share of all energy used in a typical hospital; lighting and wall receptacles often represent the second highest end use.

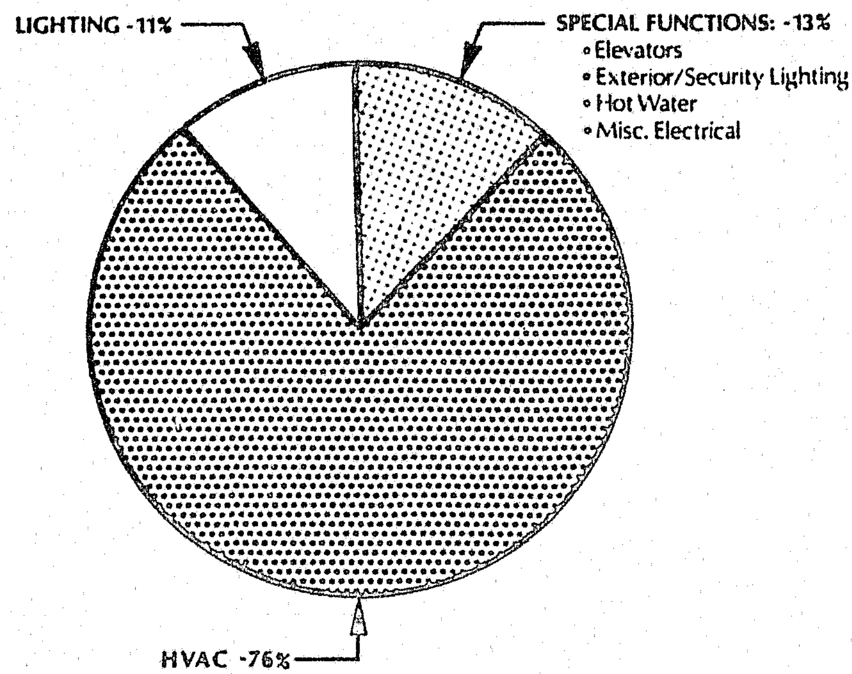


MAJOR ENERGY END USES IN A TYPICAL U.S. HOSPITAL
(Adapted from Practical Energy Management in Health Care Institutions, Blue Cross of Greater Philadelphia, July, 1978, Page 2)

Public Buildings

Although consumption percentages will vary with buildings' designated functions and the climate zones in which they are located, the figure below illustrates major energy uses of a "typical" office building. Again, space conditioning represents the area of highest consumption.

Energy uses for other types of local government buildings (i.e., warehouses, jails, etc., are not available).

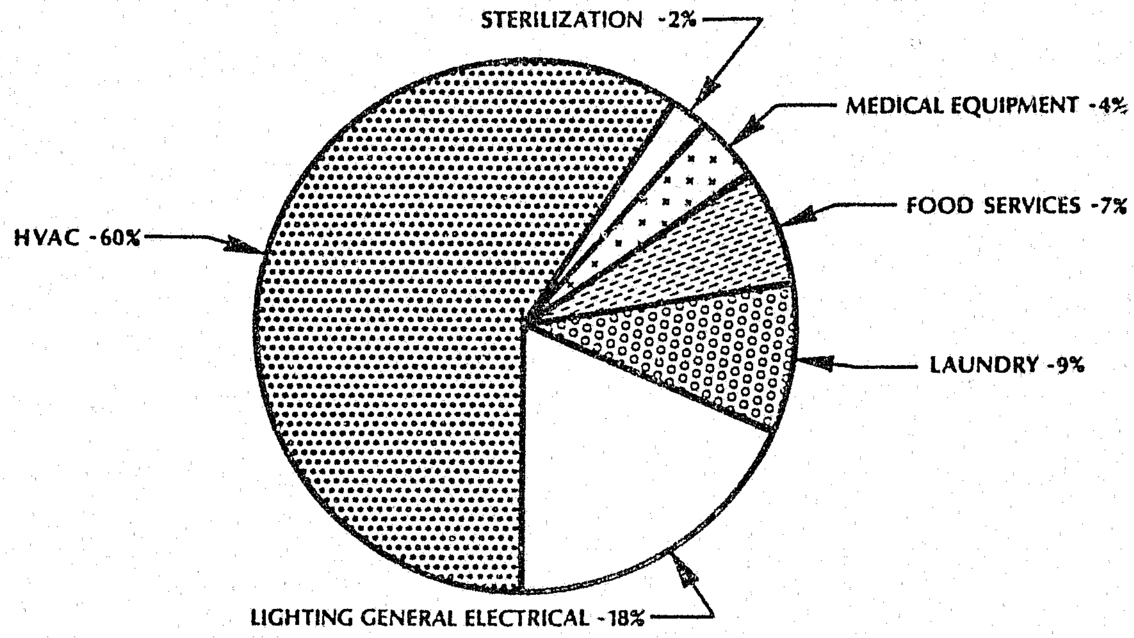


MAJOR ENERGY END USES IN A TYPICAL U.S. OFFICE BUILDING
(Adapted from Energy Audit Workbook for Office Buildings, Fuel & Energy Consultants, Inc., 1978, Page 2)

Long-Term Public Care Facilities

Public care facilities, such as nursing homes, which have not implemented comprehensive energy management programs, usually exhibit a typical energy consumption when compared to other buildings of a similar type, size, use, and climate zone. It is not unusual to discover total energy consumption in the range of 300,000-360,000 BTU's per gross square foot per year, especially in the cooler climate zones.

The figure below indicates typical energy uses for a nursing home facility. Notice that space heating, cooling, ventilation, and lighting contribute to over three-fourths of the total consumption of the facility. These areas, then, represent major energy conservation opportunities.



MAJOR ENERGY END USES IN A TYPICAL U.S. NURSING HOME
(Adapted from Energy You Can Bank On, Colorado Energy Conservation and Alternatives Center for Commerce and Industry, 1978, Page 44)

UNDERSTANDING ENERGY BILLINGS

The first step in any audit is to review all utility bills for the past few years. This may or may not uncover some discrepancies, but it will provide a better understanding of energy billings and give you a handle on where and how energy is consumed in the building.

In most cases a bill will include charges for:

Energy: Most electric utilities use a declining sliding block approach for the energy charge; that is, so much per KWH for the first 1000 KWH, so much per KWH for the second thousand, and so on. In most cases the more KWH you consume the less per KWH you pay.

Customer Related: Some utilities add what is called customer-related costs. These comprise a special charge which reflects part of the distribution investment, part of the operating and maintenance costs, costs for accounting and collection, and so on. This is generally included in the rate base.

Demand: The demand charge is designed to make the customer pay his fair share of the utility's fixed investment in the production, transmission and distribution equipment required to meet his maximum requirements. The charge is based on the rate at which electricity is consumed. The more used at any given time, the larger the utility's investment in generation, transmission and distribution systems has to be. For example, consider two users: A and B, both consuming an equal number of KWH each day. User A consumes electric energy 24 hours a day and user B consumes it eight hours a day. User B requires the utility to have generating and distribution capacity three times the capacity required to serve user A during the 16 hours per day that B is not operating, so user B is billed for this extra investment.

The consumer's actual demand is computed as the average amount of energy consumed in a predetermined interval, usually 15, 30 or 60 minutes. Regardless of the interval, the highest demand recorded during a month becomes the actual demand for the month.

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The effectiveness with which energy is used is rated in terms of load factor:

$$\text{Load} = \frac{\text{Energy Used (in KWH)}}{\text{Highest Demand (in KW)}} \times \frac{1}{\text{Time}} \text{ (720 hrs, usually).}$$

For example, if you consume 700,000 KWH in a 30-day period and during that time establish a peak demand of 1500 KW, you would have a load factor of 64.8%.

In essence, the lower the established demand, the higher the load factor; the higher the load factor; the lower the relative cost for electric service.

The techniques used most often to improve load factor are demand management and demand control. The two are not synonymous terms. Demand control refers to the electro-mechanical procedure of load shedding. Demand management encompasses demand control as well as other activities which can help reduce demand charges even more.

Low Power Factor Penalty: Another charge sometimes applied is a penalty for "low power factor." The power which must be supplied to any induction load such as induction motor, transformer, fluorescent lamp, etc., is made up of real and reactive power.

Real power, or the working power, is measured in kilowatts (KW). The reactive, or magnetizing current, is required to produce the flux necessary for the operation of any induction equipment. Without magnetizing current, energy could not flow through the core of a transformer or across the gap of an induction motor. The unit used to measure reactive power is the kilovar or KVAR.

The vector sum--not the arithmetical sum--of the real power and the reactive power is the apparent power, measured in kilovolt-amperes or KVA.

Power factor is a ratio or real power (KW) to apparent power (KVA) or,

$$\text{Power Factor} = \frac{\text{Real Power (KW)}}{\text{Apparent Power (KVA)}}$$

Electric utilities must provide both real and reactive power for their customers. Reactive power does not register on a kilowatt hour meter, but producing it still requires the utility to put additional investment into generating, transmission and distribution facilities.

Many utilities make up for the expense of producing reactive power by including power factor provisions in their rates. As it so happens, many utilities are defining low power as anything less than .9.

Some power factor improvement will prove worthwhile if your electric use meets one or more of the following conditions:

* power demand is recorded on bill (in KVA);
* electric rate has a KVAR or power factor penalty clause;
* there are problems with voltage regulation or chronic low voltage, or
* load growth limits capacity and you need more capacity.

Causes for low power factor typically are lightly loaded motors which draw an excessive amount of reactive power and increase energy losses in the overall distribution system. Power factor correction can be made through installation of capacitors. It is advisable to review the need for and amount of power factor correction on specific types of loads with either the utility, equipment manufacturer, or your consultant.

DETERMINING HOW MUCH ENERGY YOU USE

The only way that you can determine if you are saving energy and dollars is to keep accurate records. The best sources of information for those records are your utility bills and meters. The purpose of this section is to explain how to interpret your utility bills and how to organize that information so that it is meaningful.

The following two pages illustrate how to record data from your utiliity bill on energy data sheets. The first page demonstrates how to record one month's energy bill information. The next time period's data is to be recorded on the next line. (If you have utility bills from several past years, it would be wise to select a baseline year such as 1975 or 1976 so that you can compare your present usage to it.)

The next page explains how to record electrical data. The same type of information can be recorded for other types of fuel sources on separate data sheets. (Blank data sheets are supplied in the Appendix so that you may begin your own energy data collection.)

After recording your final month's fuel consumption, add the monthly fuel consumptions. Record the total annual consumption in the "total" row.

Please note that two conversion factors are used for both electricity and steam consumption. The larger figures indicates the values to be used in reporting in compliance with the April 2, 1979, Federal Register, Part VI, Department of Energy, Energy Measures and Energy Audits Grant Programs for Schools and Hospitals and Buildings Owned by Units of Local Government and Public Care Institutions: Section 450.42 (a)(11). These larger figures represent point of generation values and include transmission losses and production inefficiencies.

The smaller of the conversion factors for electricity and steam are to be used for institutional record keeping since these reflect on-site consumption. Remember, these factors are standard conversions and are not adjusted for altitude.

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Although the format of your utility bill may be different, the contents are the same. If you have a question, call your local utility for an explanation.

Energy Data Form

Month	A Reading Date FROM	A Reading Date TO	B KWH Used CURRENT	B KWH Used BASE	C Measured Demand KW CURRENT	C Measured Demand KW BASE	D $ Cost CURRENT	D $ Cost BASE	E FCA-Fuel Cost Adjustment $ CURRENT	E FCA-Fuel Cost Adjustment $ BASE	F Total Cost D+E=F CURRENT	F Total Cost D+E=F BASE	G $/KWH F÷B=G CURRENT	G $/KWH F÷B=G BASE
Jan														
Feb														
Mar														
Apr														
May														
Jun														
Jul														
Aug														
Sep														
Oct	10-19	11-20	28080		110.40		$1,135.01		$18.06		$1,153.07		.04	
Nov														
Dec														

	CURRENT	BASE
Column B Totals		
On-Site BTU Conversion Factor	x 3 413	x 3 413
Total BTU's		
Column B Totals		
Point of Generation BTU Conversion Factor	x 11,600	x 11,600
Total BTU's		

ELECTRICITY ______________ KWH/YR

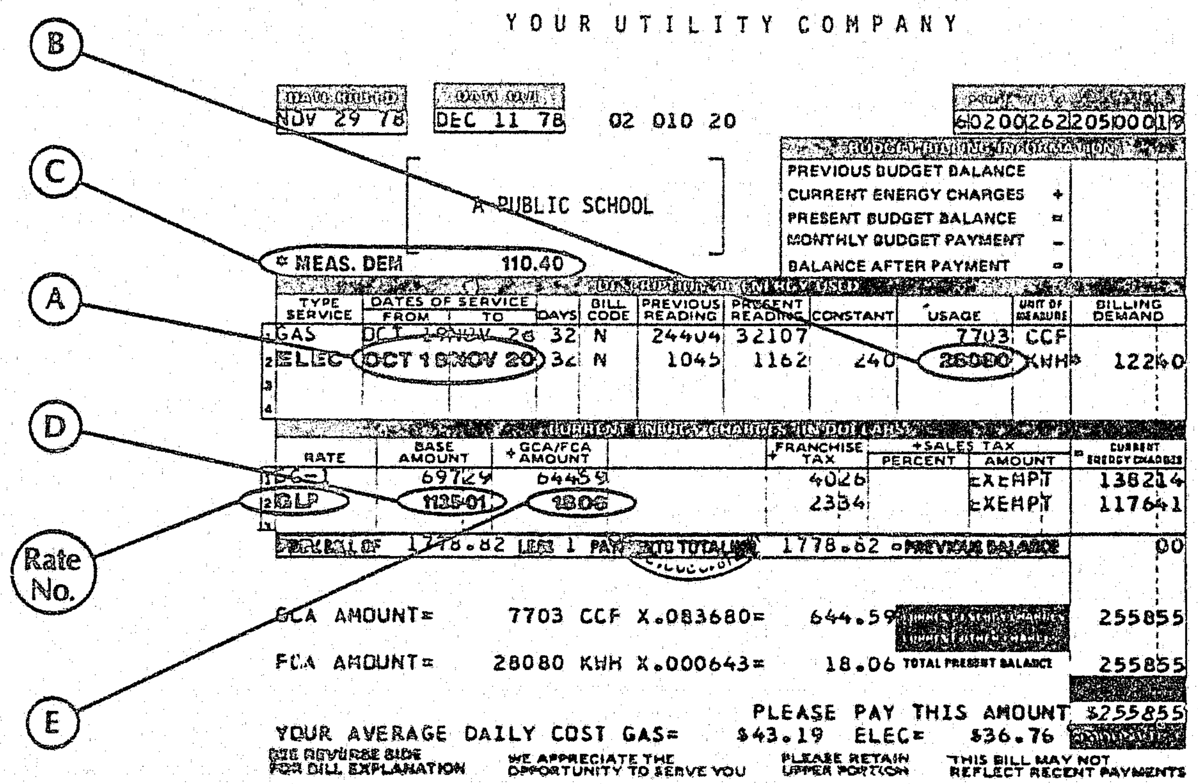
Electricity Rate No. *GLP*

Building *A Public School*

NOTES: This form is intended to be a working document. It is kept monthly, you will see how effective your Energy Conservation Programs are.

CURRENT means current month.

BASE means the corresponding month of your base year.



Energy Data Form

Month	A Reading Date FROM	A Reading Date TO	B Gas Used CCF CURRENT	B Gas Used CCF BASE	C Gas Cost CURRENT	C Gas Cost BASE	D Gas Cost Adjustment CURRENT	D Gas Cost Adjustment BASE	E Total Cost =C+D+E CURRENT	E Total Cost =C+D+E BASE	F $/CCF E÷B=F CURRENT	F $/CCF E÷B=F BASE	G Heating Degree Days CURRENT	G Heating Degree Days BASE
Jan														
Feb														
Mar														
Apr														
May														
Jun														
Jul														
Aug														
Sep														
Oct	10-19	11-20	7703		$697.29		$644.59		$1341.88		$.17		737	
Nov														
Dec														
TOTAL														
BTU Conversion Factor			x 103,000	x 103,000										
Total BTU's														

NATURAL GAS ______________ CCF/YR

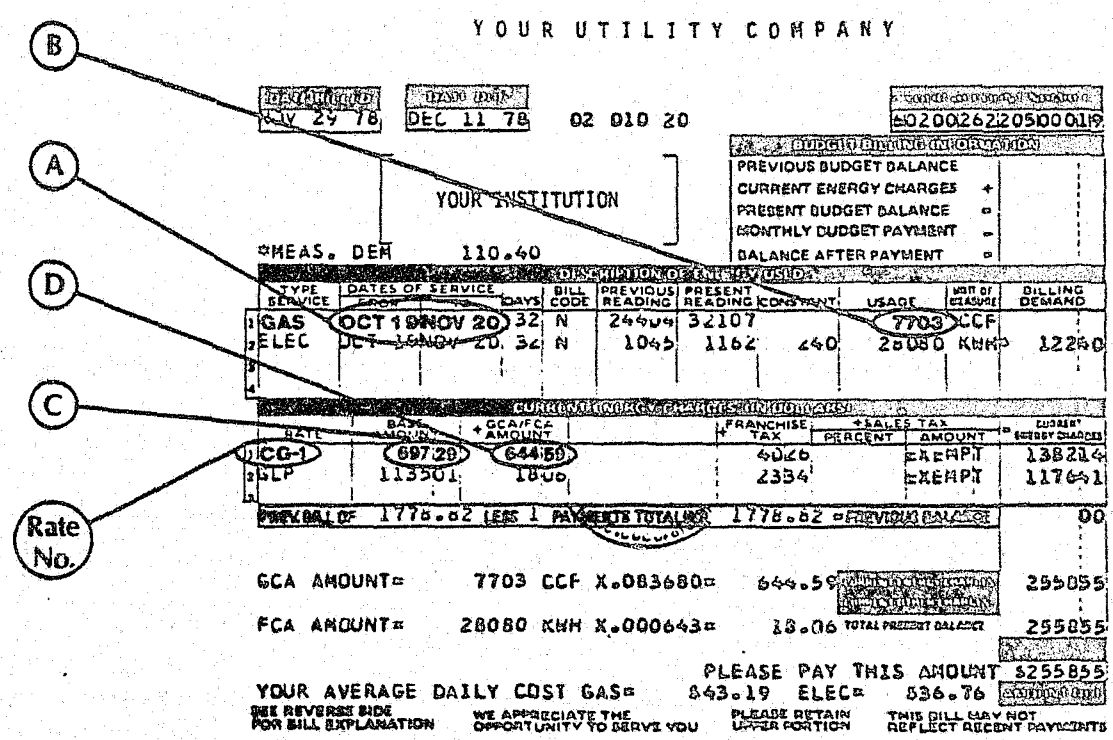
Natural Gas Rate No. *CG-1*

Building *Your Institution*

NOTES: This form is intended to be a working document. If it is kept monthly, you will see how effective your Energy Conservation Programs are.

CURRENT means current month.
BASE means the corresponding month of your base year.

NOTE: Billing units may vary according to your utility's billing procedure. For example, natural gas may be billed in cubic feet (CF), in hundreds of cubic feet (CCF), in thousands of cubic feet (MCF), or in therms. Since the PEA form uses MCF, CCF billings, which are common to small buildings, should be converted to MCF on the PEA form by moving the decimal point one place to the left. The example above uses CCF because of its common use in many locations (e.g., 7703 CCF= 770.3 MCF).



DEVELOPING ENERGY CONSUMPTION DATA

A form such as the one on the following page can be used to log energy consumption data. In addition to supplying data for the Energy Audit, they can be used to develop an Energy Utilization Index, or EUI. The EUI is a reference which reduces all forms of energy used (electricity, oil, gas, etc.) to one common base (British Thermal Units or BTU's) and divides that total by the total number of gross conditioned square feet in the building. The EUI is most useful as a ready reference which quickly shows changes in overall energy consumption from month to month, year to year, one month of one year to the same month in the following year, etc. It also facilitates comparisons between similar buildings enabling you to determine quickly which buildings are most energy efficient.

Detailed Energy Cost and Consumption (ECC) forms are also provided. The optional information identified in these forms will provide for a more thorough understanding of energy consumption characteristics of a building.

ENERGY USE IN BTUs PER SQUARE FOOT

MONTH	ELECTRICITY						NATURAL GAS				OIL				Other				TOTAL ENERGY		
	CONSUMPTION		DEMAND		COST				COST				COST				COST				
	KWH	MILLION BTU	ACTUAL	BILLED	TOTAL	PER KWH	MCF	MILLION BTU	TOTAL	PER MCF	GALLON	MILLION BTU	TOTAL	PER GALLON	Unit	MILLION BTU	TOTAL	PER Unit	MILLION BTU	TOTAL COST	BTU PER SQ.FT.*
JAN																					
FEB																					
MAR																					
APR																					
MAY																					
JUN																					
JUL																					
AUG																					
SEP																					
OCT																					
NOV																					
DEC																					
TOTAL																					

multiply KWH x .0116 = MMBTU

multiply MCF x 1.03 = MMBTU

* Note: BTU per Square Foot: Divide total energy BTU by number of square feet of conditioned (heated and/or cooled) space in building or facility metered for gas and electricity.

TOTAL ENERGY (in MMBTU) ____________________

Gross Conditioned square feet * of ____________________

= __________ MMBTU/SQ.FT./YR

** = EUI of __________ BTU/SQ.FT./YR

**Remember to move decimal point of million BTU figure six places to the right to convert MMBTU/GSF/YR to BTU/GSF/YR

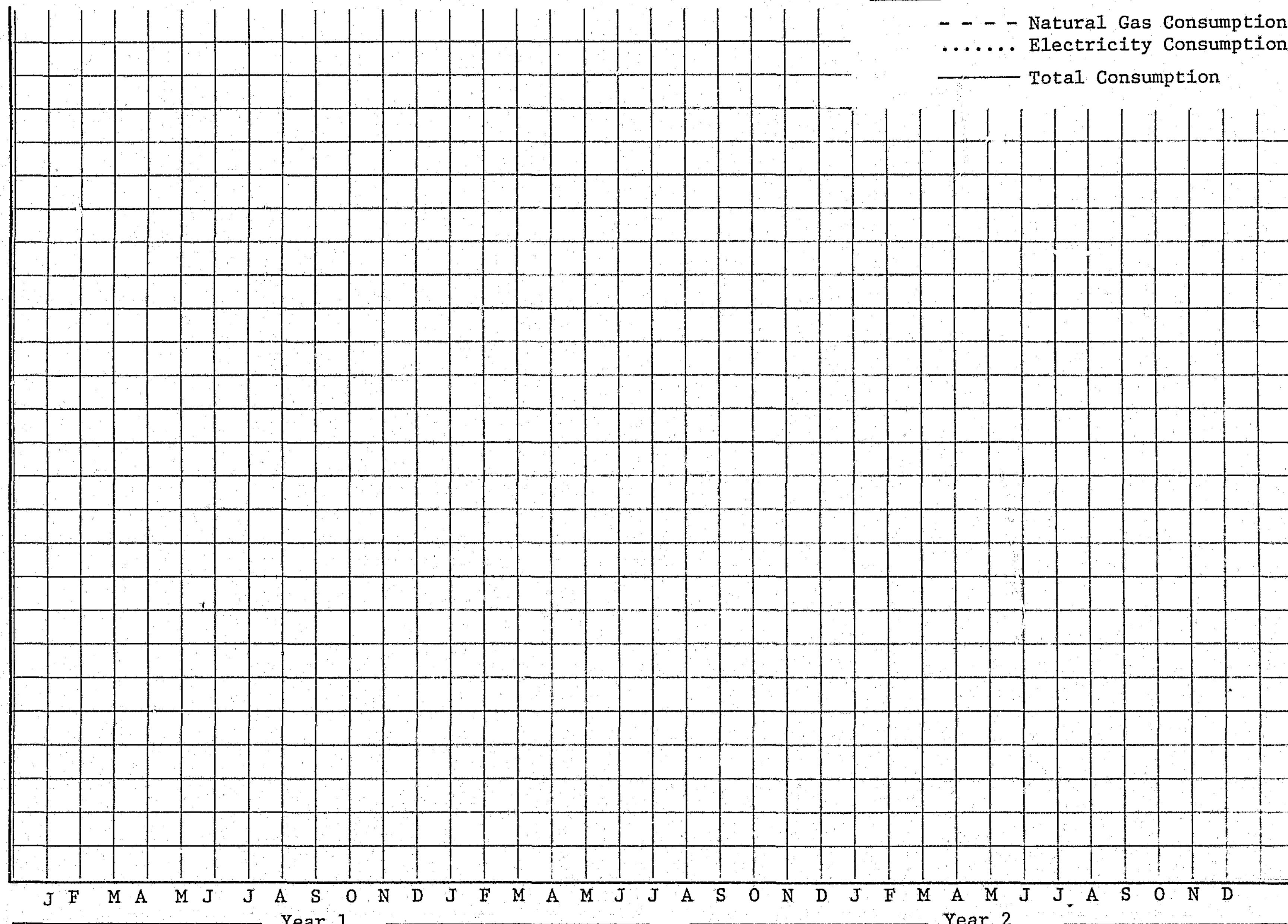
EUI COMPARISON CHART
(complete by using monthly BTU usage from
Energy Consumption Record on previous page)

MBTU

(Insert appropriate units based on building consumption)

Legend:

- - - - Natural Gas Consumption
.... Electricity Consumption
——— Total Consumption



ENERGY COST AND CONSUMPTION SUMMARY FORMS (ECC 1-6)

Completed samples of Energy Cost and Consumption (ECC) summary forms follow. They are offered as a suggested method of monitoring energy consumption in buildings, especially before and after the implementation of maintenance and operating procedures and the installation of energy conservation measures. Such information is required by 10 CFR 455, Para. 455.63(c) of the federal regulations which states that "such annual reports shall identify each building and shall provide data on the actual energy use of that building ... on a monthly or quarterly as well as annual basis consistent with the annual billing cycle for the building."

See the Appendix for blank forms.

CONTINUED

1 OF 5

(SAMPLE)

U.T.S.A. (MAIN CAMPUS) – 401
(a) BUILDING NAME AND I. D. NUMBER

(c) FISCAL YEAR 1976-77

FORM ECC-1 2/79 REV 5/79

ELECTRICITY:

(v) METER TYPE: K. W. X KVAR — DEMAND PERIOD:

* KWH X OTHER — 15 Min. X Other — Min.

MONTH	10^3 GROSS SQ. FT. BUILDING SIZE (d)	DAYS IN BILLING PERIOD (e)	DEMAND KVA (f)	DEMAND P.F. (g)	DEMAND KW (j)	DEMAND CHARGE $ (k)	10^3 KWH (l)	LOAD FACTOR (m)	FULL COST ADJUST. $ (n)	TOTAL CHARGES $ (o)	COST PER KWH ¢ (p)	10^6 BTU TOTAL SITE (r)	10^6 BTU TOTAL SOURCE (s)	10^3 BTU PER SQ. FT. SITE (t)	10^3 BTU PER SQ. FT. SOURCE (u)
SEPTEMBER	799.4	30	N.A.	.92	3,192	7,062	1,316.0	.57	26	37,227	2.83	4491.5	15266	5.62	19.08
OCTOBER	799.9	32		.92	3,436	6,939	1,360.8	.56	⟨640⟩	37,491	2.76	4,644.5	15,785	5.81	19.73
NOVEMBER		31		.92	3,416	7,555	1,349.6	.53	1,039	39,456	2.92	4,606.0	15,655	5.76	19.57
DECEMBER		33		.91	3,080	6,816	1,215.2	.50	12,310	46,953	3.86	4,147.5	14,096	5.19	17.62
JANUARY		29		.91	3,136	6,939	1,282.4	.59	⟨4565⟩	31,747	2.48	4,377.0	14,876	5.47	18.60
FEBRUARY		29		.91	3,136	6,939	1,349.6	.62	13	37,885	2.81	4,606.0	15,655	5.76	19.57
MARCH		29		.92	3,136	6,939	1,344.0	.62	3320	41,061	3.06	4,587.0	15,590	5.73	19.49
APRIL		32		.92	3,136	6,939	1,332.8	.55	2266	39,747	2.98	4,549.0	15,460	5.69	19.32
MAY		30		.92	3,080	6,816	1,148.0	.52	1722	34,808	3.03	3,918.0	13,317	4.90	16.65
JUNE		29		.92	3,080	6,816	1,260.0	.59	3125	38,809	3.08	4,300.5	14,616	5.38	18.27
JULY	↓	32		.92	3,024	6,693	1,304.8	.62	⟨496⟩	36,118	2.77	4,453.5	15,136	5.57	18.92
AUGUST	799.9	29		.92	3,136	6,939	1,198.4	.55	1019	35,383	2.95	4,090.0	13,901	5.11	17.38
ANNUAL TOTALS	799.9	365	↓	AVG. .92	AVG. 3,141	83,392	15,461.6	AVG. .56	19,139	456,685	AVG 2.95	52,770.5	179,353	65.97	224.22

ANNUAL PEAK DEMAND: 3416 *

IN KWH

(m) = (l) + [(j) x (e) x 24 hrs.]
(r) = (l) x 3.413
(s) = (l) x 11.60

*

(t) = (r) + (d)
(u) = (s) + (d)
(p) = (o) + [(l) x 1000]

*

NAME OF ELECTRIC UTILITY: CITY PUBLIC SERVICE
ADDRESS: P.O. Box 2678, S.A. Tx. 78289
TELEPHONE: 512-225-2541
CONTACT: JIM BOWEN
ELECTRIC RATE DESIGNATION: LLP

*

ANNUAL ELECTRIC COST PER SQ. FT. = ANNUAL TOTAL (o) + (d) = $\frac{\$456,685}{799,900}$ = ¢0.57

ANNUAL ELECTRIC BTU COST/MMBTU (1,000,000 BTU) = ANNUAL TOTAL (o) ÷ ANNUAL TOTAL (r) = $\frac{\$456,685}{52,770.5}$ = \$8.65 (COST AT SITE)

* *

* INDICATES SOME POSSIBLE ENTRY CONFUSION

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(SAMPLE)

U.T.S.A. (MAIN CAMPUS) – 401
(a) BUILDING NAME AND I. D. NUMBER

FISCAL YEAR 1976-77
(c)

NATURAL GAS: *

(b) HEAT CONTENT (at site) 1033 BTU PER CU. FT. (MAY VARY FROM MONTH-TO-MONTH)

MONTH	10^3 GROSS SQ. FT. BUILDING SIZE (d)	DAYS IN BILLING PERIOD (e)	BILLED MCF (f)	FUEL COST ADJUST. $ (g)	TOTAL CHARGES $ (h)	COST PER MCF $ (j)	10^6 BTU TOTAL SITE (k)	10^6 BTU TOTAL SOURCE (l)	10^3 BTU PER SQ. FT. SITE (m)	10^3 BTU PER SQ. FT. SOURCE (n)	FUEL COST ¢ PER SQ. FT. (o)	FUEL COST PER MMBTU $ SITE (p)
SEPTEMBER	826.1	30	277.5	49	597	2.15	286.7	N.D.A.	.325	N.D.A.	.07	2.08
OCTOBER		30	638.7	91	1314	2.06	659.8		.799		.16	1.99
NOVEMBER		33	1059.4	129	2139	2.02	1094.4		1.325		.26	1.95
DECEMBER		33	1169.5	202	2418	2.07	1208.1		1.462		.29	2.00
JANUARY		35	1413.0	(288)	2384	1.69	1459.6		1.767		.29	1.63
FEBRUARY		24	665.4	315	1583	2.38	687.4		.832		.19	2.30
MARCH		28	710.3	337	1694	2.38	733.7		.888		.21	2.31
APRIL		32	933.1	442	2216	2.37	963.9		1.167		.27	2.30
MAY		30	804.7	381	1915	2.38	831.3		1.006		.23	2.30
JUNE		30	717.1	255	1625	2.27	740.8		.897		.20	2.19
JULY		32	724.6	85	1469	2.03	748.1		.906		.18	1.96
AUGUST	826.1	29	620.1	115	1303	2.10	640.6		.775		.16	2.03
ANNUAL TOTALS	826.1	366	9,733.4	2113	20,657	AVG. 2.12	10,054.6		12,171		TOTAL 2.51¢	AVG. $2.05 *

(j) = (h) ÷ (f)
(k) = (f) x (b) ÷ 1000
(l) = (f) x (b) ÷ 1000 (?) N.D.A.
(m) = (k) ÷ (d)
(n) = (l) ÷ (d)
(o) = (h) ÷ (d) x 1000
(p) = (h) ÷ (k)

*

* NAME OF GAS UTILITY: CITY PUBLIC SERVICE
ADDRESS: P.O. BOX 2678, S.A., TX. 78289
TELEPHONE: 512-225-2541
CONTACT: JIM BOWEN
GAS RATE: INDUSTRIAL, CLASS A *

FORM ECC-2 2/79 REV. 3/79

* INDICATES POSSIBLE ENTRY CONFUSION

(a) BUILDING NAME AND I.D. NUMBER

METER TYPE:

(c) FISCAL YEAR ______

CHILLED WATER and STEAM/HOT WATER (STRIKE ONE)

CHILLED WATER ______ METER MFGR. ______
STEAM ______ METER MFGR. ______
CONDENSATE ______ METER MFGR. ______

MONTH	10^3 GROSS SQ.FT. BUILDING SIZE (f)	DAYS IN BILLING PERIOD (g)	NET BILLED TON-HRS. CHILLED WATER (h)	NET BILLED MMBTU STEAM/HW (j)	FUEL COST ADJUST. $ (k)	TOTAL CHARGES $ (l)	10^6 B T U TOTAL SITE (m)	10^6 B T U TOTAL SOURCE (n)	10^3 B T U PER. SQ. FT. SITE (o)	10^3 B T U PER. SQ. FT. SOURCE (p)	ENERGY COST PER SQ.FT. $ (r)	ENERGY COST $ PER MMBTU (TOTAL) SITE (s)	
SEPTEMBER													
OCTOBER													
NOVEMBER													
DECEMBER													
JANUARY													
FEBRUARY													
MARCH													
APRIL													
MAY													
JUNE													
JULY													
AUGUST													
	**	*	*	*	* $	* $	*	*	*	*	* $	$ AVG.	

* ANNUAL TOTAL
** SAME AS AUGUST

(m) = (h) x 0.012 + (j)
(n) = (m) x (1.0+) Factor (?) N.D.A.
(o) = (m) ÷ (f)
(p) = [(m) ÷ (f)] x (1.0+) Factor (?) N.D.A.

(r) = (l) ÷ [(f) x 1000]
(s) = (l) ÷ (m)

NAME OF UTILITY: ______

ADDRESS: ______

TELEPHONE: ______

CONTACT: ______

RATES: ______

(a) BUILDING NAME AND I.D. NUMBER ______________________

METER TYPE:

(c) FISCAL YEAR ______________

CHILLED WATER and STEAM/HOT WATER (STRIKE ONE)

CHILLED WATER ______________ METER MFGR. ______________

STEAM ______________ METER MFGR. ______________

CONDENSATE ______________ METER MFGR. ______________

MONTH	10^3 GROSS SQ.FT. BUILDING SIZE (f)	DAYS IN BILLING PERIOD (g)	NET BILLED TON-HRS. CHILLED WATER (h)	NET BILLED MMBTU STEAM/HW (j)	FUEL COST ADJUST. \$ (k)	TOTAL CHARGES \$ (l)	10^6 B T U TOTAL SITE (m)	10^6 B T U TOTAL SOURCE (n)	10^3 B T U PER. SQ. FT. SITE (o)	10^3 B T U PER. SQ. FT. SOURCE (p)	ENERGY COST PER SQ.FT. \$ (r)	ENERGY COST \$ PER MMBTU (TOTAL) SITE (s)	
SEPTEMBER													
OCTOBER													
NOVEMBER													
DECEMBER													
JANUARY													
FEBRUARY													
MARCH													
APRIL													
MAY													
JUNE													
JULY													
AUGUST													
	**	*	*	*	* \$	* \$	*	*	*	*	* \$	\$ AVG.	

* ANNUAL TOTAL
** SAME AS AUGUST

(m) = (h) x 0.012 + (j)
(n) = (m) x (1.0+) Factor (?) N.D.A.
(o) = (m) ÷ (f)
(p) = [(m) ÷ (f)] x (1.0+) Factor (?) N.D.A.

(r) = (l) ÷ [(f) x 1000]
(s) = (l) ÷ (m)

NAME OF UTILITY: ______________

ADDRESS: ______________

TELEPHONE: ______________

CONTACT: ______________

RATES: ______________

(a) BUILDING NAME AND I. D. NUMBER ______________________ (c) FISCAL YEAR ____________

(d) FUEL OIL: _____ #2 @ 138,690 BTU/GAL., _____ #6 @ 149,690 BTU/GAL SOURCE BTU/GAL. ____________

(e) PROPANE: _____ AT 95,476 BTU/GAL., _____ OTHER ____________ BTU/GAL. SOURCE BTU/GAL. ____________

MONTH	10^3 GROSS SQ. FT. BUILDING. SIZE (f)	DAYS IN BILLING PERIOD (g)	AMT. BILLED 10^3 GALLONS (h)	FUEL COST ADJUST. $ (j)	TOTAL CHARGES $ (k)	COST Per GAL. $ (l)	10^6 B T U TOTAL SITE (m)	10^6 B T U TOTAL SOURCE (n)	10^3 B T U PER SQ. FT. SITE (o)	10^3 B T U PER SQ. FT. SOURCE (p)	FUEL COST PER SQ. FT. $ (r)	FUEL COST PER MMBTU SITE $ (s)	
September													
October													
November													
December													
January													
February													
March													
April													
May													
June													
July													
August													
	**	*	*	* $	* $	AVG. $	*	*	*	*	* $	$ AVG.	

* ANNUAL TOTAL - ** SAME AS AUGUST

(l) = (k) ÷ (h) x 1000
(m) = (h) x [(d) or (e) ÷ 1000]
(n) - (m) x (1.0+) factor N.D.A.
(o) = (m) ÷ (f)

(p) = (n) ÷ (f)
(r) = (k) ÷ [(f) x 1000]
(s) = (k) ÷ (m)

NAME OF OIL-PROPANE SOURCE: ____________

ADDRESS: ____________

TELEPHONE: ____________

CONTACT: ____________

FUEL RATE: ____________

FORM ECE-4 2/79 REV. 3/79

(a) BUILDING NAME AND I.D. NUMBER ______________________

(c) FISCAL YEAR ______________

OTHER FUEL TYPE: (d) FUEL NAME: ______________

METERING METHOD & MFGR. ______________ (e)

BTU CONTENT PER UNIT MEASURE ______________ (t)

MONTH	10^3 GROSS SQ. FT. BUILDING SITE (f)	DAYS IN BILLING PERIOD * (g)	QUANTITY BILLED (h)	FUEL COST ADJUST. $ (j)	TOTAL CHARGES $ (k)	COST PER FUEL UNIT $ (l)	10^6 B T U TOTAL		10^3 B T U PER SQ. FT.		FUEL COST PER SQ.FT. $ (r)	FUEL COST PER MMBTU SITE $ (s)	
							SITE (m)	SOURCE (n)	SITE (o)	SOURCE (p)			
SEPTEMBER													
OCTOBER													
NOVEMBER													
DECEMBER													
JANUARY													
FEBRUARY													
MARCH													
APRIL													
MAY													
JUNE													
JULY													
AUGUST													
	**	*	*	*$	*$	$ AVG.	*	*	*	*	*$	$ AVG.	

*ANNUAL TOTAL ** SAME AS AUGUST

(h) - from billing
(l) = (k) ÷ (h)
(m) = (h) x (t) ÷ 10^6
(n) = (m) x (1.0÷) Factor (?) N.A.
(o) = (m) ÷ (f)
(p) = (n) ÷ (f)
(r) = (k) ÷ (f)
(s) = (k) ÷ (m)

NAME OF UTILITY CO.: ______________

ADDRESS: ______________

TELEPHONE: ______________

CONTACT: ______________

RATE: ______________

(SAMPLE)

U.T. SAN ANTONIO (MAIN CAMPUS) - 401
(a) BUILDING NAME AND I. D. NUMBER

(c) FISCAL YEAR 1976-77

FORM ECC-6 2/79 REV. 3/79

* CITY WATER *

(g) METER TYPE: TURBINE X; POS. DISPL. —; OTHER —

METER MFGR. HERSEY

*

MONTH	HEATING DEGREE DAYS (h)	COOLING DEGREE DAYS (i)	DAYS IN BILLING PERIOD (k)	BILLED CCF: DOMESTIC B.E. (l)	IRRIGATION B.E. (m)	PROCESS B.E. (n)	TOTAL (o)	TOTAL CHARGES $ (p)	COST PER CCF $ (r)	CCF PER 1000 SQ.FT. (s)	10^3 GROSS SQ. FT. BUILDING SIZE (t)
SEPTEMBER	0	383	30	4,288	7,638	3,880	15,806	4,007	.25	19.1	826.1
OCTOBER	160	45	31	4,288	11,373	2,190	17,851	4,704	.26	21.6	
NOVEMBER	382	0	30	4,288	8,719	1,758	14,765	3,902	.26	17.9	
DECEMBER	461	0	30	3,216	11,322	1,818	16,356	4,315	.26	19.8	
JANUARY	643	0	32	3,216	11,822	1,835	16,873	4,450	.26	20.4	
FEBRUARY	336	3	28	3,216	11,153	2,238	16,607	4,381	.26	20.1	
MARCH	144	158	31	3,216	10,487	2,847	16,550	4,366	.26	20.0	
APRIL	32	98	30	3,216	10,567	2,567	16,350	4,314	.26	19.8	826.1
MAY	0	311	30	2,144	10,931	3,155	16,230	4,283	.26	19.4	835.8
JUNE	0	502	31	2,144	9,676	4,750	16,570	4,371	.26	19.8	
JULY	0	620	31	2,144	9,553	5,103	16,800	4,431	.26	20.1	
AUGUST	0	681	31	2,144	6,850	5,856	15,850	4,184	.26	19.0	835.8
ANNUAL TOTAL	2,158	2,701	365	41,808	116,803	37,997	196,608	51,708	.26	237.0	835.8

SEE "LOCAL" WEATHER DATA FOR DEGREE DAY ENTRIES

CCF = 100 CU. FT. = 748 GAL. = 6235.5 lbs.
1000 Gal - 1.34 C.C.F.

FOR (l), (m), and (n) USE BEST ESTIMATE IF NOT METERED SEPARATELY

(o) = CCF FROM BILLING
(r) = (P) ÷ (o)
(s) = (o) ÷ (t) x 1000 = CCF/SQ.FT
(s) = (o) ÷ (t) = CCF/1000 SQ.FT. *

* *

NAME OF CITY WATER UTILITY: CITY WATER BOARD
ADDRESS: P.O. Box 2449, S.A., Tx. 78298
TELEPHONE: 512-225-7461
CONTACT: WALTER GARRISON
RATES: WATER: $73.60 - FOR 1ST 250 CCF
0.19 - ALL REMAINING CCF
SEWER: $71.76 - FOR 1ST 500 CCF
0.07 - ALL REMAINING CCF

* INDICATES POSSIBLE ENTRY CONFUSION.

INSTRUCTIONS

ENERGY COST AND CONSUMPTION SUMMARY FORMS (ECC-1 - 6)

ECC-1: ELECTRICITY

(d) Building size (expressed as millions of gross square feet), including significant areas which are not heated or cooled.

(e) Number of calendar days shown on billing.

(f)(j) Demand will be in terms of KVA OR KW. Fill in appropriate factor as shown on billing.

(g) Power factor as shown on billing.

(k) Monthly demand charges from billings or rate schedule.

(l) Thousands of kilowatt hours (1,215,627 KWH would be entered as 1,215.)

(m) Actual consumption (KWH) divided by the projection of what the consumption would have been if usage were at the demand (peak) rate for each hour in the billing period.

(n) Obtained from billing.

(o) Obtained from billing.

(p) Total monthly billing divided by total monthly consumption. ($.0236 would be entered as 2.36¢ per KWH).

(r) Converts kilowatt hours used in the building to millions of BTU's.

(s) Converts kilowatt hours used in the building to millions of BTU's required to generate the electricity at the power plant. This number is larger because power plants are not 100% efficient, and distribution losses are also unavoidable.

(t)(u) Site and source building energy usage per square foot expressed as thousands of BTU's per square foot.

NOTE: When performing mathematical computations, it is suggested that all table entries be converted from millions or thousands to the actual number, using all significant zeros. For example, convert 1,215 x 10^3 KWH entered in Column (l) to 1,215,000 prior to any calculations.

ECC-2: NATURAL GAS

(f) Thousands of cubic feet from monthly billing. (Be sure that billing is expressed in thousands.)

(h) Enter 1,030 BTU's per cubic foot as the heat content of natural gas.

(j) Gas cost expressed as dollars per thousand cubic feet of gas consumed.

(k) Convert thousands of cubic feet to millions of BTU's.

(l) Disregard column for source energy.

(m) Energy consumption expressed in thousands of BTU's per square foot.

(n) Disregard column.

(p) Fuel cost per million BTU's.

ECC-3: CHILLED WATER AND STEAM OR HOT WATER
(If steam heat, cross out hot water and vice versa.)

(h) Chilled water is usually billed in "ton-hours".

(j) Steam/hot water is usually billed in terms of millions of BTU's.

(k) Disregard if not shown on bill.

(m) Compute total heating and cooling energy by converting ton-hours of cooling to millions of BTU's (multiply "h" by .012) and adding the heating energy entered in Column j. Enter sum in Column m.

(n) Disregard entry.

(p) Disregard entry.

(r) Dollars per square foot.

(s) Dollars per million BTU's.

ECC-4: FUEL OIL/PROPANE

Completion of this form is similar to previous ECC forms, with the exception that fuel oil and propane are billed in gallon quantities. These quantities are converted to BTU's, and using conversion factors provided, entered in the appropriate columns.

(n) (p) Disregard columns.

ECC-5: OTHER FUELS

If a fuel other than those previously mentioned is used to heat or cool the building, enter the appropriate data on ECC-5. BTU values for other fuels can be obtained in most engineering handbooks.

ECC-6: WATER

(h)(j) These columns are for recording heating and cooling degree days obtained from the weather station nearest the building being audited. Refer to the Appendix in this manual for example of standard weather data information. Published weather data is available on a monthly basis (approximately 30 days after the last day of the month) and as an annual summary which is published in April or May of each year. In addition, degree day information may be requested by telephone from weather stations. In any event, be sure that the degree days entered are for the appropriate month of that year and not for some previous year.

CALCULATING SIMPLE PAYBACK

There are several accepted approaches to calculating the period of time that may be required for the energy cost savings of the Energy Conservation Measures (ECMs) to equal the initial investment. The variations generally relate to such financial considerations as interest rates, availability of capital, projected fuel prices, etc.

For purposes of the Energy Audit, however, simple payback is sufficient. It is the simplest to calculate, and is generally quite effective in measuring the relative need for ECMs. Simple payback is the specific method of calculation for the Energy Audit required by NECPA.

To determine the simple payback, divide the estimated implementation cost of the ECM by the estimated annual energy savings. The result is the number of years required to pay off the initial capital investment.

$$\text{Simple Payback (years)} = \frac{\text{Initial Cost of ECM in \$}}{\text{Annual Energy Savings in \$}}$$

Generally, authorities recommend not proceeding with items that require more than seven to ten years to pay off. This varies greatly according to the local needs, financial situation and political climate. The projects you do first are almost always going to have the greatest and fastest results. It should be remembered that the eligible payback period for each ECM in the NECPA program is between one year and fifteen years.

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LIFE CYCLE SAVINGS

The Simple Payback calculation and ranking is an accurate way to compare energy conservation options but is only intended for comparison. Actual dollar savings to implement a conservation option must include energy price escalation on a life-cycle basis.

Life-cycle savings is the dollar savings accrued by an energy saving option over its life.

Suppose an energy saving option with a 7-year life-cycle saved $100 a year in energy costs at current prices. If energy did not increase in cost, then the energy option would have saved $700 over its 7-year life. However, prices of energy are escalating at approximately 20% per year. As a result, an option which saves $100 this year will save much more in the following years. The following chart is used to find the appropriate escalation factor at selected escalation rates.

ENERGY PRICE ESCALATION*

Energy Cost Escalation Rate	ESCALATION FACTOR 5.00 years	7.00 years	10.00 years	15.00 years
10%	6.72	10.44	17.53	34.95
15%	7.75	12.73	23.34	54.72
20%	8.93	15.50	31.15	86.44

*Adapted from Fritz Dressler, Practical Energy Management in Health Care Institutions, 199, p. 7.

For example, the escalation factor for an option with a 7-year life expectancy and at a 20% escalation rate would be 15.50. To determine the life-cycle savings, multiply the escalation factor times the first years savings. If an item saves $100 the first year and has a 7-year life expectancy, then:

$100 x 15.50 = $1,500 saved over the life of the item.

Source: Energy You Can Bank On, page 105, developed by the Colorado Energy Conservation and Alternatives Center for Commerce and Industry for the Colorado Office of Energy Conservation.

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Besides the material cost, equipment cost, labor cost, design cost, project supervision cost, and energy price escalation, other factors should be considered in determining the true return on the investment in an energy conservation project for a building. Such other factors include recurring costs in connection with the operation, preventative and corrective maintenance, and inventory management of the energy conservation measures. In order to give a building owner a true picture of the energy cost savings over the lifetime of the measure, all relevant factors must be considered.

THE NECPA ENERGY AUDIT

Those directing and performing the NECPA Energy Audit must know what to look for and understand what they are looking at. The level of expertise required usually is marginally proportionate to the complexity of the systems involved. One of the keys to making the survey is lack of bias. One of the problems which feasibly could develop when in-house personnel are involved is a tendency -- conscious or subconscious -- to downplay certain deficiencies which could reflect poorly on certain individuals. This is why the individual with day-to-day responsibility for the building's operation is absolutely excluded from performing the NECPA Energy Audit for that building.

Whoever conducts the survey first should obtain a copy of the architectural, mechanical and electrical design drawings and specifications to familiarize himself with the building's configuration and design, and electrical and mechanical systems and equipment layout, operation and control. If such drawings are not available, it may be necessary to develop single-line diagrams of existing mechanical and electrical systems. The surveyor also should be given access to any written operating and maintenance procedures manuals supplied by equipment manufacturers or original building design professionals. He also should be familiar with utility rate schedules as well as materials which related to any planned building modernization programs and their applications.

Once the surveyor has familiarized himself with the various building systems and equipment data, the next step is to conduct the walk-through survey. The basic tools required for this task are writing implements and paper, although a tape recorder may prove to be a valuable substitute, especially for interviews with selected personnel. Instruments which could be helpful but are not required for the Energy Audit generally include lightmeters, thermometers and 3/4"-12 ft. steel tape.

The items which require investigation and analysis are listed in the NECPA Preliminary Energy Audit (PEA) and Energy Audit (EA) Forms and the maintenance and operating procedures checklist included in each section of the workbook.

PERFORMING THE ENERGY AUDIT

The NECPA Energy Audit is designed to be conducted with a minimum of effort. Here is a sample of the steps, approximate time required and appropriate individuals who can perform each step.

Steps	Performed By	Approximate Time Needed for Small to Average Building*
Preliminary Energy Audit 1. Collect utility bills	Utility company and/or clerical personnel	1 or 2 days (elapsed time)
2. Review blueprints and plans, determine square footage, location of major equipment, etc.	Auditor	1 - 2 hours
3. Convert utility usage to BTUs/sq.ft./year	Auditor	½ hour
4. Complete all energy use data, building name, location, etc. on the PEA.	Auditor	2 - 4 hours
5. Complete pages 5 and 6 of the PEA.	Engineer, architect or building personnel familiar with building characteristics	3 - 6 hours
Energy Audit 6. Conduct walk-thru, check HVAC, Lighting, Envelope, Ancillary equipment and renewable resource potential in order or simultaneously. The M&O checklist included in each each section of the workbook or similar checklists should be used.	Auditor (one or two assistants to record findings, if possible)	2 - 6 hours for small to average size building (10,000 25,000 sq.ft.)
7. Make recommendations and complete Energy Audit Forms	Auditor/assistants	8 - 16 hours

* 10,000 - 30,000 square feet

ENERGY MANAGEMENT PLAN OUTLINE

The following outline is provided to illustrate the various components of a comprehensive energy management plan for an institution. The outline is not intended to be all inclusive of a plan that may be developed to meet the needs of a particular institution. Each building owner should use this or similar outlines in writing a comprehensive energy management plan narrative. It is intended that procedures be developed for implementing the activities stated below.

An energy management plan is an evolving process. As data is collected and analyzed, the plan should be expanded to include such data, data analyses, and procedures recommended as a result of such data analyses. Thus the plan becomes a living document that may assist the administrative board, the chief administrative officer, the energy manager, the system-wide energy management committee, the building-level management team and others in saving energy and related costs.

A. Pre-Plan Activities

1. Chief administrative officer presents the need for an energy management plan to the administrative board. (A statement of need or justification for energy management is identified.)

2. Administrative board passes a resolution for the chief administrative officer to develop a plan. (Resolution identified)

3. The chief administrative officer appoints an energy manager and an energy management committee.

4. The energy management committee assesses the current energy data on the building including total energy consumption and costs and considers energy policy alternatives. (Current energy data, data analysis and alternatives are identified.)

Source: <u>Plan of the State of Texas for Technical Assistance and Energy Conservation Measures Available to Schools, Hospitals, Units of Local Government and Public Care Institutions</u>, Appendix G, (TENRAC).

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5. The chief administrative officer presents energy policy objectives to the administrative board for the development of an official board position. Such policy recommendations may be developed by the energy management committee in coordination with the energy manager.

6. The official energy policy objectives of the board are announced. (Energy policy objectives are identified.)

B. The Energy Management Plan

1. The chief administrative officer develops directives on the establishment of a system-wide energy management committee and an energy management team for each building including the team's composition and responsibilities. (Directives about committee team and composition and responsibilities are identified.)

2. The energy management team of building energy auditors attends the energy auditor training programs conducted by the State as well as training sessions conducted by the building owner.

3. The energy management committee develops procedures for collecting preliminary energy audit data on all or most buildings. (Procedures are identified.)

4. The energy management committee develops PEA data analysis methodologies. (Methodologies are identified.)

5. The energy management team conducts the preliminary energy audit (PEA form developed by the State plus any supplemental information desired by the building owner) on all or most buildings in order to identify the buildings that are most wasteful of energy. (PEA forms and instructions, institutional supplemental data, and procedures for using PEA data to target buildings for subsequent energy audits are identified.)

6. Each building energy management team reports the PEA data to the energy manager and energy management committee.

7. The energy management committee develops procedures for collecting energy audit data on buildings identified as targets by the preliminary energy audit. (Procedures for collecting data are identified.)

8. The energy management committee develops EA data analysis methodologies. (Methodologies are identified.)

9. The energy management team conducts the energy audit (EA form developed by the State plus any supplemental information desired by the building owner) on those buildings which were identified by the PEA as wasting the most energy. (EA forms and instructions, institutional supplemental data and procedures for using PEA and EA data to target buildings for subsequent technical assistance are identified.)

10. Each building energy management team reports the EA data and recommendations for maintenance and operating procedures to the energy manager and energy management committee.

11. The energy management committee and energy manager analyze the EA data and recommendations and authorize the implementation of maintenance and operating procedures in each building. (Maintenance and operating procedures or the location of lists of maintenance and operating procedures are identified.)

12. The building energy management team members monitor the maintenance and operating procedures implemented by the day-to-day operator of the building. (Monitoring procedures are identified.)

13. The energy manager and energy management committee members review the energy audit data to identify low cost energy conservation measures for buildings as well as measures that may be installed throughout a system of buildings.

14. The chief administrative officer and the administrative board review the recommendations for low cost Energy Conservation Measures and authorize the expenditure of funds. (Low cost measures are identified.)

15. The chief administrative officer and the administrative board review the recommendations of the energy manager and energy management committee for hiring engineers or an architect-engineer team to conduct a detailed engineering analysis (Technical Assistance) of buildings which have the greatest potential for saving energy. Based on an analysis of the recommendations, the board and/or the chief administrative officer authorizes the expenditure of funds for technical assistance. (TA budget is identified.)

16. The energy manager solicits cost estimates from various qualified technical assistance analysts to determine the estimated cost of conducting technical assistance in each targeted building. (Any procurement procedures are identified.)

17. The energy manager completes applications for technical assistance, based on the TA analyst's cost estimates, to be submitted to the State for federal funding to supplement the institution's matching funds. (Instructions for completing TA applications are identified.)

18. A technical assistance analyst is contracted to conduct a detailed engineering analysis of each targeted building. A building owner may decide to conduct technical assistance even though a federal grant is not awarded. (Technical Assistance report format and content of contractual agreements with technical assistance analyst were identified.)

19. After the Technical Assistance report is submitted to the energy management committee, the committee reviews the report data and energy conservation recommendations. The committee recommends Energy Conservation Measures to the chief administrative officer and the administrative board.

20. The energy manager completes energy conservation measures applications based on the ECM directives of the administrative board for submission to the State for federal funding. (Instructions for completing the ECM application are identified.)

21. The chief administrative officer contracts for professional engineering services for the design and supervision of the ECM project and for the acquisition and installation of materials and equipment. A building owner may decide to install energy conservation measures even though a federal grant is not awarded. (Any procurement procedures and content of contractual agreements are identified.)

22. Develop a schedule for the installation of the energy conservation measures.

23. Use forms developed by the State and the building owner to monitor the energy consumption in the buildings prior to and subsequent to the installation of the energy conservation measures. (Energy consumption monitoring forms are identified.)

24. The energy management teams, the energy manager, and the energy management committee review and evaluate the plan and recommend changes to the chief administrative officer and the administrative board.

25. The administrative board modifies the energy management plan as needed.

26. Any modifications to the plan are implemented systemwide.

Any institution may expand upon the various plan elements described above including data management requirements, grant application procedures, administrative policies and directives, and training programs for creating awareness and development of the operational proficiency of employees. In addition, other plan elements may be considered including:

1. Fiscal policies and procedures.
2. Laws, regulations and code requirements.
3. Energy efficient standards for existing buildings.
4. Energy efficient standards for new buildings.
5. Optimum energy use targets of buildings.
6. Communications regarding policy, directives, plan accomplishments, awards, incentives and public relations.
7. Energy management handbook for the administration and operation of the facility's energy systems.
8. Contingency plans for an energy crisis.
9. Renewable energy source research, testing and demonstration, if possible.

HEATING, VENTILATING AND AIR CONDITIONING

Source Ackowledgement: Portions of the following narrative description of HVAC maintenance and operation improvements are based on recommendations contained in Total Energy Management for Hospitals, U. S. Department of Health, Education and Welfare Publication No. 78-613, Hyattsville, Maryland, 1978, pp. 219-34.

HEATING, VENTILATING AND AIR CONDITIONING

By far the biggest energy user in any building is the HVAC -- heating, ventilating and air conditioning -- system. HVAC, the environmental control system, often comprises 60% of the typical building's energy usage.

Two facts are particularly important:

1. Because of the complexity and high energy consumption of HVAC units, maintenance procedures are especially important to efficient, and thus less expensive, operation.

2. Most of today's public buildings have HVAC systems designed when energy was cheap. The theory behind such systems, and the accompanying poor weatherization, was that energy cost less than the necessary capital investment.

Therefore needed improvements are not at all hard to locate. And common sense logic is by far the most important tool the auditor needs.

General HVAC Systems Description and Modification Suggestions:

Here are comments about the major elements of the heating, ventilating and air conditioning systems, and the various types of equipment found in each:

Single Zone System

A zone is an area or group of areas in a building which experience 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.

* 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% reduction in air volume will permit a reduction in fan power input by about 27% of original. This modification will limit the degree to which the zone serviced can be heated or cooled as compared to current capabilities.

* Raising supply air temperatures during the cooling season and reducing them during the heating season reduces the amount of heating and cooling which a system must provide. But as with air volume reduction, it limits heating and cooling capabilities.

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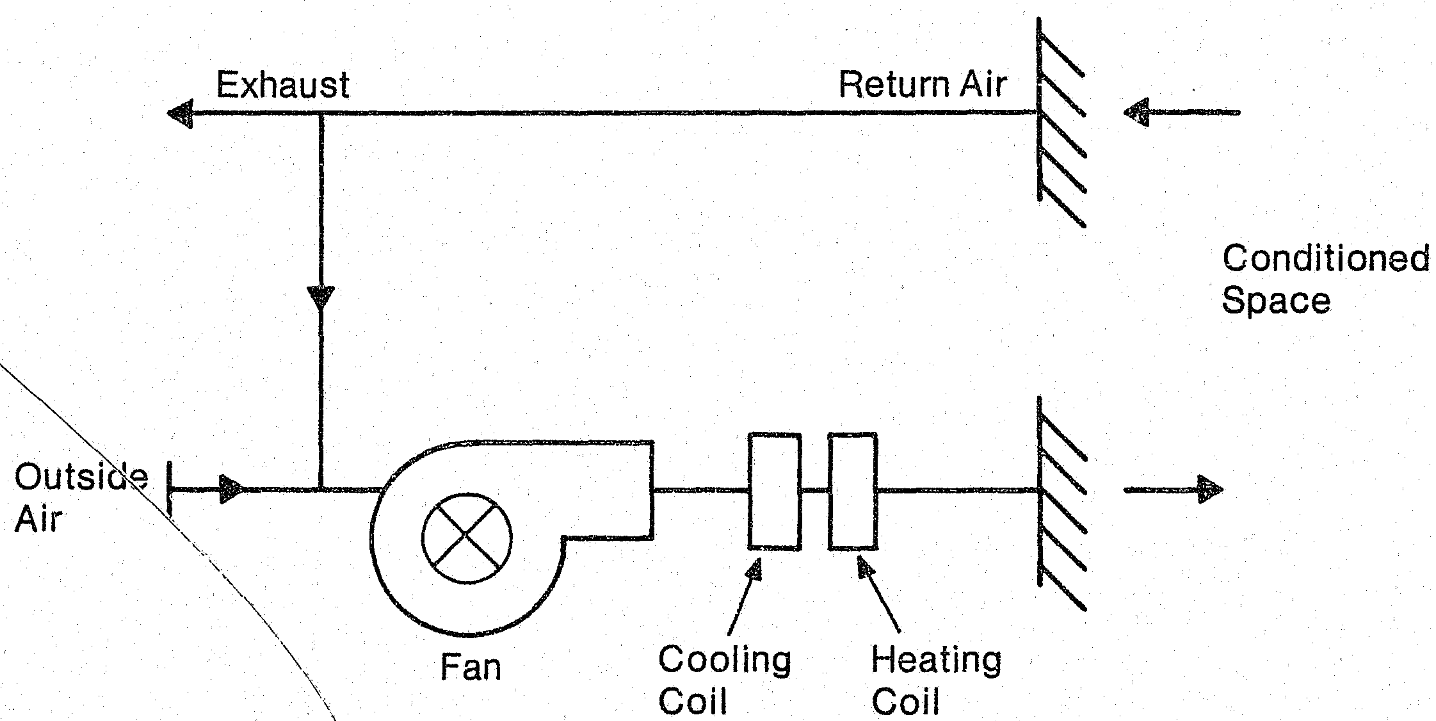
Central Station Single-Zone



* Using the cooling coil for both heating and cooling by modifying the piping will enable removal of the heating coil, which provides energy savings in two ways. First, air flow resistance of the entire system is reduced so that air volume requirements can be met by lowered fan speeds. Second, system heat losses are reduced because surface area of cooling coils is much larger than that of heating coils, thus enabling lower water temperature requirements. Heating coil removal is not recommended if humidity control is critical in the zone serviced and alternative humidity control measures will not suffice.

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 air off the heating coil, (i.e., hot deck), and cold air off the cooling coil, (i.e., cold deck), to meet the varying loan requirements of the zone involved. Steps which can be taken to improve energy efficiency of multizone systems include:

* 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.

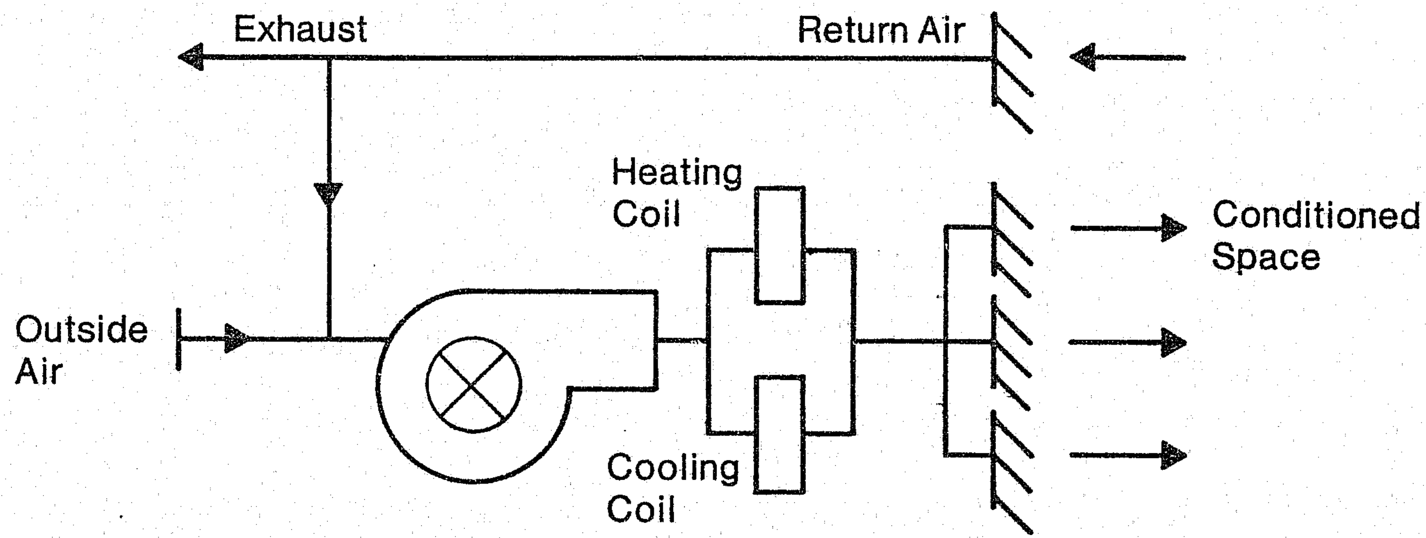
* Consider installing demand reset controls which will regulate hot and cold deck temperatures according to demand. When properly installed, and with all hot deck or cold deck dampers partially closed, the control will reduce hot and raise cold deck temperatures progressively until one or more zone dampers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

* Consider converting systems serving interior zones to variable volume. Conversion is performed by blocking off the hot deck, removing or disconnecting mixing dampers, and adding low pressure variable volume terminals and pressure bypass.

Terminal Reheat System

The terminal reheat system essentially is a modification of a single-zone system which provides a high degree of temperature and humidity control; however terminal reheat is most energy expensive, because it cools and reheats the same air or water. The central heating/cooling unit provides air at a given temperature to all zones served by the system. Secondary terminal heaters then reheat air to a temperature compatible with the load requirements of the specific space involved. Obviously the high degree of control provided by this system requires an excessive amount of energy. Several methods of making the system more efficient include:

Multi-Zone



* Reheat System
* Convert Interior Zones To VAV
* Change Control Settings To Require At Least One Cold Deck And One Hot Deck Damper To Be Closed At All Times
* Dampers Often Leak

* Reduce air volume of single zone units.

* If close temperature and humidity control must be maintained for equipment purposes, lower water temperature and reduce flow to reheat coils. This still will permit control, but will limit the system's heating capabilities somewhat.

* If close temperature and humidity control are not required, convert the system to variable volume by adding variable volume valves and eliminating terminal heaters.

Variable Air Volume System

A variable volume system provides heated or cooled air at a constant temperature to all zones served. VAV boxes located in each zone or in each space adjust the quantity of air reaching each zone or space depending on its load requirements. Methods of conserving energy consumed by this system include:

* Reduce the volume of air handled by the system to that point which is minimally satisfactory.

* Lower hot water temperature and raise chilled water temperature in accordance with space requirement.

* Lower air supply temperature to that point which will result in the VAV box serving the space with the most extreme load being fully open.

* Consider installing static pressure controls for more effective regulation of pressure bypass (inlet) dampers.

* Consider installing fan inlet damper control systems if none now exist.

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:

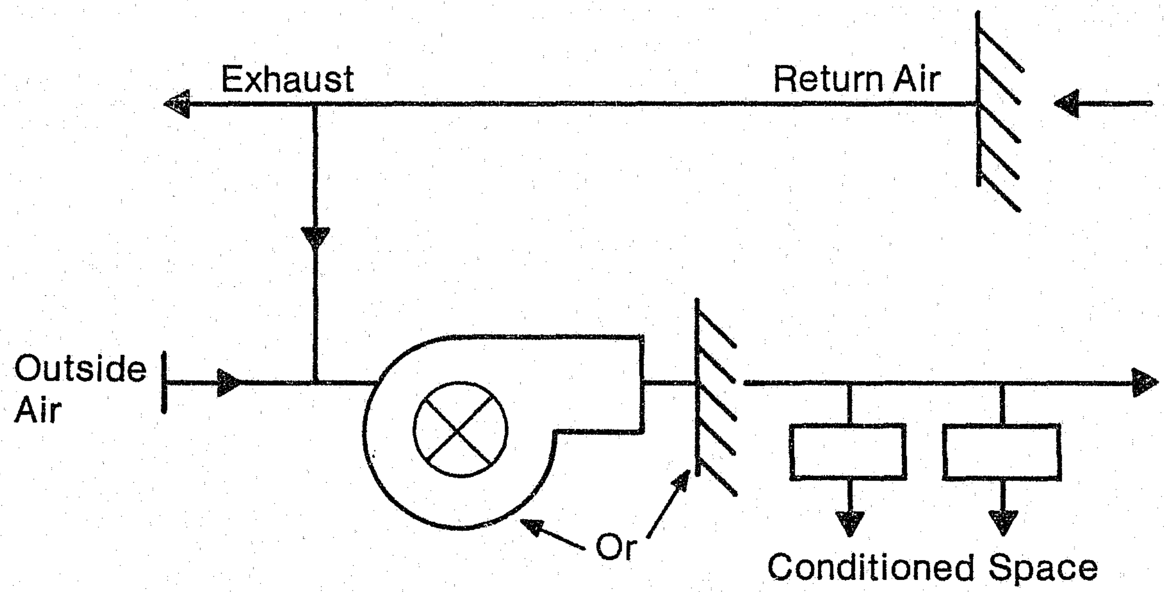
* Determine the minimum amount of airflow which is satisfactory and reset the constant volume device accordingly.

* Investigate the possibility of converting the system to variable (step controlled) constant volume operation by adding the necessary controls.

Induction Systems

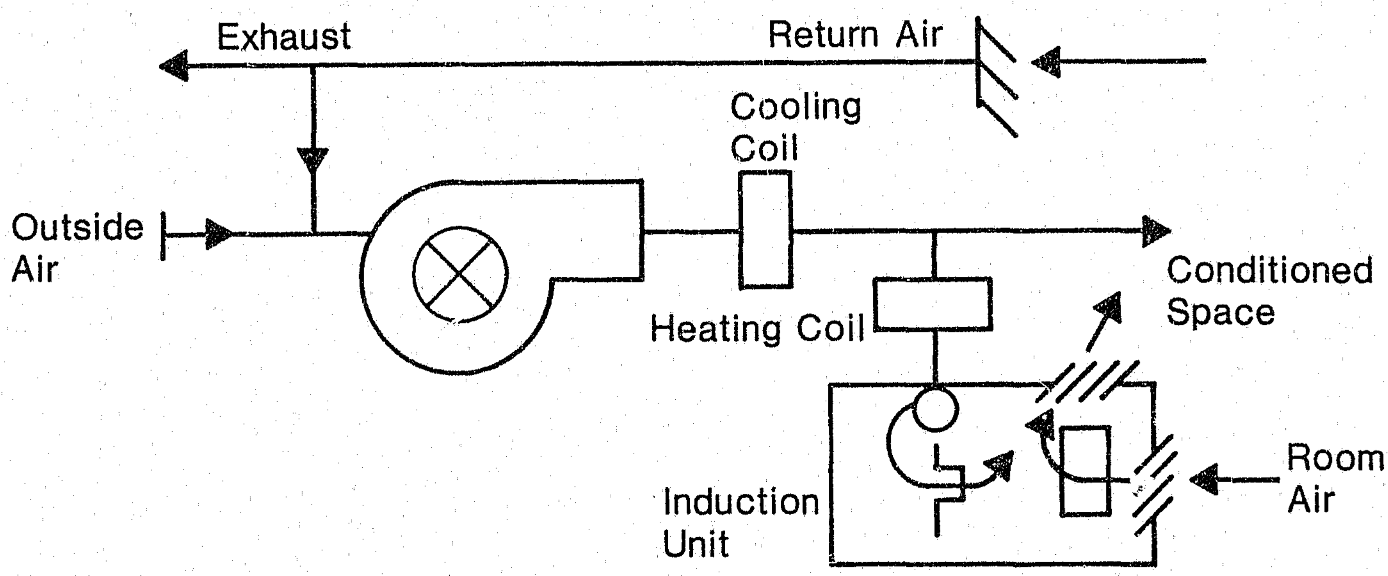
Induction systems comprise an air handling unit which supplies heated or cooled primary air at high pressure to induction units located on the outside walls of each

Variable Volume



* Generally A Very Efficient System
* Inlet Vanes Or Discharge Dampers Create Varying Volume

Induction



* High Pressure Delivery Requires Larger Horsepower Motors
* Reheat
* Restricted Room Air Flow Through Coil
* Dirty Coils Drastically Effect System Capacity By Hindering Induction

space served. The high pressure primary air supplied by the air handling unit is discharged within the unit through nozzles inducing room air through a cooling or heating coil in the unit. The resulting mixture of primary air and induced, or room air (see diagram), is discharged to the room at a temperature dependent upon the cooling and heating load of the space. Methods for conserving energy consumed by this system include:

* Set primary air volume to original design values when adjusting and balancing work is performed.

* Inspect nozzles. If metal nozzles common on most older models are installed, determine if the orifices have become enlarged from years of cleaning. If so, chances are that the volume/pressure relationship of the system has been altered. As a result, the present volume of primary air and the appropriate nozzle pressure required must be determined. Once done, rebalance the primary air system to the new nozzle pressures and adjust individual induction units to maintain airflow temperature. Also, inspect nozzles for cleanliness. Clogged nozzles provide higher resistance to air flow, thus wasting energy.

* Set induction heating and cooling schedules to minimally acceptable levels.

* Reduce secondary water temperatures during the heating season.

* Reduce secondary water flow during maximum heating and cooling periods by pump throttling or, for dual pump systems, by operating one pump only.

* Consider manual setting of primary air temperature for heating, instead of automatic reset by outdoor or solar controllers.

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:

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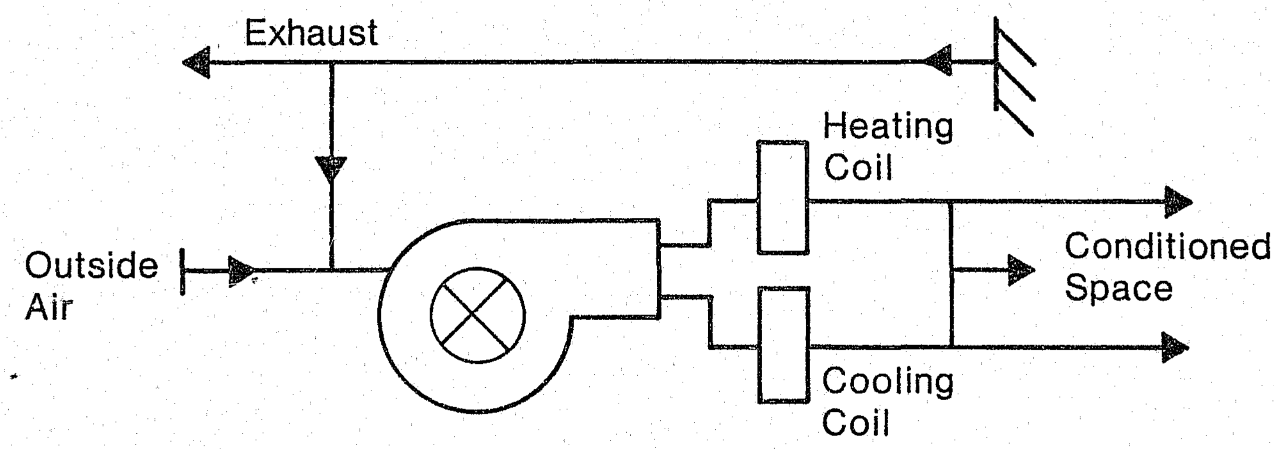
Dual-Duct



* Reheat System
* Method for Improving:
  Close Off Heating Section And Repipe Cooling Coil Into 2-Pipe System, i.e., Either Heating Or Cooling.
* If Not, Reduce The Temperature Of The Hot Duct And Increase Temperature Of The Cold Duct To Point That Temperature Requirement Of Most Critical Zone Can Just Be Met.

* Lower hot deck temperature and raise cold deck temperature.

* Reduce air flow to all boxes to minimally acceptable level.

* When no cooling loads are present, close off cold ducts and shut down the cooling system. Reset hot deck according to heating loads and operate as a single duct system. When no heating loads are present, follow the same procedure for heating ducts and hot deck. It should be noted that operating a dual-duct system as a single duct system reduces air flow, resulting in increased energy savings through lowered fan speed requirements. But it also decreases air changes.

Fan Coil System

A fan coil system usually comprises 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:

* Reduce air flow to minimally satisfactory levels.
* Balance water flows to minimally satisfactory levels.
* When heating and cooling loads are minimal, shut off fans so enabling the coil to act as a convector.
* Consider installing interlocks between the heating and cooling systems of each unit to prevent simultaneous heating and cooling.
* Consider face zoning two-pipe systems from four-pipe central system to avoid changeover losses.

Refrigeration Equipment

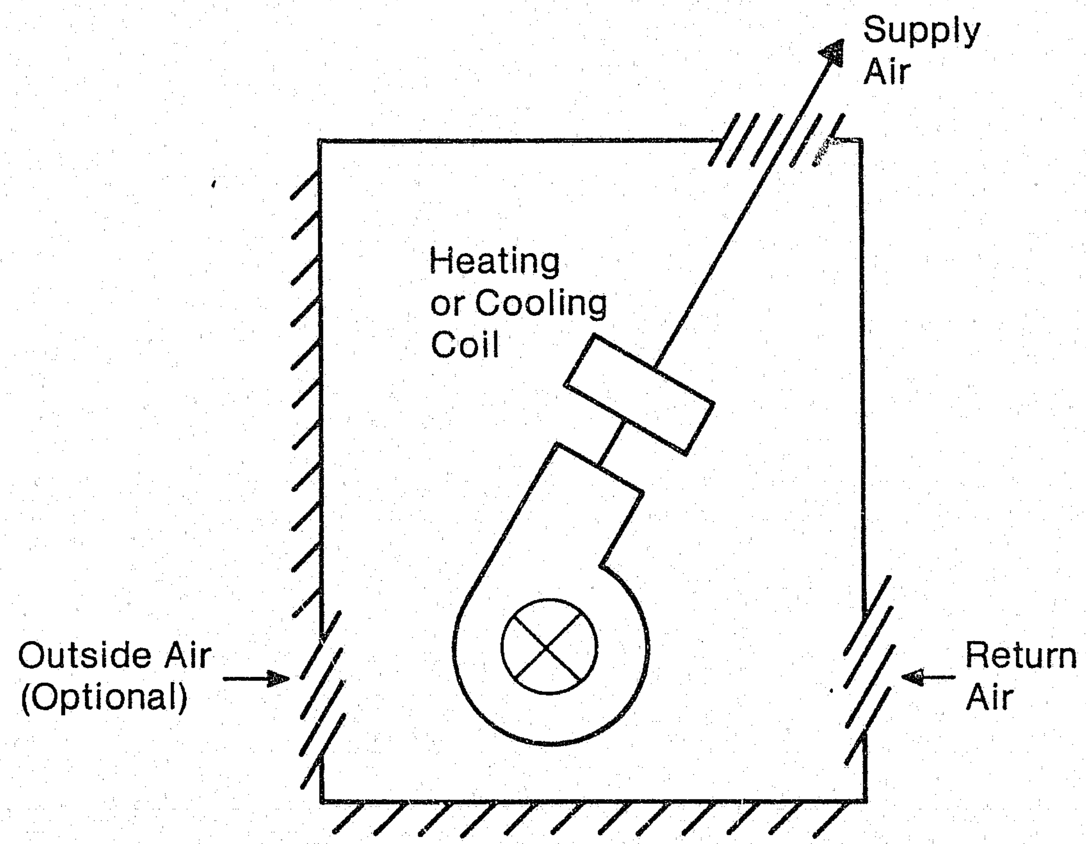
* Circuit and Controls

  -- Inspect moisture-liquid indicator on a regular basis. If the color of the refrigerant indicates "wet," it means there is moisture in the system. This is a particularly critical problem because it can cause improper operation or costly damage. A competent mechanic should be called in to perform necessary adjustments and repairs immediately. Also, if there are bubbles in the refrigerant flow as seen through the moisture-liquid indicator, it may indicate that the system is low in refrigerant. Call in a mechanic to add refrigerant if necessary and to inspect equipment for possible refrigerant leakage.

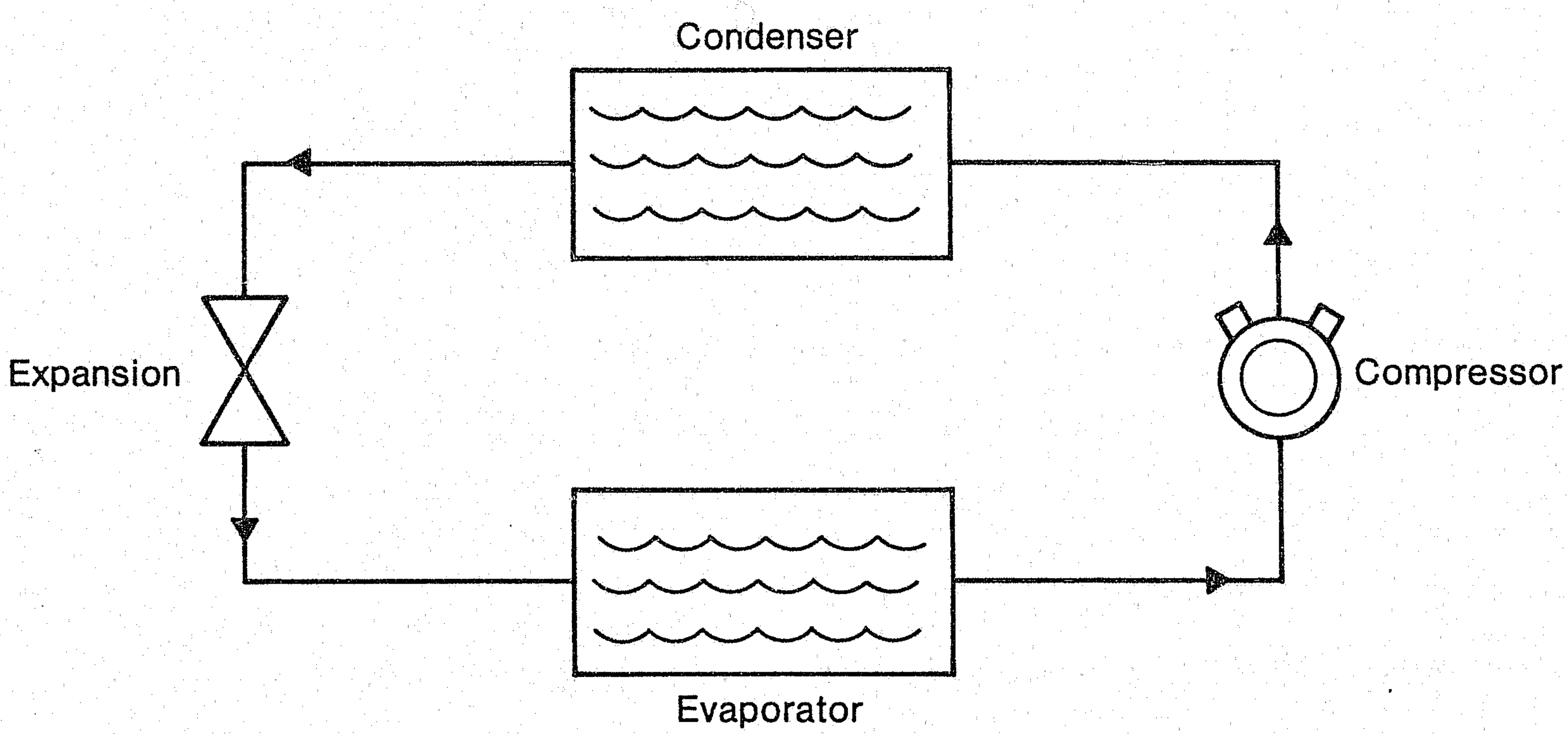
  -- Use a leak detector to check for refrigerant and oil leaks around shaft seal, sight glasses, valve bonnets, flanges, flare connections, relief valve on the condenser assembly and at pipe joints to equipment, valves and instrumentation.

  -- Inspect equipment for any visual changes such as oil spots on connections or on the floor under equipment.

Fan Coil Unit (2-Pipe)



Refrigeration Diagram:



-- 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.

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

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

-- Inspect tension and alignment of all belts and adjust as necessary.

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

-- Inspect insulation on suction and liquid lines. Repair as necessary.

* Compressor

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

-- Observe the noise made by the compressor. If it seems to be excessively noisy, it may be a sign of a loose drive coupling or excessive vibration. Tighten compressor and motor on the base. If noise persists, call a competent mechanic.

-- Check all compressor joints for leakage. Seal as necessary.

-- Inspect the purge for air and water leaks. Seal as necessary.

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

* Air-Cooled Condenser

-- Keep fan belt drive and motor properly aligned and lubricated.

-- Inspect refrigeration piping connections to the condenser coil for tightness. Repair all leaks.

-- Keep condenser coil clean to permit proper air flow.

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

* Evaporative Condenser

-- Inspect piping joints and seal all leaks.

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

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

-- Use water treatment techniques if local water supply leaves surface deposits on the coil.

-- Follow guidelines for fan and pump maintenance.

* Watercooled Condenser

  -- 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.

* Cooling Towers

  -- Perform chemical analysis to determine if solid concentrations are being maintained at an acceptable level.

  -- Check overflow pipe clearance for proper operating water level.

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

  -- Follow guidelines for fan maintenance.

  -- Keep the tower clean to minimize both air and water pressure drop.

  -- Clean intake strainer.

  -- 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.

  -- Inspect spray filled or distributed towers for proper nozzle performance. Clean nozzles as necessary.

  -- Inspect gravity distributed tower for even water depth in distribution basins.

  -- Monitor effectiveness of any water treatment program which may be underway.

* Chillers

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

  -- Inspect for evidence of clogging. A qualified mechanic should be called in to service equipment in accordance with manufacturer's specifications.

* Absorption Equipment

  -- Clean strainer and seal tank on a regular basis.

  -- Lubricate flow valves on a regular basis.

  -- Follow manufactures instructions for proper maintenance.

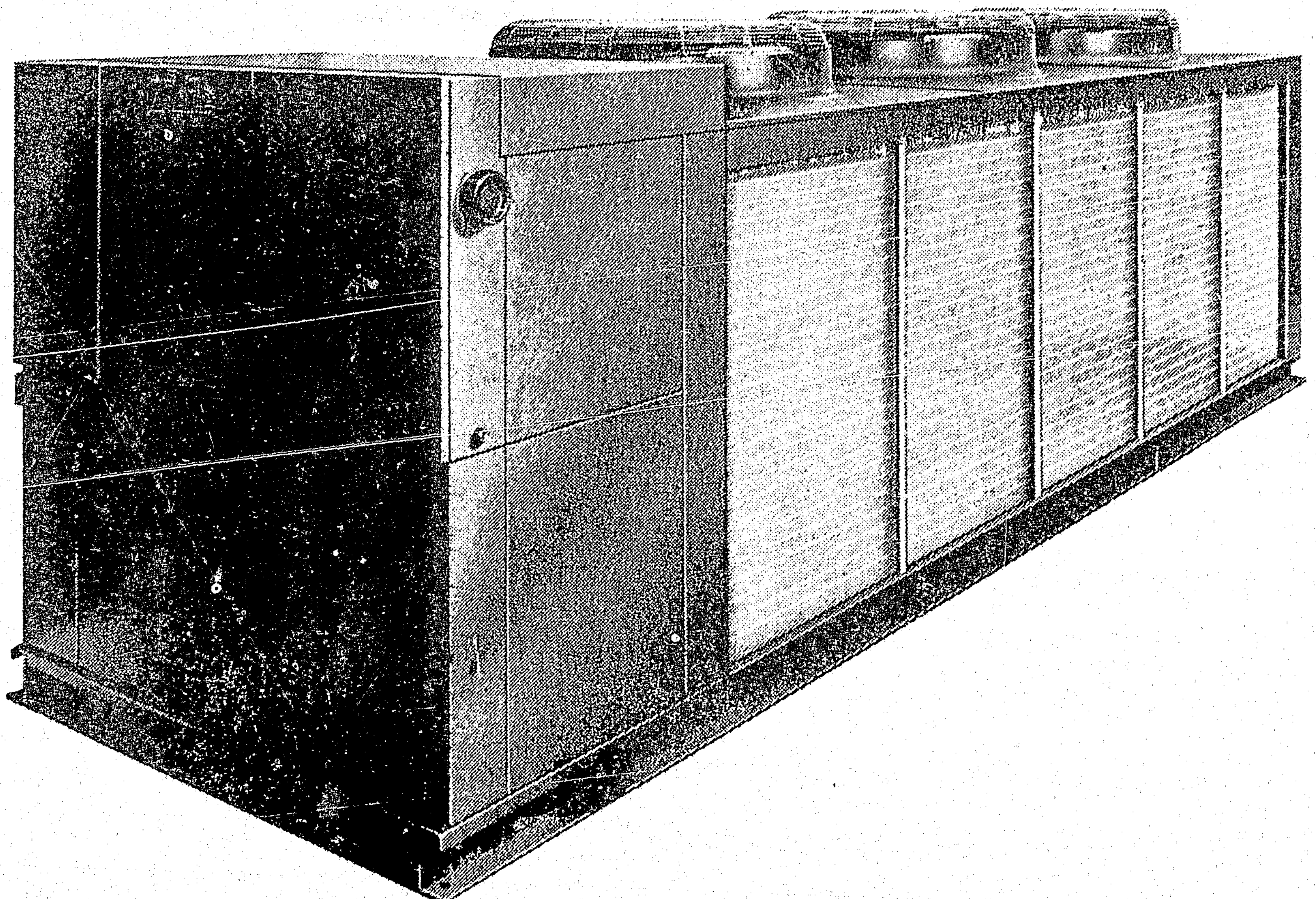
* Self-Contained Units (Windows and through-the-wall units; heat pump,etc.)

  -- Clean evaporator and condenser coils.

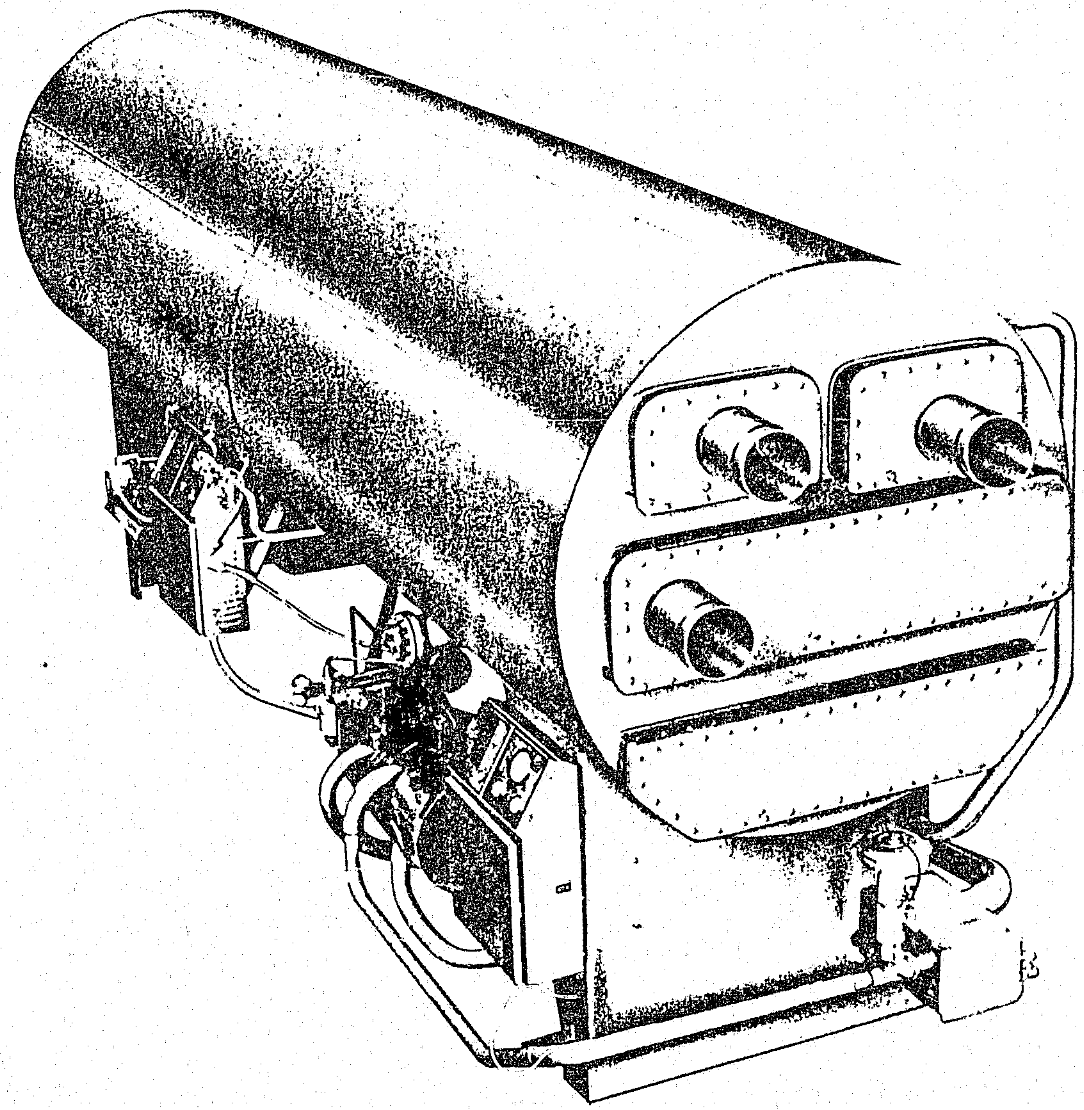
  -- Keep air intake louvers, filters and controls clean.

  -- Keep air flow from units unrestricted.

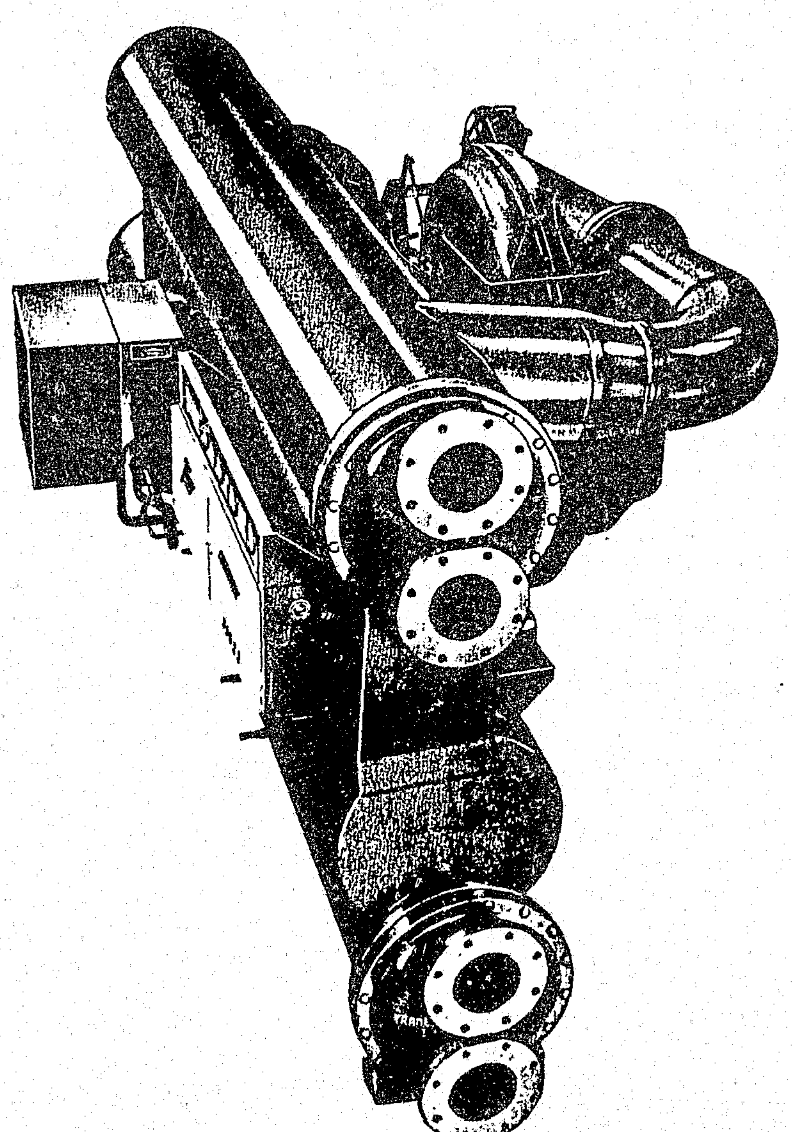
RECIPROCATING CHILLER



ABSORPTION CHILLER



CENTRIFUGAL CHILLER



-- Caulk openings between unit and windows or wall frames.

-- Check voltage. Full power voltage is essential for proper operation.

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

Heating Equipment

There are also many different kinds of heating systems installed in existing office buildings and other public facilities. Certain common maintenance guidelines to improve efficiency of operation include the following:

* Boilers (General)

-- Inspect boilers for scale deposits, accumulation of sediment or boiler compounds on water side surfaces. 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 and possibly can lead to overheating of furnace, cracking of tube ends and other problems.)

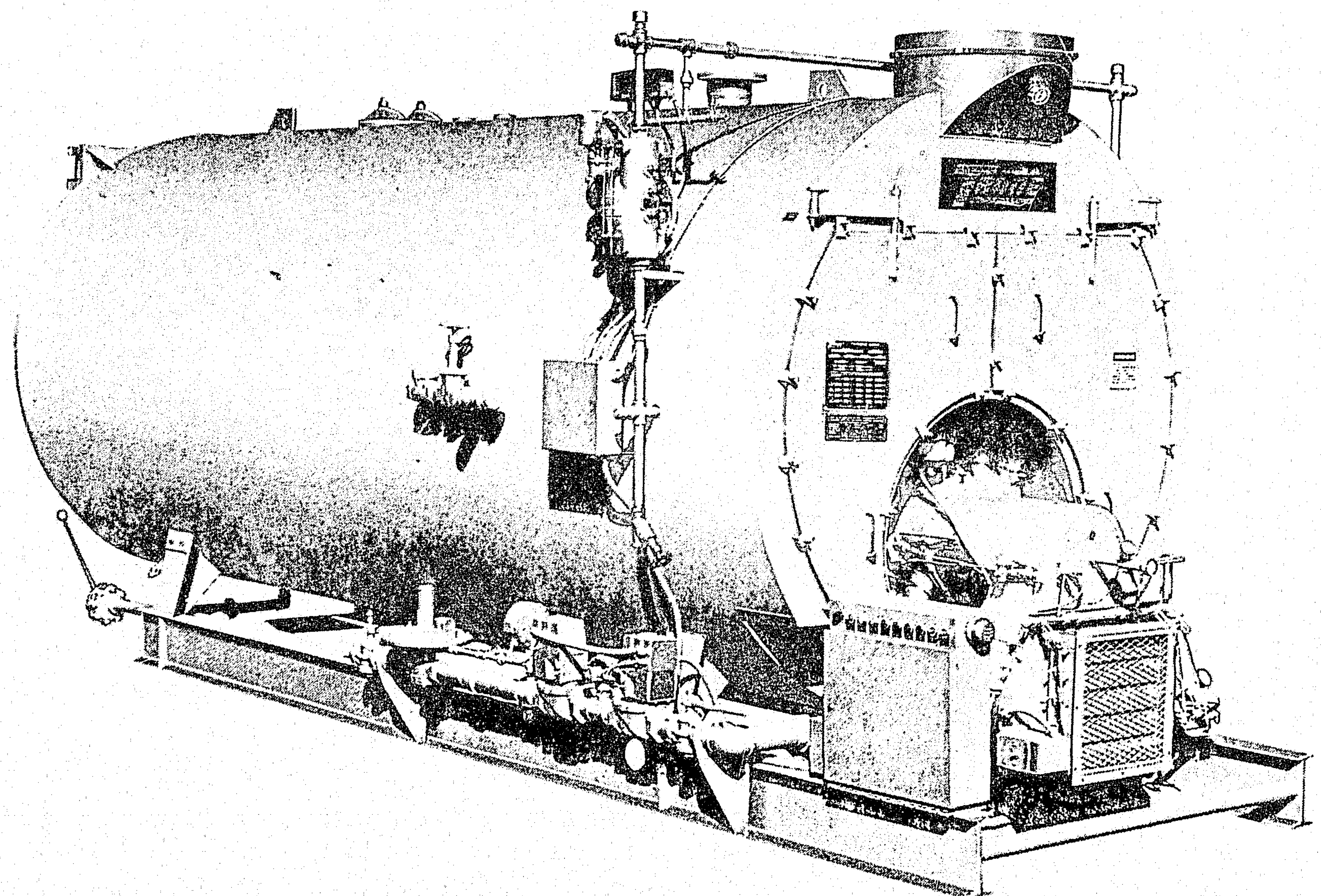
-- Fireside of the furnace and tubes must be inspected for deposits of soot, flyash and slag. Fireside refractory surface also must be observed. Soot on tubes decreases heat transfer and lowers efficiency. (If your boiler does not now have one, consider installation of a thermometer in the vent outlet. It can save inspection time and often can prove to be more accurate than visual inspection alone.) If 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 clean burning fire.

-- Inspect door gaskets. Replace them if they do not provide a tight seal.

-- Keep a daily log of pressure, temperature and other data obtained from instrumentation. This is the best method available to determine the need for tube and nozzle cleaning, pressure or linkage adjustments, and related measures. Variations from normal can be spotted quickly, enabling immediate action to avoid serious trouble. On an oil-fired unit, indications of problems include an oil pressure drop, which may indicate a plugged strainer, faulty regulating valve, or an air leak, in the suction line. An oil temperature drop can indicate temperature control malfunction or a fouled heating element. On a gas-fired unit, a drop in gas pressure can indicate a drop in the gas supply pressure or malfunctioning regulator.

-- Note firing rate when log entries are made. Realize that even 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°F in five minutes.

FIRETUBE BOILER



-- Inspect stacks. They should be free of haze. If not, it probably indicates that a burner adjustment is necessary.

-- Inspect linkages periodically for tightness. Adjust when slippage or jerky movements are observed.

-- 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.

-- Inspect nozzles or cup of oil-fired units on a regular basis. Clean as necessary.

-- Check burner firing period. If it's improper, it could be a sign of faulty controls.

-- Check boiler stack temperature. If it is too high (more than 150°F above steam or water temperature) clean tubes and adjust fuel burner.

-- 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%. There should be no carbon monoxide. For a gas-fired unit, CO_2 should be present at 9 or 10%. For #2 oil, 11.5-12.8%; for #6 oil, 13 to 13.8%.

-- The air-to-fuel ratio must be maintained properly. 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 free of charge or for a token fee only.

-- Inspect all boiler insulation, refractory, brickwork, and boiler casing for hot spots and air leaks. Repair and seal as necessary.

-- Replace all obsolete or little-used pressure vessels.

-- Examine operating procedures when more than one boiler is involved. It is far better to operate one boiler at 90% capacity than two at 45% capacity each. The more boilers used, the greater the heat loss.

-- Clean mineral or corrosion build-up on gas burners.

* Central Furnaces, Make-Up Air Heaters and Unit Heaters

  -- All heat exchanger surfaces should be kept clean. Check air-to-fuel ratio and adjust as necessary.

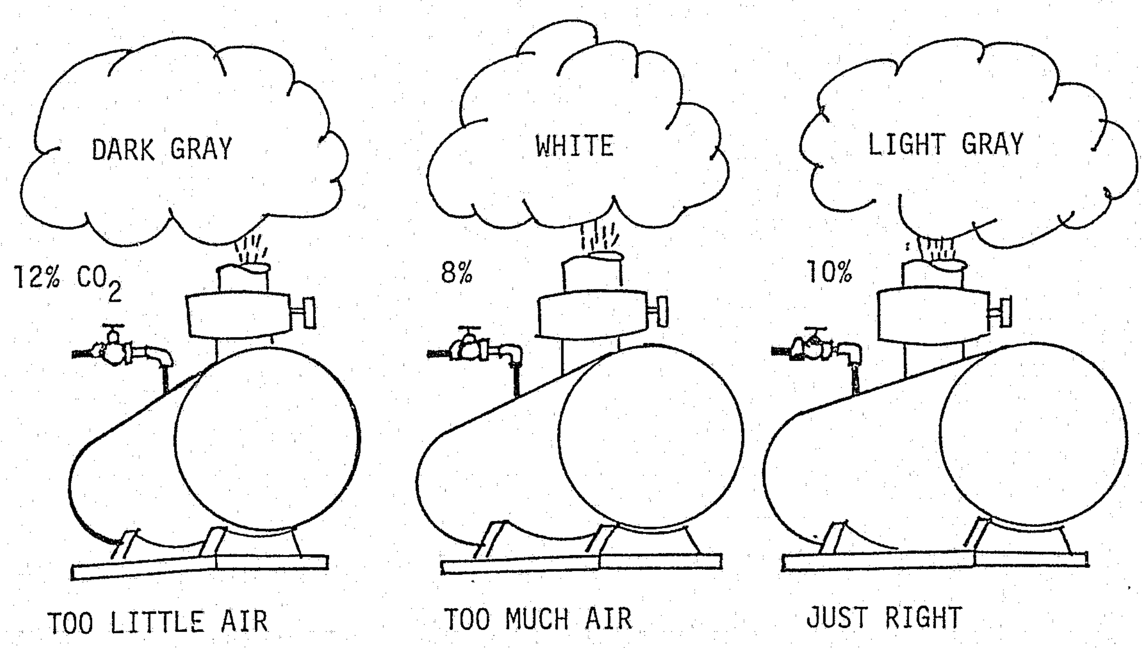
  -- Inspect burner couplings and linkages. Tighten and adjust as necessary.

  -- Inspect casing for air leaks and seal as necessary.

  -- Inspect insulation and repair or replace as necessary.

  -- Follow guidelines suggested for fan and motor maintenance.

Air/Fuel Ratio

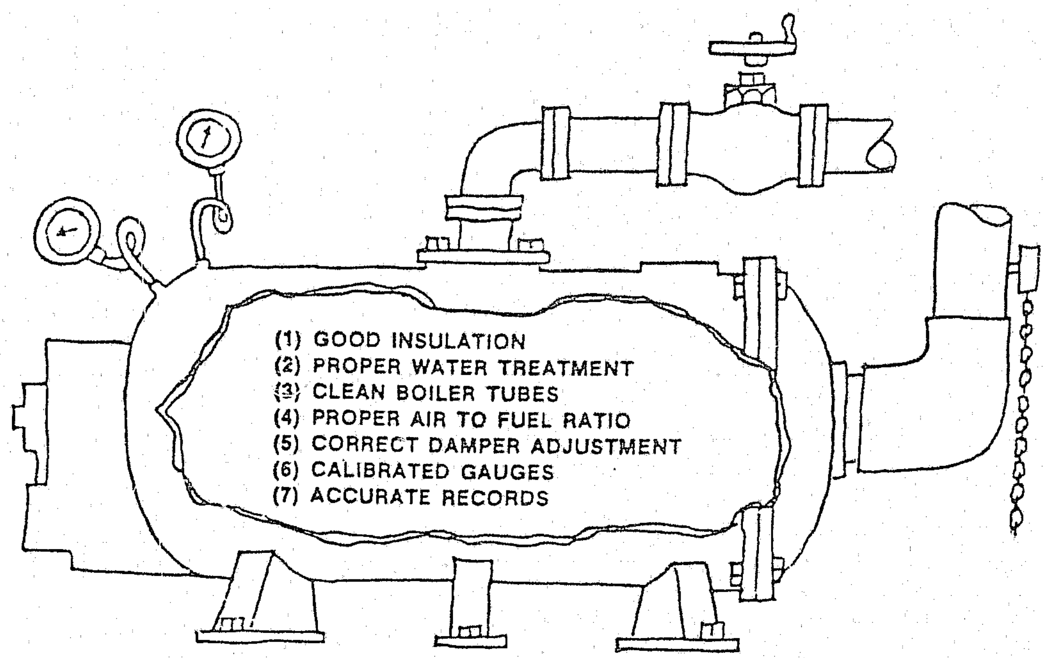


SAVINGS FOR EVERY $100 FUEL COSTS BY INCREASING COMBUSTION EFFICIENCY

(Assuming constant radiation and other unaccounted-for losses)

From an original efficiency of:	To an increased combustion efficiency of: 55%	60%	65%	70%	75%	80%	85%	90%	95%
50%	$9.10	16.70	23.10	28.60	33.30	37.50	41.20	44.40	47.40
55%		8.30	15.40	21.50	26.70	31.20	35.30	38.90	42.10
60%			7.70	14.30	20.00	25.00	29.40	33.30	37.80
65%				7.10	13.30	18.80	23.50	27.80	31.60
70%					6.70	12.50	17.60	22.20	26.30
75%						6.30	11.80	16.70	21.10
80%							5.90	11.10	15.80
85%								5.60	10.50
90%									5.30

Boiler Operation



* Radiators, Convectors, Baseboard and Finned Tube Units

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

  -- 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. Otherwise, the units will short cycle (go on and off quickly), wasting fuel.

  -- Heat transfer surfaces of radiators, convectors, baseboard and finned-tube units must be kept clean for efficient operation.

* Electric Heating

  -- Keep heat transfer surfaces of all electric heating units clean and unobstructed.

  -- Keep air movement in and out of the units unobstructed.

  -- Inspect heating elements, controls and, as applicable, fans on a periodic basis to ensure proper functioning.

  -- As appropriate, check reflectors on infrared heaters for proper beam direction and cleanliness.

  -- Determine if electric heating equipment is operating at rated voltage as necessary.

  -- Check controls for proper operation.

Hot and Chilled Water Piping

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

* Check flow measurement instrumentation for accuracy. Adjust, repair or replace as necessary.

* 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.

* Inspect strainers. Clean regularly.

* 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.

* Inspect vents and remove all clogs. Clogged vents retard efficient air elimination and reduce efficiency of the system.

Steam Piping

* Inspect insulation of all mains, risers and branches, economizers and condensate receiver tanks. Repair or replace as necessary.

* Check automatic temperature-control system and related control valves and accessory equipment to ensure that they are regulating the system properly in the various zones -- in terms of building heating needs, not system capacity.

* Inspect zone shut-off valves. All should be operable so steam going into unoccupied spaces can be shut off.

* Inspect steam traps. Their failure to operate correctly can have a significant impact on the overall efficiency and energy consumption of the system. Several different tests can be utilized to determine operations.

  -- 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 steam, 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's cold, the trap is not working at all.

  -- Check back pressure on downstream side.

  -- Measure temperature of return lines with a surface pyrometer. Measure temperature drop across the trap. Lack of drop indicates steam blow-through. Excessive drop indicates that the trap is not passing condensate. Adjust, repair or replace all faulty traps.

Self-Contained Systems

Energy consumption of self-contained systems, such as roof-top, window, through-the-wall and other heating and/or cooling units, can be modified as follows:

* If multiple units are involved, consider installation of centralized automatic shut-off and manual override control.

* If units are relatively old, consider replacing them with more efficient air-to-air heat pumps or similar units have a higher equivalent efficiency rating.

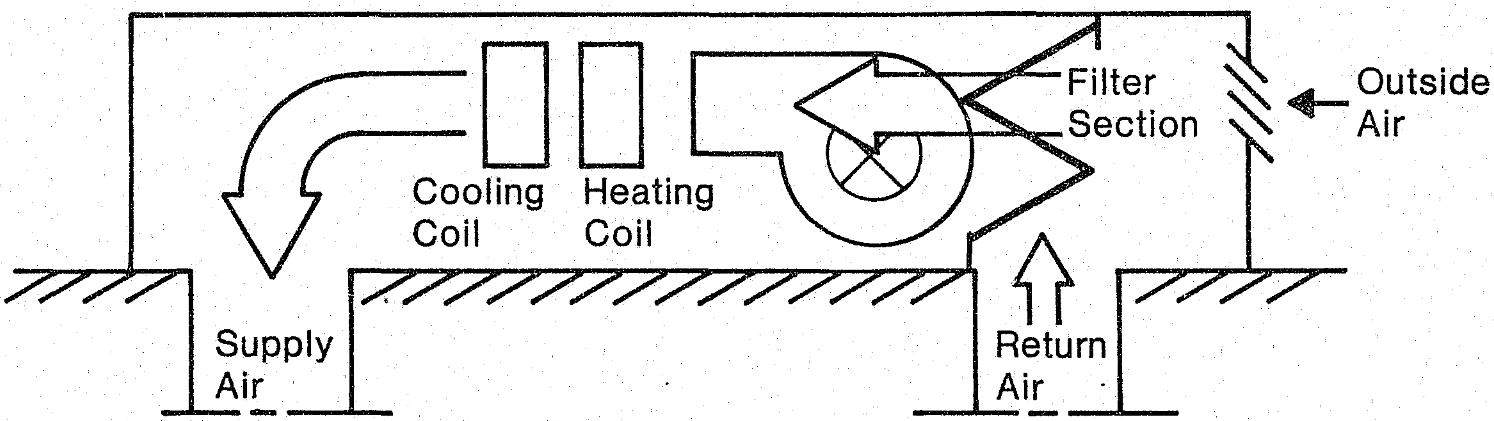
Distribution Systems

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

Hydronic Systems -- Hydronic systems are those which utilize water for transferring heating and cooling.

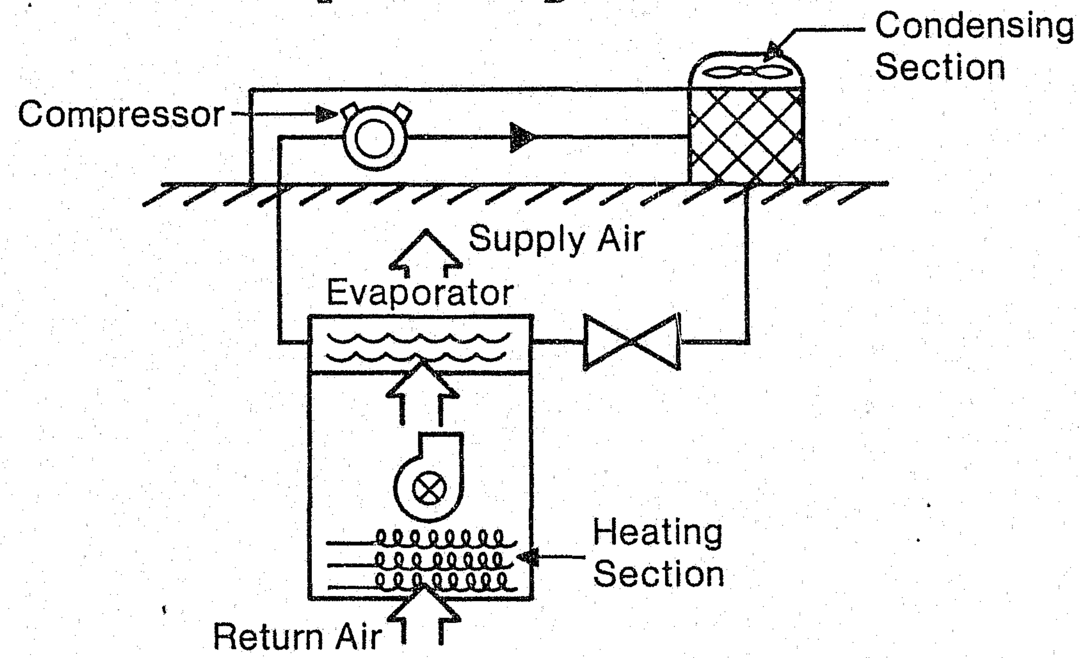
Steam Systems -- Steam systems are those which utilize steam as a heat source. The steam can be provided either by an on-site boiler or by district steam.

Rooftop Unit:



* Refrigerant Or Chilled Water Cooling
* Hot Water, Steam, Gas Or Electric Heat
* Single-Zone Or Multi-Zone System
* Resultant Savings Opportunities From Each Of The Various Components As Noted Previously

Split System:



* Very Common In Smaller Buildings Or As Additional Capacity For Large Buildings
* Primarily Maintenance Opportunities
* Turn Off When Not Needed
* Night Setback
* Reduce Temperature Settings

Air Distribution Systems -- Air distribution systems are those which use air for heating and/or cooling.

Adjusting HVAC Controls

The controls originally installed in your building probably were designed more in light of initial costs than they were for their ability to conserve energy. In addition, just five years use without adequate maintenance -- which seldom is performed -- can cause controls to go out of calibration, becoming even less sensitive. A program of control adjustment and modification should consider the following guidelines:

* 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 set point, actuator travel and action, and proper sequence of operation.

* 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 replacing pilots of gas burning equipment with electric ignition devices.

Reducing Ventilation Levels

Air brought into a building for ventilation must be heated or cooled and often humidified or dehumidified. Ventilation systems account for an estimated 10 percent of a building's overall energy consumption, yet it is generally agreed that most building codes demand levels of ventilation in excess of what is actually needed to provide for the safety and comfort of building occupants.

Building code ventilation standards should be examined to ensure that they are realistic in their appraisal of health and safety needs. Consider the following ventilation guidelines recommended by the National Bureau of Standards:

Oxygen Supply	3 CFM/person
Cafeterias	10-12 CFM/person
Smoking Areas	25-40 CFM/person
Odor Control	5 CFM/person
Toilet Exhaust	10-15 air changes/hour
Corridors	2 air changes/hour

Heating, Ventilating and Air-Conditioning Systems Guidelines

Consider the following guidelines in selecting a new HVAC system:

* Do not buy equipment with excess capacity. Most equipment works at maximum efficiency when running at full capacity. Most systems, however, are designed to meet extreme weather conditions, which seldom occur, resulting in inefficiency.

* Provide adequate zones of control. Without control zones, large areas often have to be overcooled or overheated to satisfy the needs of small areas. Zoning thus reduces the HVAC load.

* Group areas with similar heating, cooling and ventilation requirements to facilitate selective ventilation.

* Use waste heat. Until recently, the heat generated by a building's lights, machinery, and people was ignored. Rising energy prices, however, are stimulating a great deal of interest in waste heat recovery systems, which can retrieve up to 80 percent of waste heat, creating a two-fold energy benefit:

  -- Waste heat can be used to supplement, and sometimes replace, expensive fuel-based heat; and

  -- Removal of waste heat eliminates an expensive burden on the air-conditioning system.

These systems are expensive, but usually pay for themselves quickly with energy savings. The Smithsonian Institution installed a heat recovery system, which paid for itself in four months. An HVAC maintenance program should be initiated when the building is completed, based on guidelines outlined in the following section of this manual.

Economizer Cycle

An economizer cycle is the air handling equipment utilizing outdoor air during the winter season to cool the interior of the building. Two types of economizer cycles are enthalpy control and dry bulb changeover temperatures.

UNIT MAINTENANCE RECORD

Year:	1. Lubrication (see manufacturer's specifications)			2. Clean Filters (Monthly)		3. Semi-Weekly Inspection (Belts, Motor Vibration, Bearing Vibration, Vents, Leakage)																														
	Performed Date:	By:	Date Next Scheduled	Date:	By:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
JAN																																				
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HVAC
Operations and Maintenance Checklist

Source: Making Cents of Your Energy Dollar, Volume I, U.S. Department of Energy, as adapted by the State of Colorado, 1979.

The checklist provides suggestions for the most common energy wasters in a building. Situations cited as "true" are those which exist in the building. The Energy Auditor then recommends actions to be taken from those suggestions.

	EXISTS T	EXISTS F	RECOM. Yes	RECOM. No

Administrative System

A-1. Thermostats on heating/cooling units are vulnerable to occupant adjustment. ☐ ☐

Suggested O & M's:

- Reset Thermostats to correct settings. ☐ ☐
- Install or replace locking screws to prevent tampering. ☐ ☐

Suggested Retrofits.

- Install tamper-proof locking covers on thermostats. ☐ ☐
- Install pre-set solid state electric thermostats if existing controls are electric. ☐ ☐
- Relocate thermostats in return air ducts where they will be inaccessible to occupants. ☐ ☐

A-2. Thermostat settings have not been adjusted for change in seasons. ☐ ☐

Suggested O & M's:

- Adjust thermostats to 68° F in heating season and to 78° F during cooling season. ☐ ☐
- * Change the location of thermostats from areas subject to extreme temperature fluctuations, such as next to windows, or over a heating or cooling unit. ☐ ☐

Suggested Retrofits:

- Replace existing thermostat with one that has a separate setting for cooling and a separate setting for heating, or use one thermostat to control heating and another thermostat to control cooling. ☐ ☐

A-3. Unoccupied or little used areas are heated or cooled unnecessarily. ☐ ☐

Suggested O & M's:

- Reduce winter thermostat settings to 55° F in unoccupied areas. ☐ ☐
- * Where possible, turn off heating systems if nothing in space can freeze. ☐ ☐
- Use spot heaters/coolers in large spaces with low occupancy. ☐ ☐
- Turn off cooling systems in unoccupied areas, if possible. ☐ ☐
- * Disconnect electrical devices, close drapes, and shut off air systems, if nothing in space can freeze. ☐ ☐

Suggested Retrofits:

- Install system controls to reduce heating/cooling of unoccupied spaces. ☐ ☐

A-4. Off-hour activities are commonplace. ☐ ☐

Suggested O & M's:

- Reschedule off-hour activities to accommodate partial shutdown of building systems. ☐ ☐
- Reschedule custodial and cleaning activities during working hours whenever possible. ☐ ☐
- Re-examine original assumptions regarding occupancy patterns and building usage. Modify patterns for increased energy efficiency. ☐ ☐

Suggested Retrofits:

- Install an automated energy management system that will control all spaces in accordance with usage. ☐ ☐

A-5. Building temperatures are not adjusted for unoccupied periods. ☐ ☐

Suggested O & M's:

- Reduce thermostat settings by a minimum of 10° F at nights, for weekends and holidays during heating season. ☐ ☐
- Shut down all air conditioning units at night, on weekends and holidays. ☐ ☐

Suggested Retrofits:

- Install automatic controls such as time clocks or automated management systems. ☐ ☐

An asterisk (*) means that the implementation of the suggested "O & M", if checked, may require special training for maintenance or operating personnel or create other overriding circumstances that make implementation impractical.

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	EXISTS		RECOM.	
	T	F	Yes	No

A-6. Heating/cooling equipment is operating in lobbies, corridors, vestibules and/or other public areas. ☐ ☐

Suggested O & M's:

* • Close supply ducts and radiators and/or lower heating set points in the above areas if there is no possibility of freeze-up. Disconnect electrical heating units *(or switch off at breaker box).* ☐ ☐

• Close air conditioning supply ducts serving the above areas. ☐ ☐

Suggested Retrofits:

• Properly adjust and balance air/water systems and controls. ☐ ☐

A-7. Heating/cooling equipment is started before occupants arrive and/or is operating during last hour of occupancy. ☐ ☐

Suggested O & M's:

• Experiment with start-up times and duration of operation to determine satisfactory comfort levels for occupants. Reduce or turn off heating and cooling during the last hour of occupancy, allowing the building to "coast". ☐ ☐

Suggested Retrofits:

• Install a time clock or an automated energy management system that will reduce heating and/or turn off air conditioner. ☐ ☐

A-8. Use of equipment associated with laundry and custodial services coincides with heavy electrical demand periods. ☐ ☐

Suggested O & M's:

• Require that major electrical equipment be used in accordance with guidelines that avoid peak electrical demand periods. ☐ ☐

Suggested Retrofits:

• Install a demand control system to automatically monitor power demand and shut off assigned secondary loads to lower demand peaks to pre-established level. ☐ ☐

A-9. Blinds and curtains are not used to help insulate the building. ☐ ☐

Suggested O & M's:

• Instruct personnel to close interior shading devices to reduce night heat loss in winter and to reduce solar heat gain during the summer. ☐ ☐

• Repair or replace damaged or missing shading devices. ☐ ☐

• Place reminders where appropriate. ☐ ☐

Suggested Retrofits:

• Add reflective or heat absorbing films to reduce solar heat gain in summer. *(Caution: Natural lighting and solar heat gain in winter will be reduced. Also, unless protected by an additional layer of glass, these films are subject to damage.)* ☐ ☐

• Install outdoor shading devices. ☐ ☐

A-10. No records of maintenance for motors and motor driven equipment are available. ☐ ☐

Suggested O & M's:

• Using name plate data, prepare an up-to-date list of all motors and pumps used in the facility and list routine maintenance to be performed on each. Check regularly for: ☐ ☐

1. Correct motor voltage and amperage.
2. Loose connections and worn contacts.
3. Unbalanced voltages on 3-phase motors.
4. Improper grounding.
5. Packing wear.
6. Wear and binding on bearings and drive belts.
7. Proper sequencing of pumps and motors.

Suggested Retrofits:

• Replace worn equipment with more efficient units, if available. ☐ ☐

An asterisk (*) means that the implementation of the suggested "O & M", if checked, may require special training for maintenance or operating personnel or create other overriding circumstances that make implementation impractical.

	EXISTS		RECOM.	
	T	F	Yes	No

A-I1. Control devices are not inspected on a regular basis. ☐ ☐

Suggested O & M's:

- Routinely check all time clocks and other control equipment for proper operation; correct time and day; and proper programming of on-off set points. Protect from unauthorized adjustment. ☐ ☐

Suggested Retrofits:

- Consider using an automated energy management system as an alternative. ☐ ☐

A-I2. Conditioned air or heated water is discarded. ☐ ☐

Suggested O & M's:

- None Practical

Suggested Retrofits:

- It is important for a building owner to be aware of heat recovery measures. However, it is not wise to install such equipment without first analyzing the energy characteristics of the building, performance of the hardware, and how it fits into the overall energy plan. ☐ ☐

Ventilation System

V-1. An excessive quantity of outdoor air is used to ventilate the building. ☐ ☐

Suggested O & M's:

* o Reduce outdoor air quantity to the minimum allowed by codes by adjusting outdoor air dampers during hours of occupancy. ☐ ☐

Suggested Retrofits:

o Replace old style dampers with new high quality, opposed-blade models with better close-off ratings. ☐ ☐

V-2. Outdoor air intake dampers open when building is unoccupied. ☐ ☐

Suggested O & M's:

o Close outdoor air dampers when building is unoccupied. Be sure dampers have proper seals and adjust to insure complete closure. ☐ ☐

* o Where codes permit, close outdoor air dampers during first and last hours of occupancy to permit fast warm-up and cool-down. ☐ ☐

Suggested Retrofits:

o Install controls which will automatically close dampers during unoccupied periods. ☐ ☐

V-3. Ventilation systems are not utilized for natural cooling capability. ☐ ☐

Suggested O & M's:

* o Whenever possible, use outside air for cooling rather than using refrigeration. *(Use economizer cycle, if available.)* ☐ ☐

Suggested Retrofits:

o Install an economizer cycle with enthalpy control to optimize use of outside air for cooling. ☐ ☐

V-4. Exhaust system operation is not programmed. ☐ ☐

Suggested O & M's:

o Discontinue use of unnecessary exhaust fans. ☐ ☐

* o Re-wire toilet exhaust fans to operate only when lights are on. *(Fans are often wired in reverse. Correct as needed.)* ☐ ☐

o Schedules should be established so exhaust fans run only when needed. ☐ ☐

o Consider grouping smoking and areas with similar exhaust requirements together so they may be served by one exhaust system. ☐ ☐

Suggested Retrofits:

o Install time clocks or other controls to shut exhaust system off when not needed *(as permitted by code.)* ☐ ☐

o Install a rheostat in series with exhaust fan to modulate fan speed so no more than the necessary amount of air will be exhausted. ☐ ☐

o Install chemical or electronic odor or particulate remover to reduce the need for using outside air for ventilation. ☐ ☐

o Install controlled or gravity dampers on all exhaust ducts to close ducts when fan is not operating. ☐ ☐

An asterisk (*) means that the implementation of the suggested "O & M", if checked, may require special training for maintenance or operating personnel or create other overriding circumstances that make implementation impractical.

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	EXISTS T	EXISTS F	RECOM. Yes	RECOM. No
V-5. Return, outdoor air and exhaust dampers are not sequencing properly.	☐	☐		
Suggested O & M's:				
o Adjust damper linkage.			☐	☐
o Be sure damper motors are operating properly.			☐	☐
o Readjust position indicators to accurately indicate damper positions.			☐	☐
o Reset linkage or replace dampers if blades do not close tightly.			☐	☐
o Close all outdoor air intake dampers when equipment is shut off and when building is unoccupied.			☐	☐
Suggested Retrofits:				
o Replace old style dampers with new high quality opposed-blade models with better close-off ratings.			☐	☐
V-6. During heating season, temperature of air flow to space feels too cold.	☐	☐		
Suggested O & M's:				
o Raise supply temperature to a minimum of 60° F in interior zones and 65° F in perimeter zones during winter. Be sure to lower the supply temperature to 55° F during the cooling season. *(Check local codes.)*			☐	☐
* o Reduce air volume to prevent a draft effect during heating season.			☐	☐
Suggested Retrofits:				
o None Practical				
V-7. Air flow to space feels unusually low or is inconsistent from one space to another.	☐	☐		
Suggested O & M's:				
o Utilize ductwork access openings for any obstructions such as loose hanging insulation *(in lined ducts)*, loose turning vanes and accessories, and closed volume and fire dampers. Adjust, repair or replace as necessary.			☐	☐
o Inspect all room air outlets and inlets — diffusers, registers and grilles. They should be kept clean and free of all dirt and obstructions. Clean and remove obstructions as necessary.			☐	☐
o Clean or replace dirty or ineffective filters on a regular basis.			☐	☐
o Post signs instructing occupants not to place objects where they will obstruct air flow.			☐	☐
* o Consider rebalancing system.			☐	☐
Suggested Retrofits:				
o None Practical				

Heating System

	EXISTS T	EXISTS F	RECOM. Yes	RECOM. No
H-1. Multiple boilers or heaters fire simultaneously.	☐	☐		
Suggested O & M's:				
o Adjust controls so boiler #2, for example, will not fire until boiler #1 no longer satisfies demand.			☐	☐
Suggested Retrofits:				
o Purchase and install automatic staging controls if applicable.			☐	☐

An asterisk (*) means that the implementation of the suggested "O & M", if checked, may require special training for maintenance or operating personnel or create other overriding circumstances that make implementation impractical.

	EXISTS T	EXISTS F	RECOM. Yes	RECOM. No
H-2. Stack temperature appears excessively high — *(greater than 400° F plus room temperature.)*	☐	☐		
Suggested O & M's:				
* o Insure proper amount of air for combustion is available in furnace room.			☐	☐
o Examine and clean air intake filters.			☐	☐
* o Perform flue gas analysis on a regular basis to insure proper air to fuel ratio.			☐	☐
* o If furnace is over-firing, verify that spuds and nozzles are properly sized. Also check that fuel pressures are not too high.			☐	☐
NOTE: *Checks and maintenance of boiler operations should be performed by qualified personnel. If there are none on the staff of the institution, consider hiring a service contractor.*				
Suggested Retrofits:				
o Purchase kit for flue gas analysis if frequent testing is anticipated.			☐	☐
H-3. Water in heating system is heated when there is no need.	☐	☐		
Suggested O & M's:				
o Turn off boiler, pumps or heat source.			☐	☐
Suggested Retrofits:				
o Install control to automatically shut down heat generating device when outside air temperature reaches 60° F.			☐	☐
H-4. Space temperatures are higher or lower than thermostat settings.	☐	☐		
Suggested O & M's:				
* o Recalibrate thermostat.			☐	☐
* o Blow out moisture, oil and dirt from pneumatic lines *(for pneumatic systems)*. Clean contacts if control system is electrical.			☐	☐
* o Recalibrate controllers.			☐	☐
* o Insure control valves and dampers are modulated properly.			☐	☐
* o Insure heat generating device is producing heat and heat distribution to the space is unobstructed.			☐	☐
* o Make sure air intake volume is not excessive.			☐	☐
Suggested Retrofits:				
o For electric control systems, install pre-set solid state thermostats which do not require calibration.			☐	☐
H-5. Heating system hot water temperature feels excessively hot during periods of mild weather.	☐	☐		
Suggested O & M's:				
* o Experiment with hot water temperature reduction until an acceptable comfort level is reached.			☐	☐
* o Make sure reset controls work properly.			☐	☐
Suggested Retrofits:				
o Purchase and install automatic temperature controls to schedule heating water temperature according to outside temperature.			☐	☐
H-6. Condensate from street steam is being discharged to sewer drain.	☐	☐		
Suggested O & M's:				
o None Practical				
Suggested Retrofits:				
o Install pump to return condensate to boiler or return condensate by gravity if possible. Condensate also can be used to heat domestic water or boiler combustion air prior to its return to the boiler feedwater system.			☐	☐

An asterisk (*) means that the implementation of the suggested "O & M", if checked, may require special training for maintenance or operating personnel or create other overriding circumstances that make implementation impractical.

EXISTS T F — RECOM. Yes No

H-7. Heating pilot lights are on during cooling season.

Suggested O & M's:

* o Turn pilots off. *(Enter shut-off and turn-on dates in your log book and post a notice in the boiler/furnace room.)*

Suggested Retrofits:

o Replace worn units with new electronic ignition models to avoid unnecessary fuel consumption.

H-8. Steam, condensate and heating water piping insulation is in disrepair or missing.

Suggested O & M's:

o Inspect pipes for broken or missing insulation. Repair or replace as needed.

Suggested Retrofits:

o Install additional pipe insulation in accordance with design specifications and energy conservation codes.

H-9. Operation of burner is accompanied by excessive smoke and soot.

Suggested O & M's:

* o Inspect burner nozzles for wear, dirt and incorrect spray angles. Clean and adjust as necessary.
* o Verify that oil is flowing freely and oil pressure is correct.
* o Perform flue gas analysis to set proper air to fuel ratio.

Suggested Retrofits:

o Purchase kit for flue gas analysis if frequent testing is anticipated.

H-10. Burner short-cycles.

Suggested O & M's:

o Hot water temperature limit switch may be set too low. Reset as required.
o Thermostat may be faulty. Replace if necessary.

Suggested Retrofits:

o None Practical

Cooling System

C-1. Space temperature is higher or lower than thermostat setting.

Suggested O & M's:

* o Re-calibrate space thermostat.
* o Blow out moisture, oil and dirt from pneumatic lines on pneumatic control system. Clean contacts on electric control system.
* o Re-calibrate controllers.
* o Verify that control valves and dampers modulate properly, especially the economizer section of the system.

o Limit excessive outdoor air intake when not operating economizer cycle.

Suggested Retrofits:

o For electric control systems install pre-set, solid state thermostats which do not require calibration.

An asterisk (*) means that the implementation of the suggested "O & M", if checked, may require special training for maintenance or operating personnel or create other overriding circumstances that make implementation impractical.

	EXISTS T	EXISTS F	RECOM. Yes	RECOM. No
C-2. Chiller is operating during cold weather to provide air conditioning.	☐	☐		
Suggested O & M's:				
o None Practical				
Suggested Retrofits:				
o Provide a water interchange system injecting cooling tower condenser water directly into the system's chilled water circuits. Except for pumping and cooling tower fan horsepower, this provides "free" cooling. Special care must be taken in treating and filtering condenser water.			☐	☐
o If system is forced air, using DX coils and air cooled condenser, install economizer cycle to obtain free cooling.			☐	☐
C-3. Reheat coils are used to maintain zone temperatures.	☐	☐		
Suggested O & M's:				
* o Lower hot water temperature.			☐	☐
* o Raise chilled water temperature. This will result in higher supply air temperatures to space.			☐	☐
o During summer months, turn hot water flow off by shutting valve at reheat coil or by turning off hot water circulating pump.			☐	☐
Suggested Retrofits:				
o Convert to variable air volume system if the reheat coils are not necessary to supply heat during the heating season.			☐	☐
C-4. Multiple air conditioning compressors start at the same time.	☐	☐		
Suggested O & M's:				
o Adjust electric controls to stage compressor operation properly.			☐	☐
Suggested Retrofits:				
o Should automatic controls not exist, purchase and install. This will allow compressor #2, for example, to cut in when compressor #1 can no longer satisfy air conditioning load.			☐	☐
C-5. Building utilizes a dual duct or multizone system.	☐	☐		
Suggested O & M's:				
* o Lower hot deck temperature.			☐	☐
* o Raise cold deck temperature.			☐	☐
* o During summer months, turn heating source off.			☐	☐
* o If unit has an economizer cycle, turn mechanical cooling off in winter.			☐	☐
Suggested Retrofits:				
o Convert dual duct or multizone systems to variable air volume, if building has a separate heating system.			☐	☐
o Install controls to automatically reset hot and cold deck temperatures.			☐	☐
C-6. Insulation on cooling line pipes and ducts appears inadequate.	☐	☐		
Suggested O & M's:				
o Repair or replace damaged insulation.			☐	☐
Suggested Retrofits:				
o Insulate all delivery lines and ducts in accordance with recommended R-values.			☐	☐

An asterisk (*) means that the implementation of the suggested "O & M", if checked, may require special training for maintenance or operating personnel or create other overriding circumstances that make implementation impractical.

	EXISTS		RECOM.	
	T	F	Yes	No

C-7. Air conditioning load trips circuit breaker on extremely warm days. ☐ ☐

Suggested O & M's:

* o Tighten wire lugs if loose. ☐ ☐
* o Replace defective circuit breakers. ☐ ☐

o Clean condenser on air cooled systems. ☐ ☐

* o Clean scale build-up in condenser on water cooled systems. ☐ ☐

Suggested Retrofits:

o Consider installing insulated underground storage tank that would allow night operation of chiller when electrical demand is low. This reservoir tank would be a source of supply of chilled water for daytime operation. Chiller would not be operated during the day. ☐ ☐

C-8. Air of inadequate volume or temperature is being discharged through grilles, and the space temperature cannot be maintained. ☐ ☐

Suggested O & M's:

o Defrost evaporator coil if iced. Determine cause of icing and correct. ☐ ☐

o Clean evaporator coil, fins and tubes. ☐ ☐

o Clean or replace air filters. ☐ ☐

o Fire damper may be closed. Open and replace fusible link if necessary. ☐ ☐

o Balancing damper may have slipped and closed. Open to correct position and tighten wing nut. ☐ ☐

* o If fan is rotating backwards, reverse rotation by reversing electrical contacts. ☐ ☐

o Clean condenser coil and/or water tower nozzles. ☐ ☐

Suggested Retrofits:

o Install differential pressure-sensing switches to trip alarm when air flow drops significantly. ☐ ☐

C-9. Refrigeration condensers or coils are dirty, clogged and/or not functioning efficiently. ☐ ☐

Suggested O & M's:

o Determine if normal operating temperatures and pressures have been identified and if all gauges are checked frequently to insure design conditions are being met. ☐ ☐

* o Increased system pressure may be due to dirty consensers which decrease system efficiency. High discharge temperatures often are caused by defective or broken compressor valves. Repair or adjust as required. ☐ ☐

o Inspect the liquid line leaving the strainer. If it feels cooler than the liquid line entering the strainer, it is clogged. It is very clogged if frost or sweat is visible at the strainer outlet. Clean as required. ☐ ☐

o Clean coils and/or other elements as needed on a scheduled basis. Include dehumidification coils. ☐ ☐

Suggested Retrofits:

o None Practical

C-10. Chilled water piping, valves and fittings are leaking. ☐ ☐

Suggested O & M's:

o Repair joint or piping leaks. ☐ ☐

o Repair or replace valves. ☐ ☐

Suggested Retrofits:

o None Practical

An asterisk (*) means that the implementation of the suggested "O & M", if checked, may require special training for maintenance or operating personnel or create other overriding circumstances that make implementation impractical.

	EXISTS T	EXISTS F	RECOM. Yes	RECOM. No
C-11. Refrigeration compressor runs continually. *(Direct expansion systems.)*	☐	☐		
Suggested O & M's:				
*• Contacts in starter circuits of controls may be fused. Repair and replace as necessary.			☐	☐
*• Bubbles in eight glass indicate low refrigerant charge. Repair leaks and recharge.			☐	☐
*• Refrigerant charge may be too high. Check discharge pressure and purge excess.			☐	☐
*• Compressor valves may be leaking. Overhaul compressor.			☐	☐
*• Liquid line solenoid valve may be stuck open. Repair or replace.			☐	☐
Suggested Retrofits:				
• Load may be greater than design. Consider replacing with chiller and water cooled condenser system.			☐	☐

SAMPLE CALCULATIONS

Source: Making Cents of Your Energy Dollar, Volume I, U.S. Department of Energy, as adapted by the State of Colorado, 1979.

The sample calculations refer to the Action(s) immediately preceding. The calculations are intended as working examples of how the professional energy auditor determines cost and payback of energy conservation actions.

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POTENTIAL ENERGY SAVINGS CALCULATIONS

CHECKLIST ITEM NO. V4

O&M DISCONTINUING USE OF EXHAUST FANS

ENERGY USE AND RATING INFORMATION:

A.	NAMEPLATE RATING OF EXHAUST FANS	________	HP
B.	CURRENT ANNUAL EXHAUST FAN OPERATION	________	HRS/YR
C.	ADJUSTED ANNUAL EXHAUST FAN OPERATION	________	HRS/YR
D.	ASSUME FANS ARE 75% LOADED		
E.	.746KW = 1 HP		
F.	ASSUME MOTOR EFFICIENCY OF 85%		

ENERGY SAVINGS CALCULATIONS:

______ (HP) x ______ (HRS/YR) x .75 x .746 (KW/HP) ÷ .85 =

________ (KWY/YR)

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POTENTIAL ENERGY SAVINGS CALCULATIONS

CHECKLIST ITEM NO. H7

O&M TURNING PILOT LIGHTS OFF IN COOLING SEASON

ENERGY USE AND RATING INFORMATION

A. Number of identical pilots turned off (from inspection) ________ pilots

B. Amount of gas consumed per hour by one pilot in A (from local utility) ________ cubic ft/hr

C. Heat value of gas (from local utility or use 1030) ________ BTU/cubic ft.

D. Number of hours per year pilot will be turned off (estimated) ________ hrs/yr

ENERGY SAVINGS CALCULATIONS:

$$\underset{A}{\underline{\qquad\qquad}} \times \underset{B}{\underline{\qquad\qquad}} \times \underset{C}{\underline{\qquad\qquad}} \times \underset{D}{\underline{\qquad\qquad}} = \text{BTU/yr}$$

(NOTE: Repeat this calculation for each pilot light size. Record total savings below.)

____________ BTU's
(Est. Energy Saved)

CONTINUED

2 OF 5

LIGHTING

Because the lighting systems of many existing public buildings were designed within the restrictions of initial cost economies, without knowledge about final space use and subdivision, and without benefit of relatively recent developments and research findings in the field, there is significant potential for lighting system modification. These modifications can reduce substantially the energy consumed by the lighting system (and associated costs) while still providing building occupants with the quality and quantity of illumination required to perform their various tasks and functions.

Before undertaking any change, you must recognize that a lighting system is just that -- a system. Its many elements are interrelated just as the lighting system itself is interrelated with other systems in the building. While energy can be conserved by properly removing lamps and luminaires, realize that such action should be taken only after the entire system has been analyzed and all options evaluated. While conservation of energy is important, it must be achieved in a manner consistent with other requirements, including those of productivity and visual comfort; aesthetics; federal, State and local codes and ordinances, etc. Moreover, it is important to recognize that major alterations to a lighting system can have a significant impact on heating and cooling systems, most of which were designed to consider the amount of heat given off by the lighting system as originally designed. For these reasons, it is suggested strongly that competent technical assistance be obtained before any significant modifications are made and that modifications be made only in light of the building's illumination needs, the lighting system which currently exists, and the many different options which can be utilized.

The following discussion highlights many of the actions which should or can be taken to implement an effective program of lighting energy management.

Source: Much of the narrative discussion is based on Total Energy Management for Hospitals, op. cit., pp. 34-39.

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 only general. 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 the suitability of some lamps 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 one to two years, depending on local energy costs.

*Ballasts add at least 15-20% to the rated energy usage of bulbs.

Source: National Electrical Manufacturers Association and National Electrical Contractors Association, Total Energy Management: A Practical Handbook on Energy Conservation and Management, First Edition, (Washington, D.C., December 1975) p. 33.

Usage Patterns Modifications

An excellent initial step for a program of lighting management is to modify usage patterns based on factors identified during the building energy audit. It should be noted that steps such as developing an effective lighting usage program would have to be updated and modified as changes are made to the lighting system, but for the most part such modifications should be relatively simple once the initial steps have been undertaken.

Establish an effective lighting usage program: a planned program to turn lights on when and where they are needed. The major advantages of such programs are that they can be tailored to the individual characteristics of the space and needs of its occupants, and implemented relatively inexpensively and quickly. The key element of a lighting usage program is a lighting schedule related to occupant usage patterns. Personnel should be assigned, trained, and made responsible for the efficient utilization of lighting by means of established schedules for the control of lighting.

Define the exact nature of occupancy for each period of time. Determine the amount of lighting needed for safety and security purposes. Provide detailed instructions for system operation to responsible employees by means of charts, posting and/or color coding switches. Train the responsible employees to assure understanding and compliance with the procedures.

Reducing Lighting Levels

Of the various illumination level standards, one published by the U.S. Department of Energy in "Lighting and Thermal Operations Guidelines" is considered the most appropriate for office work.

The principal feature of the standard is the promotion of non-uniform illumination. Only the task has full illumination and the lighting in the surrounding areas can and should be reduced.

Tasks that are somewhat more difficult visually, but of short duration, can usually be handled at the lower foot-candle level by moving the eyes and task closer together or perhaps by spending more time looking, rather than increasing the illumination level.

RECOMMENDED FEA MAXIMUM LIGHTING LEVELS

Task or Area	Footcandle Levels	How Measured
Hallways or corridors	10 ± 5	Measured average, minimum 1 footcandle
Work and circulation areas surrounding work stations	30 ± 5	Measured average.
Normal office work, such as reading and writing (on task only), store shelves, and general display areas	50 ± 10	Measured at work station.
Prolonged office work which is somewhat difficult visually (on task only)	75 ± 15	Measured at work station.
Prolonged office work which is visually difficult and critical in nature (on task only)	100 ± 20	Measured at work station.

Source: Federal Energy Administration, Lighting and Thermal Operations: Energy Conservation Principles Applied to Office Lighting, Conservation Paper Number 18, (Washington, D.C., April 15, 1975) pp. v-6, v-7

LIGHTING: DOLLAR SAVING OPPORTUNITIES

NO/LOW COST

Survey With Light Meter
- Remove Bulbs, Tubes and Ballasts
- Start Using Energy Efficient Bulbs and Tubes

Clean Bulbs and Tubes

Clean Fixtures

Set Manual Lighting Schedule

RETROFIT

Remove Fixtures

Rewire Switches

Retrofit With Energy Efficient Ballasts and Tubes

Replace Incandescent Fixtures with HID or Fluorescent

Replace Mercury With Metal Halide HPS, LPS

Use Photocells

Use Timers

COLOR RENDERING INDEX (CRI)

Lamp Type	CRI
Natural Light	100
Incandescent	97
Fluorescent	
Cool White	67
Deluxe Cool White	86-89
Warm White	56
Warm White Deluxe	71
Daylite	75
Vita-Lite	91
Ultralume	85
Energy Efficient	
Lite-White	48
Econo-O-White	51
Mercury	22-52
Metal Halide	65-70
High Pressure Sodium	20
Low Pressure Sodium	0

Color Rendering Index is a method of comparing a specific light source to natural light. The higher the CRI, the more closely that light source simulates natural light.

COMPARISON OF TYPICAL DISCHARGE LAMP PERFORMANCE

Lamp Type		Initial			End of Life**		
			Lumens Per Watt				
		Lumens	Lamp	Lamp/Ballast	Lumens	Lumens per Watt	Rated Average Life **
Low Pressure Sodium	180 W	33,000	180	150	33,000	117	18,000
High Pressure Sodium	400 W	50,000	125	106	35,000	76	24,000
Super Metalarc	400 W	40,000	100	88	27,200	60	15,000
Metalarc (Metal Halide)	400 W	34,000	85	75	22,500	50	20,000
Mercury	400 W	23,000	57	51	15,700	35	24,000
Fluorescent VHO	2/215 W	32,000	74	71	21,760	48	15,000

* Includes ballast losses.
** Operated on 10 Hour Burning Cycle.

Source: Sylvania

REPRESENTATIVE RECOMMENDED ILLUMINATION LEVELS ON TASK*

Schools

Area	Recommended Footcandles on Task
Task	
Reading printed material	30
Reading pencil writing	70
Spirit duplicated material	
Good	30
Poor	100
Drafting, benchwork	100
Lip reading, chalkboards, sewing	150
Classrooms	
Art rooms	70
Drafting rooms	100
Home economics rooms	
Sewing	150
Cooking	50
Ironing	50
Sink activities	70
Note-taking areas	70
Laboratories	100
Lecture rooms	
Audience area	70
Demonstration area	150
Music rooms	
Simple scores	30
Advanced scores	70
Shops	100
Sight-saving rooms	150
Study halls	70
Typing	70
Corridors and stairways	20
Dormitories	
General	10
Reading books, magazines, newspapers	30
Study desk	70

Source: Illumination Engineering Society, "IES Lighting Handbook."

Local Government Buildings

Area	Recommended Footcandles on Task
Drafting rooms	
Detailed drafting and designing, cartography	200
Rough layout drafting	150
Accounting Offices	
Auditing, tabulating, bookkeeping, business machine operation, computer operation	150
General offices	
Reading poor reproductions, business machine operation, computer operation	150
Reading handwriting in hard pencil or on poor paper, reading fair reproductions, active filing, mail sorting	100
Reading handwriting in ink or medium pencil on good quality paper, intermittent filing	70
Private offices	
Reading poor reproductions, business machine operation	150
Reading handwriting in hard pencil or on poor paper, reading fair reproductions	100
Reading handwriting in ink or medium pencil on good quality paper	70
Reading high contrast or well-printed materials	30
Conference rooms	
Critical seeing tasks	100
Conferring	30
Note-taking during projection (variable)	30
Corridors	20
Court rooms	
Seating area	30
Court activity area	70

Source: Illumination Engineering Society, "IES Lighting Handbook."

Hospitals/Public Care Institutions

Area	Recommended Footcandles on Task
Anesthetizing and preparation room	30
Autopsy and morgue	
Autopsy room	100
Autopsy table	1000
Museum	50
Morgue, general	20
Central sterile supply	
General, work room	30
Work tables	50
Glove room	50
Syringe room	150
Needle sharpening	150
Storage areas	30
Issuing sterile supplies	50
Corridor	
General in nursing areas--daytime	20
General in nursing areas--night (rest period)	3
Operating, delivery, recovery, and laboratory suites and service areas	30
Examination and treatment	
General	50
Examining table	100
Exits, at floor	5
Intensive care nursing areas	
General	30
Local	100
Laboratories	
General	50
Close work areas	100
Lobby (or entrance foyer)	
During day	50
During night	20
Locker rooms	20
Medical records room	100
Nurses station	
General--day	70

Source: Illumination Engineering Society, "IES Lighting Handbook."

Area	Recommended Footcandles on Task
General--night	30
Desk for records and charting	70
Table for doctor's making or viewing reports	70
Nurseries, infant	
General	30
Examining, local at bassinet	100
Examining and treatment table	100
Nurses station and work space (See Nurses Station)	
Obstetrical suite	
Labor room, general	20
Labor room, local	100
Scrub-up area	30
Delivery room, general	100
Substerilizing room	30
Delivery table	2500
Clean-up room	30
Recovery room, general	30
Recovery room, local	100
Patients' rooms (private and wards)	
General	20
Reading	30
Observation (by nurse)	2
Night light, maximum at floor (variable)	0.5
Examining light	100
Toilets	30
Pharmacy	
Compounding and dispensing	100
Manufacturing	50
Parenteral solution room	50
Active storage	30
Alcohol vault	10
Surgical suite	
Instrument and sterile supply room	30
Clean-up room, instrument	100
Scrub-up area (variable)	200
Operating room, general (variable)	200
Operating table	2500
Recovery room, general	30
Recovery room, local	100
Anesthesia storage	20
Substerilizing room	30
Waiting rooms, or areas	
General	20
Local for reading	30

Source: Illumination Engineering Society, "IES Lighting Handbook."

LIGHTING
Operations and Maintenance Checklist

Source: Making Cents of Your Energy Dollar, Volume I, U.S. Department of Energy, as adapted by the State of Colorado, 1979.

The checklist provides suggestions for the most common energy wasters in a building. Situations cited as "true" are those which exist in the building. The Energy Auditor then recommends actions to be taken from those suggestions.

Lighting System

L-1. Incandescent lamps are used in offices, workrooms, hallways, and gymnasiums. ☐ ☐

- Where possible use a single incandescent lamp of higher wattage rather than two or more smaller lamps of combined higher wattage. ☐ ☐
- Discontinue using extended service lamps except in special cases such as recessed directional lights where short lamp life is a problem. ☐ ☐
- Discontinue using multi-level lamps. The efficiency of single wattage lamp is higher per watt than a multi-level lamp. ☐ ☐

Suggested Retrofits:

- Replace non-decorative incandescent lamps with more energy conserving types such as fluorescents in general purpose areas and mercury vapors in large group areas. ☐ ☐

L-2. In fixtures where flourescent lamps have been removed, the ballasts have not been disconnected. ☐ ☐

Suggested O & M's:

- * Disconnect ballasts, which still use significant amounts of energy even though tubes have been removed. ☐ ☐

Suggested Retrofits:

- Replace unnecessary tubes with "dummy" types which draw little current and yet provide uniform lighting effect. ☐ ☐

L-3. When burned out fluorescent lamps and/or ballasts have been replaced, more efficient lights have not been installed. ☐ ☐

Suggested O & M's:

- * When relamping, replace fluorescent tubes with more efficient and lower wattage types such as 35-watt instead of 40-watt to achieve a reduction in electrical energy consumption. Wherever possible, replace burned out ballasts with more efficient lower wattage energy conserving ballasts. ☐ ☐
- * Consider not replacing burned out bulbs or lamps, and disconnecting ballasts in areas where delamping is possible. For example, in four-lamp fixtures allow two lamps to remain, disconnecting appropriate ballasts. ☐ ☐

Suggested Retrofits:

- Install more efficient fluorescent tubes and ballasts in all existing fixtures. *(Verify that new lamps will work with existing ballasts.)* ☐ ☐
- Lowering fixtures will increase illumination levels on the task area, and may permit a reduction in the number of fixtures or the wattage of lamps. ☐ ☐

L-4. Lamps and fixtures are not clean. ☐ ☐

Suggested O & M's:

- Establish a regular inspection and cleaning schedule for lamps and luminaires (fixtures). Dust build up reduces effectiveness. ☐ ☐
- Replace lens shielding that has turned yellow or hazy with new acrylic lenses which do not discolor. ☐ ☐

Suggested Retrofits:

- Replace outdated or damaged luminaires (fixtures) with modern types that are easy to clean. ☐ ☐

An asterisk (*) means that the implementation of the suggested "O & M", if checked, may require special training for maintenance or operating personnel or create other overriding circumstances that make implementation impractical.

	EXISTS T	EXISTS F	RECOM. Yes	RECOM. No
L-5. Exterior lighting is used.	☐	☐		
Suggested O & M's:				
* • Replace exterior 150-watt flood lamps with 75-watt flood lamps to reduce consumption while maintaining adequate illumination			☐	☐
* • Eliminate outdoor lighting where practical.			☐	☐
Suggested Retrofits:				
• Install a control device (i.e., time clock, photocell) to automatically turn off lights when not needed.			☐	☐
• Replace exterior incandescent lamps with more efficient types such as high pressure sodium, or metal halide.			☐	☐
L-6. Lights are on in unoccupied areas.	☐	☐		
Suggested O & M's:				
• Provide signs instructing occupants to turn off lights when leaving room.			☐	☐
• Organize task areas to eliminate unnecessary illumination.			☐	☐
Suggested Retrofits:				
• Rewire switches so a single switch does not control all fixtures in multiple work spaces.			☐	☐
• Provide timer switches in remote or seldom used areas where there will be brief occupancy periods.			☐	☐
L-7. Natural lighting is not optimized.	☐	☐		
Suggested O & M's:				
• Utilize natural lighting whenever possible.			☐	☐
• Clean walls or repaint with light reflective non-glossy colors.			☐	☐
Suggested Retrofits:				
• Install light sensors and dimming equipment which automatically compensate for varying natural lighting conditions.			☐	☐
L-8. Two lamps have not been removed from four-lamp fixtures where possible.	☐	☐		
Suggested O & M's:				
* • Remove two lamps and disconnect ballasts.			☐	☐
Suggested Retrofits:				
• None Practical				

An asterisk (*) means that the implementation of the suggested "O & M", if checked, may require special training for maintenance or operating personnel or create other overriding circumstances that make implementation impractical.

SAMPLE CALCULATIONS

Source: Making Cents of Your Energy Dollar, Volume I, U.S. Department of Energy, as adapted by the State of Colorado, 1979.

The sample calculations refer to the Action(s) immediately preceding. The calculations are intended as working examples of how the professional energy auditor determines cost and payback of energy conservation actions.

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POTENTIAL ENERGY SAVINGS CALCULATIONS

CHECKLIST ITEM NO. L2

O&M DISCONNECTING BALLASTS - COOLING SEASON

ENERGY USE AND RATING INFORMATION

A. Fluorescent Ballasts Consume Approximately 15% of Rated Power Requirement of Tubes Removed from Fixture.

B. For every 1000 Watts If Lighting Energy Saved, an Additional 300 Watts of Cooling Energy is saved in Texas.

C. Total Wattage of Removed Tubes. ______________ Watts.

D. Hours Used in Cooling Season ______________ Hrs/Season

E. 1000 Watts = 1 Kilowatt
Energy Savings Calculation

$\underset{A}{.15} \times \underset{B}{1.3} \times \underset{C}{\underline{\qquad\qquad}}$ (Watts) $\times \underset{D}{\underline{\qquad\qquad}}$ (Hrs/Season) -: $\underset{E}{1000}$)Watts/KW) =

________ KWH/Season

NOTE: IN HEATING SEASON, FOR EVERY BTU OF LIGHTING ENERGY SAVED, A BTU OF HEATING (OUTPUT) ENERGY WILL BE PROVIDED FROM SOME OTHER SOURCE, e.g., FURNACE, BOILER, HEAT PUMP, ETC.

POTENTIAL ENERGY SAVINGS CALCULATIONS

CHECKLIST ITEM NO. L3

O&M REPLACING BURNED OUT 40-WATT TUBES WITH MORE EFFICIENT 35-WATT TUBES

ENERGY USE AND RATING INFORMATION

A. A 14% Savings Occurs when 40-Watt Fluorescent Tubes are Replaced with an Equal Number of 35-Watt Energy Efficient Tubes.

B. For Every 1000 Watts of Lighting Energy Saved, an Additional 300 Watts of Cooling Energy is Saved in Texas.

C. Total Wattage of 40-Watt Tubes Replaced ________ Watts.

D. Hours Used in Cooling Season ________ Hrs/Season

E. 1000 Watts = 1 Kilowatt

ENERGY SAVINGS CALCULATION

$\underset{A}{\underline{.14}} \times \underset{B}{\underline{1.3}} \times \underset{C}{\underline{\qquad\qquad}}$ (Watts) $\times \underset{D}{\underline{\qquad\qquad}}$ (Hrs/Season) -: $\underset{E}{\underline{1000}}$)Watts/KW) =

________ KWH/Season

NOTE: IN HEATING SEASON, FOR EVERY BTU OF LIGHTING ENERGY SAVED, A BTU OF HEATING (OUTPUT) ENERGY WILL BE PROVIDED FROM SOME OTHER SOURCE, e.g., FURNACE, BOILER, HEAT PUMP, ETC.

BUILDING ENVELOPE

The total use of energy required in schools, hospitals, local government buildings and public care institutions for providing the proper environmental conditions of temperature, humidity, light and fresh air, involves not only the mechanical systems and services within the facility, but also the entire BUILDING ENVELOPE which must CONTAIN that man made environment and EXCLUDE the often adverse outside conditions.

Total Energy Management in a building, therefore, must take into account all the possible ways that conductive and convective heat losses and gains, outdoors-to-indoors and indoors-to-outdoors, can occur through the BUILDING ENVELOPE, through the seasons of the year. It must also consider solar heat gains, helpful in winter and unwanted in summer. And, because of the oftentimes functional complexities of a building, energy management should extend also to the separation of the environmental zones inside that building envelope.

A Total Energy Management program must begin with a thorough energy audit of the building and all its systems, not the least of which is the building envelope. That audit begins with a very thorough examination of all the physical conditions of the building which are subject to heat transfer.

All the items found to exist in the basic audit, whether or not in need of repair or installation, should be scheduled for re-examination on an appropriate periodic basis so that cost-effective and energy-effective maintenance is achieved. This scheduling may be computerized as part of the overall building Energy Management Program. The conditions and effects of the building envelope would, in that way, become part of the monthly energy consumption analysis.

There are many small ways to conserve energy in the building envelope, as well as larger, more expensive improvements which can be made, and it is important to put these opportunities into some overall perspective. From the broad point of view there are five major areas of concern. They are, in order of importance for existing building considerations:

1. Reduction of infiltration and exfiltration.
2. Reduction of solar heat gain through windows.
3. Reduction of heat loss through windows.
4. Reduction of heat gain and loss through walls, roofs, floors and slabs.
5. Reduction of internal heat transfer.

A general analysis of each of these five subjects is presented in the discussion which follows. Some specific conditions are cited, but a more complete list of possible steps in energy conservation, especially for the many small efforts which add up to meaningful savings, are listed in the energy conservation checklist tab of this manual.

Infiltration and Exfiltration

The need for a large portion of the energy used for heating and cooling a typical building results from the heat gains and losses through the building envelope. In the "typical" building the major portion of that occurs as infiltration and exfiltration--air leakage through all kinds of cracks and crevices in the building envelope.

Outside air can leak through cracks around operative window sashes and doors, between the door or window frames and the wall materials they are set in, and through joints in the basic wall construction, especially in panelized wall systems.

There are many types of building exterior treatment and the chances for leakage in and out of the building envelope vary accordingly. Consider, for example, the increasing amount of crack-footage in the following list of facade-types:

1. Individual windows set in brick walls.
2. Bands of windows set in brick walls.
3. Precast panel systems, windows in some panels.
4. Curtain wall treatment on 2 sides only.
5. Curtain wall treatment on all 4 sides.

At the same time consider the quality of the installation and the caulking materials used. These can vary from good to poor, and caulkings can change in quality with age. Happily, most of the curtain wall systems have very good details for holding the glass and for preventing leakage.

Infiltration and exfiltration vary with wind velocities and wind pressure, both positive and negative, on different sides of the building. Air pressures inside the building envelope can also be positive and/or negative, and these can combine with the exterior conditions to induce leakage wherever the potential exists.

There is also a stack effect in tall buildings, especially in such vertical spaces as stairways, elevators, and mechanical service shafts. Since warm air tends to rise, when outside air is cold there is a strong potential for infiltration at the bottom floors and exfiltration at the top.

Caulking between fixed systems and weather-stripping of movable window sashes and doors are the major means of reducing infiltration and exfiltration in the building envelope. There are probably as many types of caulking and weather-stripping materials as there are types of cracks to be filled. In general, the non-hardening, surface-skinning types of caulkings are best. Caulkings must have permanent adherence and should be chosen according to surfaces involved, and these surfaces must be clean and dry. For wide cracks a filler, or backer-rod can be used before the caulking. Weather-stripping includes compressible, closed cell foam, compressible "tubular" systems, and interlocking metal strip systems. Since there are so many different conditions which can exist for caulkings and weather-stripping it is wise to get expert advice on the subject.

Storm windows are often used to increase the thermal resistance through glass. Double glazing is also used for this purpose, but the storm window units have an advantage, generally, in increased control over leakage of air around the window frames. Depending on window framing and installation details, storm windows in secondary frames are usually more energy conserving than double glazing in a single frame, and they are often easier to accommodate in existing conditions.

Solar Heat Gain

Heat gains from solar radiation through windows in Texas buildings can have a major impact on energy use, depending on such factors as orientation, exposure and shading, winter and summer, types of glass and glass treatment.

There is so much more heat gain from solar radiation than from conduction through the glass that radiative gains must be solved before considering the conductive heat transfer through the glass. When double glazing is then considered for reducing summer heat gains there will also be a real benefit in controlling heat losses in the winter season.

The effects of orientation are different for winter and summer. In winter the sun rises a little south of east, is low in south sky at noon, and it sets correspondingly south of west. This sun movement allows a little east and well wall solar heat gain in the morning and afternoon, respectively, and a lot of mid-day sun on the south walls and into south facing windows. In the summer, the sun rises a little north of east and it sets a little north of west, and at noon it is high overhead, barely shining on southerly walls and windows. Summer solar radiation, therefore, is more severe on eastern and western exposures and not so serious on southern exposures. North facing walls and windows get no sunshine in the winter and only early morning and later afternoon angular exposure to the sun in the summer.

Exterior architectural shading for windows must relate to these sun angles. On the east and west elevations such devices must be vertical, the full height of the windows, sometimes adjustable for the actual orientation and time of day. For south facing windows, roof overhangs and horizontal, projecting "eyebrows", over <u>each</u> band of windows can be designed for complete summer shading, yet allow winter solar gains. Such shading devices, when used, are usually part of the original design and construction. They are only occasionally installed on existing structures.

External shading devices are the most effective method of controlling solar heat gain because they prevent the sun from shining directly on the glass. There are some external sun shading devices available which can be fixed to the window openings, and which provide meaningful shading. Sometimes these devices can be removed or adjusted to allow winter solar heat gain.

Internal shading devices include drapes, venetian blinds, vertical louver blinds, roller blinds, and variations of these basic types. While less effective than other methods of solar heat gain, internal shades are relatively inexpensive and they are much more easily adjustable to the times of most solar gain and to the needs for light and view.

Tinted or reflective glass, and reflective polyester films applied to the inside of the glass may also be used to reduce solar heat gain. The tinted or reflective glass can be used to replace existing glass or to create double glazing (storm windows). The films are self-adhesive but require special care in application. With storm windows the film should be on the inner face of the outside layer of glass (do not put it on the inner glass or the reflected heat will be trapped).

An example of solar heat gain reduction involves the application of reflective solar film to 10,000 sq. ft. of east, south, and west windows in a 10 story office building in Miami, Florida. The annual energy savings calculated was 15% with a payback of just over two years.

In winter solar heat gain is beneficial and its usefulness must be balanced against solar gains in the summer according to orientation, types of glass, reflective films, latitude, solar control devices and percentage of sunshine. Note that about 10% less sunlight penetrates double glazing than single glazing. However, double glazing reduces the heat load due to conduction, and the benefits from this more than offset the loss of solar radiation.

Heat Loss Through Windows

On the national scale, it has been estimated that 20% of our energy goes to space conditioning in buildings. Of this, 25% results from heat losses and gains due to the relatively high thermal conductivity of windows -- an energy use equivalent to an average of 1.7 million barrels of oil a day.

The rate of conductive heat flow through various parts of the building envelope (glass, walls, roof, floors, etc.) is expressed as a "U"-value. This rating is in units of BTUs/hour/square foot of surface/degree F. of temperature difference inside to outside. The lower the U-value the higher the insulating value of the construction rated. Typical wall and roof construction vary from U=.4 down to U=.04 depending on the basic structural materials and the type and thickness of the insulation used. Single panes of glass in still air (less than 15 mph) have a U-value of 1.13. Double glazing reduces the U-value to about .55.

These values show a greater concern for heat flow though glass than through the "solid" parts of the building envelope, the exterior walls, the roof, and floors over unheated space. It is helpful to put this difference into some sort of perspective. We can do this by comparing their U-values and what would be equivalent areas for the same transmission of BTUs per hour.

Assume the following reasonable U-values for two windows and a wall:

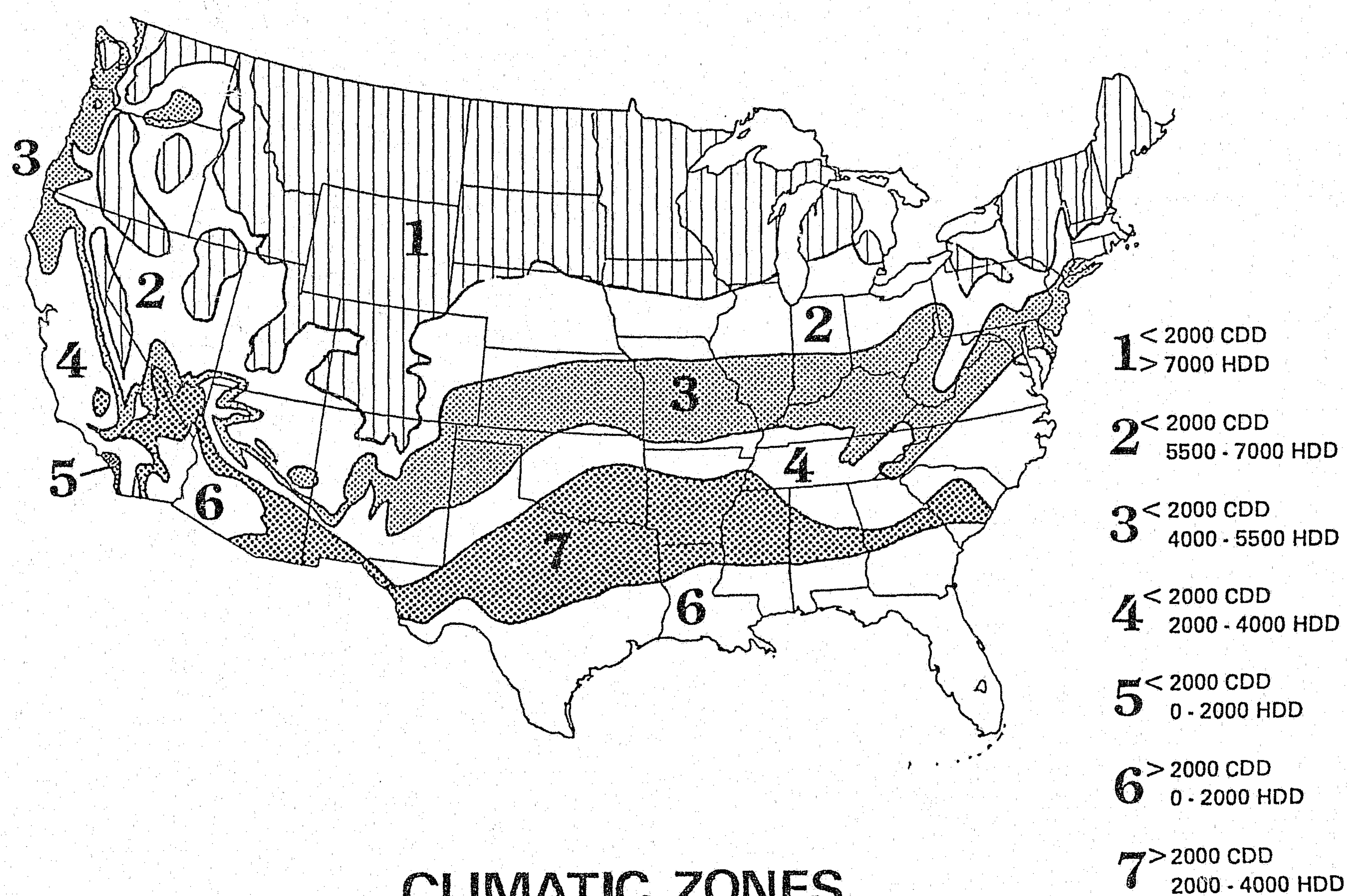
a. Windows with single glass: 1.1 U-value

b. Window with double glass: .55 U-value

U-VALUES FOR GLASS

Glass	U-Value
Single pane	1.13
Double pane	.65
Triple pane	.47
Storm window and air space	.56

Source: ASHRAE, 90-75



CLIMATIC ZONES

c. The solid wall

inside = gypsumboard insulation = R-17 wall = exterior = sheathing plus wood panel, painted	.055 U-value

We can see that the rate of heat flow through the solid wall is one-tenth that of the double glazed window which in turn is one half that of the single glass. Since this transmission rating is on a square foot basis we can also see that the same amount of heat would be transmitted through:

a.	a single glass window:	2.5' x 4' = 10 sq. ft.
b.	a double glazed window:	5' x 4' = 20 sq. ft.
c.	the solid wall:	10' x 20' = 200 sq. ft.

Using double glazing will reduce the conduction heat loss of single glazing by one half, but this will occasionally be modified somewhat by solar radiation and wind, and therefore by orientation. Wind destroys the exterior "air film" on the glass and this causes the U-value of the window to increase. Shutters, screens, trees, and other shielding devices will reduce this wind effect somewhat.

It is often easier to add storm windows to existing windows than it is to change to double glazing in the original frame. The choice will vary with the physical conditions, the present needs and replacement plans, etc., for each building. The use of storm windows may provide greater reduction in heat transfer through the windows because of the greater air space, and storm windows should give more control over air infiltration because of the second frame set tightly in the window opening.

The use of the various types of drapes, blinds, appropriate linings, etc. to cover the windows when not needed for light or view will also help reduce heat flow through windows. An added advantage provided by the drapes is that they will improve the Mean Radiant Temperature in a room or office. The occupant will not feel so easily the "cold window" in the winter or the "heat from the window" in the summer. Eliminating this human response to radiant heat flow toward or from the glass will preclude the occupants' need for more heat or more cooling for human comfort.

When rooms or zones of the building are unused or closed off, the thermal transmission through the windows, in both winter and summer, can be meaningfully reduced by closing off the windows with various types of thermal barriers. Depending on the time the space is to be closed off, and on how the space heating and cooling is to be maintained, the thermal barriers can range from simple drapes and blinds to storm windows and even opaque, insulated panels.

Heat Flow Through Walls, Roof, Floors

In energy conservation we are concerned with the rate of conductive heat flow through various types of building construction. This is the "U"-value of each complete construction, inside-to-outside, including air films, as discussed above. By contrast, we are also concerned with thermal resistance of materials such as insulation, masonry, wood, plaster, etc. to heat flow through them. The thermal resistance of a material is its "R"-value. The R-value of all materials in a wall construction can be added, and the resulting total R-value is the reciprocal of the U-value of the whole construction.

This relationship of the U-value to the total R-value, and then to the R-values of the parts of a construction, is meaningful in discussing the improvements that might be achieved by the addition of certain insulation materials. They are commercially rated by their R-values, even though we usually use the U-value as a rating of the total construction.

It is best to remember simply:

a. the higher the R-value, the better the "insulation", and
b. the lower the U-value, the better the "insulation" of the whole construction.

For most constructions of walls, and also for roofs, the basic structural materials by themselves are inadequate as thermal barriers and various amounts and types of insulation are included in their design. Part of the physical examination of the building envelope in the basic energy audit of and existing building should be an

YEARLY HEAT LOSS/SQUARE FOOT THROUGH ROOF

CITY	LATITUDE	SOLAR RADIATION LANGLEY'S	DEGREE DAYS	HEAT LOSS THROUGH ROOF BTU/FT.^{2} YEAR			
				U=0.19		U=0.12	
				a=0.3	a=0.8	a=0.3	a=0.8
MINNEAPOLIS	45°N	325	8,382	35,250	30,967	21,330	18,642
CONCORD, N.H.	43°N	300	7,000	32,462	27,678	19,649	16,625
DENVER	40°N	425	6,283	26,794	22,483	16,226	13,496
CHICAGO	42°N	350	6,155	27,489	23,590	16,633	14,190
ST. LOUIS	39°N	375	4,900	20,975	17,438	12,692	10,457
NEW YORK	41°N	350	4,871	21,325	17,325	12,911	10,416
SAN FRANCISCO	38°N	410	3,015	10,551	8,091	6,381	4,784
ATLANTA	34°N	390	2,983	12,601	9,841	7,619	5,832
LOS ANGELES	34°N	470	2,061	4,632	3,696	2,790	2,142
PHOENIX	33°N	520	1,765	5,791	4,723	3,487	2,756
HOUSTON	30°N	430	1,600	6,045	4,796	3,616	2,778
MIAMI	26°N	451	141	259	130	139	55

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YEARLY HEAT GAIN/SQUARE FOOT THROUGH ROOF

CITY	LATITUDE	SOLAR RADIATION LANGLEY'S	D.B. DEGREE HOURS ABOVE 78°F	HEAT GAIN THROUGH ROOF BTU/FT.^{2} YEAR			
				U=0.19		U=0.12	
				a=0.3	a=0.8	a=0.3	a=0.8
MINNEAPOLIS	45°N	325	2,500	2,008	8,139	1,119	4,728
CONCORD, N.H.	43°N	300	1,750	1,891	7,379	1,043	4,257
DENVER	40°N	425	4,055	2,458	9,859	1,348	5,680
CHICAGO	42°N	350	3,100	2,104	7,918	1,185	4,620
ST. LOUIS	39°N	375	6,400	4,059	12,075	2,326	7,131
NEW YORK	41°N	350	3,000	2,696	9,274	1,543	5,465
SAN FRANCISCO	38°N	410	3,000	566	5,914	265	3,354
ATLANTA	34°N	390	9,400	4,354	14,060	2,482	8,276
LOS ANGELES	34°N	470	2,000	1,733	10,025	921	5,759
PHOENIX	33°N	520	24,448	12,149	24,385	7,258	14,649
HOUSTON	30°N	430	11,500	7,255	20,931	4,176	12,369
MIAMI	26°N	451	10,771	9,009	24,594	5,315	14,716

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anaylsis of the plans, details, and specifications of its construction to determine the resistance to heat flow of its many parts. This should be done for the various details of wall and roof construction, and for any floors over unconditioned spaces.

These variables include latitude, solar radiation, "degree hours" above 80°F, winter "degree days", building and wall orientation, surface heat absorption coefficients, seasonal wind patterns and velocities, as well as the theoretical U-value of each construction.

The mass of a wall does not give it a better, lower U-value, per se. Mass simply provides a form of thermal inertia: it slows up the heat transfer and delays the impact of outdoor temperature changes on the inside conditioned space. The time delay allows the wall to act dynamically as a thermal storage system, smoothing out peaks in heat flow and reducing yearly heat loss somewhat. High mass walls of 80 to 90 lbs/sq. ft. have approximately 2% less yearly heat loss (or gain) than low mass walls of 10 to 20 lbs/sq. ft., assuming the same U-value and absorption coefficient for both walls.

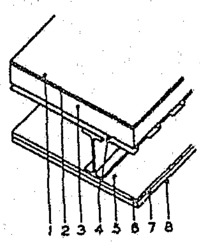
When it is determined that the U-value of a wall should be lowered as an energy conversion measure, one naturally looks for methods to increase the insulation of the wall. It is seldom possible to do this without going to some extreme measures, such as removing the interior wall suraces (gypsum board or plaster, usually) and then adding appropriately high R-value insulation before resurfacing the walls.

It is also possible to add insulation with a new facing over existing surfaces. When added to the exterior the treatment will have to be weathersealed and vapor-proofed, and it will give an entirely new look to the building unless a similar facing existed before. Such exterior treatment is feasible for low-rise structures and difficult for tall buildings, and it causes little disruption inside.

U-VALUES FOR TYPICAL WALL & ROOF CONSTRUCTION

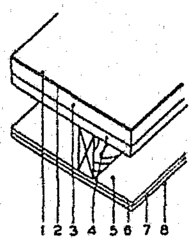
ROOFS

(Adapted from ASHRAE 72 Guide)



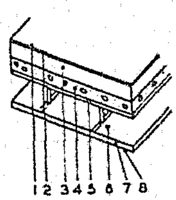
Example

Construction	Resistance (R)
1. Outside surface (15 mph wind)	*0.17*
2. Built-up roofing (3/8 in.)	*0.33*
3. Roof insulation (C = 0.24)[b]	*4.17*
4. Metal deck	*0.00*
5. Air space[c]	*0.99*
6. Metal lath and 7. 3/4 in. plas. (sand agg.)	*0.13*
8. Inside surface (still air)	*0.92*
Total resistance	*6.71*
$U = 1/R = 1/6.71$	0.15



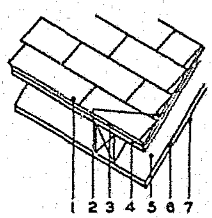
Example

Construction (Heat flow up)	Resistance (R)
1. Outside surface (15 mph wind)	*0.17*
2. Built-up roofing. (3/8 in.)	*0.33*
3. Roof insulation (C = 0.72)	*1.39*
4. Plywood deck (5/8 in.)	*0.78*
5. Air space[b]	*0.85*
6. Gypsum wallboard (1/2 in.)	*0.45*
7. Acoustical tile (1/2 in.)—glued	*1.25*
8. Inside surface (still air)	*0.61*
Total resistance	*5.83*
$U = 1/R = 1/5.83$	0.17



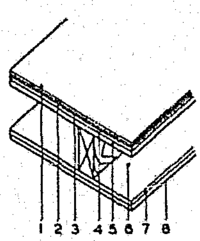
Example

Construction (heat flow up)	Resistance (R)
1. Outside surface (15 mph wind)	*0.17*
2. Built-up roofing—3/8 in.	*0.33*
3. Roof insulation (none)	—
4. Concrete slab (lt. wt. agg.) (2 in.)	*2.22*
5. Corrugated metal	*0*
6. Air space[b]	*0.85*
7. Metal lath and 3/4 in. plas. (lt. wt. agg.)	*0.47*
8. Inside surface (still air)	*0.61*
Total resistance	*4.65*
$U = 1/R = 1/4.65 =$	0.22



Example

Construction (Heat flow up)	Resistance (R)
1. Outside surface (15 mph wind)	*0.17*
2. Asphalt shingle roofing	*0.44*
3. Building paper	*0.06*
4. Plywood deck (5/8 in.)	*0.78*
5. Air space[c] (3.5 in., reflective surface)	*2.06*
6. Gypsum wallboard (1/2 in.)	*0.45*
7. Inside surface (still air)	*0.62*
Total resistance	*4.58*
$U = 1/R = 1/4.58$	0.22



Example

Heated room below unheated space

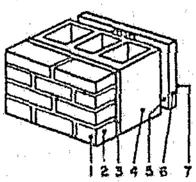
Construction (heat flow up)	Resistance (R)
1. Top surface (still air)	*0.61*
2. Linoleum or tile (avg R)	*0.05*
3. Felt	*0.06*
4. Plywood (5/8 in.)	*0.78*
5. Wood subfloor (3/4 in.)	*0.94*
6. Air space[b]	*0.85*
7. Metal lath and 3/4 in. plas. (lt. wt. agg.)	*0.47*
8. Bottom surface (still air)	*0.61*
Total resistance	*4.37*
$U = 1/R = 1/4.37 =$	0.23

U-VALUES FOR TYPICAL WALL & ROOF CONSTRUCTION

WALLS

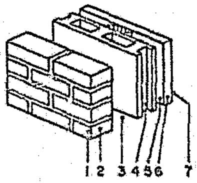
(Adapted from ASHRAE 72 Guide)

Example



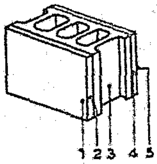
Construction	Resistance (R)
1. Outside surface (15 mph wind)	*0.17*
2. Face brick (4 in.)	*0.44*
3. Cement mortar ($\frac{1}{2}$ in.)	*0.10*
4. Concrete block (cinder agg.) (8 in.)	*1.72*
5. Air space[b] (reflective)	*2.80*
6. Gypsum wallboard, Foil back ($\frac{1}{2}$ in.)	*0.45*
7. Inside surface (still air)	*0.68*
Total resistance	*6.36*
$U = 1/R = 1/6.36 =$	0.16

Example



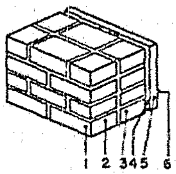
Construction	Resistance (R)
1. Outside surface (15 mph wind)	*0.17*
2. Common brick (4 in.)	*0.80*
3. Air space[b]	*0.97*
4. Concrete block (stone agg.) (4 in.)	*0.71*
5. Air space[b]	*0.97*
6. Gypsum wallboard ($\frac{1}{2}$ in.)	*0.45*
7. Inside surface (still air)	*0.68*
Total resistance	*4.75*
$U = 1/R = 1/4.75 =$	0.21

Example



Construction	Resistance (R)
1. Inside surface (still air)	*0.68*
2. Plas. (lt. wt. agg.) $\frac{5}{8}$ in.	*0.39*
3. Cement block (cinder agg.) (4 in.)	*1.11*
4. Plas. (lt. wt. agg.) $\frac{5}{8}$ in.	*0.39*
5. Inside surface (still air)	*0.68*
Total resistance	*3.25*
$U = 1/R = 1/3.25 =$	0.31

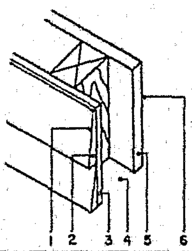
Example



Construction	Resistance (R)
1. Outside surface (15 mph wind)	*0.17*
2. Face brick (4 in.)	*0.44*
3. Common brick (4 in.)	*0.80*
4. Air space[b]	*0.97*
5. Gypsum wallboard ($\frac{1}{2}$ in.)	*0.45*
6. Inside surface (still air)	*0.68*
Total resistance	*3.51*
$U = 1/R = 1/3.51 =$	0.29

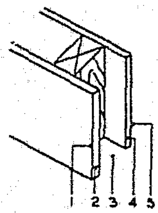
Adjustment for furring (1 × 2 in. @ 16 in. o.c.)
$= U_t \times 1.00 = 0.29 \times 1.00 = 0.29$

Example



Construction	Resistance (R)
1. Outside surface (15 mph wind)	*0.17*
2. Siding, wood, $\frac{1}{2}$ in. × 8 in. lapped (avg)	*0.81*
3. Sheathing, $\frac{1}{2}$ in. asphalt impregnated	*1.32*
4. Air space[b]	*0.97*
5. Gypsum wallboard ($\frac{1}{2}$ in.)	*0.45*
6. Inside surface (still air)	*0.68*
Total resistance	*4.40*
$U = 1/R = 1/4.12 =$	0.23

Example



Construction	Resistance (R)
1. Surface (still air)	*0.68*
2. Gypsum bd. ($\frac{1}{2}$ in.)	*0.45*
3. Air space[b]	*0.97*
4. Gypsum wall board ($\frac{1}{2}$ in.)	*0.45*
5. Surface (still air)	*0.68*
Total resistance	*3.23*
$U = 1/R = 1/3.23$	0.31

When added to the interior, such treatment is easier in tall buildings but it is disruptive to normal operations. In either case there are likely to be architectural and mechanical complications not readily discernable, and there are usually building code conditions to consider, so it is advisable to get competent professional help in such an undertaking.

Heat g · and loss through roofs can also be reduced by lowering the U-value by adding insulation. Again there are techniques for this additional treatment both on top of the roof and on the underside.

When adding insulation to the top of the roof the work is less disruptive and may be timely if the existing surface needs repair. The surface must be prepared according to what techniques are used. Both sprayed foam and rigid board insulation are available for use on roofs. Each has its own best treatment for a new top waterproof surface. When the existing roof is acceptable, especially with a new built-up roof, the new IRMA roof system of Dow Styrofoam may be appropriate, as the insulation is laid <u>over</u> the water proofing, shielding it from the sun's heat. Each case should be given the guidance of professional consultation.

Adding insulation below the roof structure may be achieved by applying it to the underside of that structure by spray application or with fitted pieces of insulation board. The complications of working above and around existing utility lines, pipes, ducts and structural members may be the determining factors involved. The need for insulating the pipes, ducts, etc., should not be overlooked, nor should their location in the attic space allow some area of the roof underside to go untreated. If the insulation is laid over the existing ceiling it is important to consider the pipe and duct insulation and possibly the need for attic ventilation.

As a rule of thumb, the inches of duct insulation required is one fifteenth of the temperature difference between the conditioned air inside the duct and the unconditioned air in the attic space.

When floors over unconditioned spaces (crawl spaces, vented and unvented; pipe and mechanical spaces, rough storage spaces; outdoor spaces) are deemed to have inadequate resistance to heat flow, the U-value can also be lowered by the addition of insulation materials. Types of treatment will vary with accessibility. Again, they include the spray applications and rigid board treatment. Where concrete floors are poured on grade, and additional floor insulation is desired it can be installed as an exterior, perimeter treatment (Dow Styrofoam, Fiberglas, etc.) of insulation board placed against the foundation, from the bottom of the exterior wall facing down to a point approximately 24 inches below grade.

Internal Heat Flow

Buildings are often very complex facilities which must house many functions, and as a result are often zoned both functionally and mechanically into a number of related areas. Occasionally the temperature, humidity and air movement requirements of these zones must be isolated or separated. Sometimes there is a contrast in the environments of two adjacent areas because one is "shut-off" momentarily or temporarily. Under these varying conditions there may well be need for energy conservation measures due to air leakage or heat flow through inadequate barriers.

Air leakage is probably the more serious of these two types of heat gain and loss, and probably the hardest to treat completely. Besides the conditions of door cracks, and leakage around electrical and utility boxes in walls, already discussed, there are the various types of ceiling penetrations: recessed lights, air conditioning grills, etc., which need appropriate seals in certain situations.

Accoustical tile "lay-in" ceilings are used in many types of general public spaces in buildings, and this may include corridors within mechanically zoned areas. These ceilings are not air tight, and, furthermore, are often used to create plenum spaces for return air systems with open grilles for air flow. They may allow more heat gains and losses than is suspected through internal structure openings. Such openings may be above walls which stop short of the structure above them; or they may be uncaulked penetrations of walls, slabs, shafts, chases, etc., for pipes, ducts, conduit, and special function services.

By its very nature, the construction of a building must accommodate many mechanical systems and services, and plenums, shafts and pipe chases must be used. Many types of wall penetrations and openings which cannot be seen above ceilings do occur.

The mechanical systems engineer for the building may be the first to suspect energy losses through such hidden paths of internal leakage: they may even be causing imbalances in his systems. Such leakage should be investigated by him and by the maintenance personnel, both on a "suspicion" basis and in the basic energy audit of the building, and treatment should be performed according to what is found.

Conductive heat flow through walls, floors, ceilings, and such internal barriers, will be of concern only when an area is much hotter or much colder than the adjacent occupied space. Such conditions should be anticipated by the building staff, especially the mechanical systems engineer and those responsible for the energy management program for the facility. They should be able to plan accordingly, even to the installation of additional insulation treatment, as well as control of air leakage.

Conclusions

While many small efforts can be made for energy conservation in the existing building envelope, some of the more complicated measures are both expensive and disruptive. Such treatment should not be viewed with dismay. Not only can the expensive, disruptive opportunities for energy conservation be planned to be carried out in any remodeling which goes with expansion, but also the experience of energy audits and Total Energy Management can make a major impact on the planning of future facilities.

The importance of controlling (1) INFILTRATION AND EXFILTRATION, and (2) SOLAR HEAT GAIN should not be lost in considering the other concerns of this chapter. These two first concerns are the only two Major Energy Conservation Opportunities which related to the BUILDING ENVELOPE out of the 20 ECO's discussed in the very complete and detailed study, Guidelines for Saving Energy in Existing Buildings. This manual is divided into two parts: Building Owners and Operators Manual, ECM-1 and Engineers, Architects and Operators Manual, ECM-2. It was prepared by Dubin-Mindell-Bloome Associates for the Federal Energy Administration, 16 June 1975. Both volumes are available through the National Technical Information Service, U.S. Department of Commerce, Springfield, Virginia 22161.

BUILDING ENVELOPE
Operations and Maintenance Checklist

Source: Making Cents of Your Energy Dollar, Volume I, U.S. Department of Energy, as adapted by the State of Colorado, 1979.

The checklist provides suggestions for the most common energy wasters in a building. Situations cited as "true" are those which exist in the building. The Energy Auditor then recommends actions to be taken from those suggestions.

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	EXISTS		RECOM.	
	T	F	Yes	No

Building Envelope System

B-1. Improper alignment and operation of windows and doors allows excessive infiltration. ☐ ☐

Suggested O & M's:

- Realign or re-hang windows or doors that do not close properly. In extreme cases consider permanent sealing of windows. ☐ ☐
- Make sure automatic door closing mechanisms work properly. Adjust for faster return. ☐ ☐
- Replace or repair faulty gaskets in garage or on other overhead doors. ☐ ☐

Suggested Retrofits:

- Consider resizing exterior doors (i.e., delivery doors), making them smaller to reduce excessive infiltration. ☐ ☐
- Add expandable separate enclosures, where practical. ☐ ☐
- Install self-closing doors on openings to unconditioned spaces. ☐ ☐
- Install a switch on overhead doors that prevents activation of heating/cooling units when door is open. ☐ ☐
- Install vestibule doors at major entrances. ☐ ☐

B-2. Ceiling/roof insulation is inadequate or has been water damaged. ☐ ☐

Suggested O & M's:

- * Before replacing water damaged insulation, repair roof where required. ☐ ☐
- Verify that vapor barrier faces the conditioned space and is intact. ☐ ☐

Suggested Retrofits:

- Add new insulation to meet recommended standard. Check the cost effectiveness of this measure particularly if your facility is over three stories. ☐ ☐

B-3. Weatherstripping and caulking around windows, doors, conduits, piping, exterior joints, or other areas of infiltration is worn, broken or missing. ☐ ☐

Suggested O & M's:

- Use quality weatherstripping and caulking to insure that all areas of infiltration are sealed. ☐ ☐
- Replace broken or cracked windows. *(Air leakage is most evident when wind is blowing against the side of the building.)* ☐ ☐

Suggested Retrofits:

- 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. ☐ ☐
- In areas with constant strong winds, consider installing wind screens to protect exterior doors from direct blast of prevailing winds. Screens can be opaque, constructed inexpensively from concrete block or can be transparent, constructed of metal framing with armored glass. Careful positioning is necessary for infiltration control. ☐ ☐

B-4. Excessive expanses of glass exist on exterior walls. ☐ ☐

Suggested O & M's:

- When replacing windows, replace with thermopanes, utilizing the same casings. ☐ ☐
- Keep curtains and drapes closed in unoccupied spaces. ☐ ☐

Suggested Retrofits:

- Totally or partially insulate windows. Consider replacing windows with walls. ☐ ☐
- Install double pane windows. ☐ ☐
- Consider adding reflective or heat absorbing film to minimize solar gain in summer and heat loss in winter. *(Any window film reduces natural lighting and winter solar gain.)* ☐ ☐
- Consider installation of adjustable outdoor shading devices. ☐ ☐

An asterisk (*) means that the implementation of the suggested "O & M", if checked, may require special training for maintenance or operating personnel or create other overriding circumstances that make implementation impractical.

	EXISTS		RECOM.	
	T	F	Yes	No
B-5. There is no insulation between conditioned and unconditioned spaces.	☐	☐		
Suggested O & M's:				
• None Practical				
Suggested Retrofits:				
• Insulate between heated/cooled spaces and unconditioned or outside areas such as parking garages, porticos, storage areas, basements and attics.			☐	☐

SAMPLE CALCULATIONS

Because of the complexity of sample calculations for maintenance and operating procedures relating to the Building Envelope, it has been determined that such calculations would provide little benefit for people conducting the energy audit. Such detailed calculations should be performed by engineers and engineer/architect teams.

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ANCILLARY FUNCTIONS

Every building has equipment and energy using facilities which vary in kind and importance with the specific function and construction of the building. Individually, these ancillary functions may be as significant as a laundry facility in a hospital or as minor as a coffee pot in an office.

But regardless of the energy used by any single piece of ancillary equipment, the total used by all the miscellaneous equipment is usually quite substantial. Much of the information needed to compute energy consumption will be found on the nameplate data of the equipment.

Computer Facilities

Recent research shows that buildings with substantial computer installations -- more than just data terminals -- frequently consume significantly more energy than buildings without such installations. While energy consumption of the computer equipment itself is partly responsible, researchers feel that the primary cause is the extent to which the computer support facilities and equipment are in use. Typically, computer operations extend into periods when a building would otherwise be unoccupied -- evening, late evening, early morning, weekends, etc. In some cases computer operations continue around-the-clock. As a result, the building systems required to support computer equipment and personnel -- HVAC, lighting, food service, elevator, and other systems -- also must be operational and so consume energy. Given the extensive amount of work performed by computers and those who man them, as well as their high rate of productivity, suggestions that their use be reduced to conserve energy would be out-of-the-question. Nonetheless, there are steps which can be taken to at least ensure that no more energy than necessary is used to support computer operations. One logical answer is proper zoning of HVAC and lighting systems to isolate the areas.

Source: Total Energy Management for Hospitals, (op. cit., pp. 40-41.)

Domestic Hot and Cold Water

Domestic hot water often consumes from 2% to 4% of the total energy used in larger buildings. Cold water, provided in drinking fountains, also is a factor in total energy consumption.

To reduce energy expenditures for hot and cold water follow these guidelines:

* Inspect water supply system and insulation and repair all leaks.
* Inspect hot water controls. If necessary, regulate, repair or replace.
* Increase insulation on hot water pipes and storage tanks.
* Reduce temperature of hot water at faucets to 110°F. Where special application requires hotter water, provide local booster heating rather than heating all water to meet special circumstances.

Kitchens and Cafeterias

A variety of steps can be taken to effect more efficient use of energy in kitchen, cafeteria and other food handling areas:

Minimal Expense

* Turn off infrared food warmers when no food is being warmed.
* Inspect refrigeration condensers routinely to ensure that they have sufficient air circulation and that dust is cleaned off coils.
* Inspect and repair walk-in or reach-in refrigerated area doors without automatic closers or tight gaskets.
* Train employees in conservation of hot water. Supervise their performance and provide additional instruction and supervision as necessary.
* Avoid using fresh hot or warm water for dish scraping.
* Keep refrigeration coils free of frost build-up.
* Clean and maintain refrigeration on water chillers and cold drink dispensers.
* Reduce temperature or turn off frying tables and coffee urns during off-peak periods.
* Preheat ovens only for baked goods. Discourage chefs from preheating any sooner than necessary.
* Run the dishwasher only when it is full.
* Cook with lids in place on pots and kettles. It can cut heat requirements in half.
* Thaw frozen foods in refrigerated compartments.
* Fans that cool workers should be directed so they do not cool cooking equipment.
* Consider using microwave ovens for thawing and fast-food preparation whenever they can serve to reduce power requirements.

Elevators and Escalators

Despite the fact that escalators draw relatively little current under no-load operation, it generally is recognized that their continuous action does tend to waste energy. Although intermittent, as-needed operation can be obtained through use of a treadle-type switch, relatively few such installations have been made due to safety concerns. When an escalator is shut down, however, it still provides a means of transportation: stationary stairs. By contrast, an elevator cannot serve any useful purpose when it is nonoperational. When elevators are running, however, they tend to be more efficient than escalators, although they cause indirect energy consumption due to stack effects created by the shaft and infiltration around cabs.

Following are a few of the options which should be considered in an effort to provide the elevator/escalator service required while conserving energy in the process.

* Encourage building occupants (and perhaps visitors) to use the stairway when only one or two stories are involved and when security permits.

* Perform a traffic review to determine if the building is properly elevatored, or over- or under-elevatored in light of use during different periods of the day. If properly elevatored or over-elevatored, take one or more elevators out of operation at least during periods of light traffic.

* If the building has automatic load-shedding or demand-limiting equipment, connect elevators to the system to enable automatic shut-down of one or more to limit peak demand.

Laundries

Hospitals and public care institutions commonly have laundry facilities. Key opportunities to look for in laundries include:

* Potential reuse of waste heat from steam lines.

* Hours of operation (could they be changed to limit demand peaks or eliminate the need for operating extra boilers or air conditionings?).

* Days of operation (must the facility operate as many days per week?).

* Eliminate extra load from high temperatures and humidity on the central or other area air conditioning systems.

Miscellaneous Equipment

Add up the smaller "incidental" equipment in the building -- such as coffee pots, typewriters, desk calculators, electric space heaters, radios, etc. -- and the total usage may be surprising. (A large coffee maker may require up to 5,000 watts, for example.)

Establish a building-wide awareness program to minimize unnecessary use of all equipment. In particular, assure that all equipment of this type is off overnight and during lunch periods.

ANCILLARY SYSTEMS
Operations and Maintenance Checklist

Source: Making Cents of Your Energy Dollar, Volume I, U.S. Department of Energy, as adapted by the State of Colorado, 1979.

The checklist provides suggestions for the most common energy wasters in a building. Situations cited as "true" are those which exist in the building. The Energy Auditor then recommends actions to be taken from those suggestions.

	EXISTS		RECOM.	
	T	F	Yes	No

Special Systems

S-1. Kitchen equipment is not used effectively. ☐ ☐

Suggested O & M's:

- Cook with lids in place on pots and kettles. ☐ ☐
- Preheat ovens only for baked goods. ☐ ☐
- Reduce temperature or turn off frying tables and coffee urns during off peak periods. ☐ ☐
- Provide ovens and fryers with loads all of the time they are heated and on. ☐ ☐
- Use dishwasher for full loads only. ☐ ☐

Suggested Retrofits:

- Consider using a heat recovery system. ☐ ☐

S-2. In-house laundry equipment is not used effectively. ☐ ☐

Suggested O & M's:

- Develop concise operating procedures for each piece of equipment. ☐ ☐
- Iron only items which require it. ☐ ☐
- Wash and dry full loads only. ☐ ☐
- Consider rescheduling laundry work hours to avoid periods when building experiences its peak electrical load. ☐ ☐

Suggested Retrofits:

- Consider using heat recovery. ☐ ☐

S-3. Special diagnostic and treatment equipment is not used effectively. ☐ ☐

Suggested O & M's:

- Periodic update on operation of equipment by equipment manufacturer's representative. ☐ ☐
- Reduce start-up and shut-down times. ☐ ☐
- Consider scheduling this equipment during electrical off-peak periods. ☐ ☐

Suggested Retrofits:

- Consider using heat recovery. ☐ ☐

S-4. In-house computer systems are adding to peak demand. ☐ ☐

Suggested O & M's:

- Periodically update on operation of equipment by manufacturer's representative. ☐ ☐
- Check cooling air temperatures for computer to confirm correct temperatures. ☐ ☐
- Minimize air leakage in and out of computer area. ☐ ☐

Suggested Retrofits:

- Consider using heat recovery. ☐ ☐

S-5. Swimming pool water temperature is too high. ☐ ☐

Suggested O & M's:

- Reduce water temperatures to 80°-84° F if users can accept it. ☐ ☐
- * Indoor pool: turn off heater and circulating pumps during periods of non-use. ☐ ☐

Suggested Retrofits:

- Outside pool: cover when not in use. ☐ ☐
- Use pool as part of heat recovery scheme and/or solar system. ☐ ☐

An asterisk (*) means that the implementation of the suggested "O & M", if checked, may require special training for maintenance or operating personnel or create other overriding circumstances that make implementation impractical.

	EXISTS T	EXISTS F	RECOM. Yes	RECOM. No
S-6. Elevators are running too often.	☐	☐		
Suggested O & M's:				
o Reduce the number of elevators in service during hours when majority of persons are not leaving or entering the building.			☐	☐
o Turn off the motor-generator set in the elevator machine room when not in use: nights, weekends, holidays, and slack periods during the day.			☐	☐
* o Reduce speed of elevator.			☐	☐
Suggested Retrofits:				
o Consider changing from motor-generator to a more efficient solid state controller.			☐	☐

Water Heating System

	EXISTS T	EXISTS F	RECOM. Yes	RECOM. No
W-1. Storage tanks, piping and water heaters are utilized inefficiently.	☐	☐		
Suggested O & M's:				
o Replace damaged or missing insulation.			☐	☐
o Reduce hot water temperature to 105°-115°F where allowed by code.			☐	☐
Suggested Retrofits:				
o Install insulation on all hot water lines and storage tanks.			☐	☐
o Install a small domestic hot water heater to maintain desired temperature in water storage tank. This could eliminate the need for operating one of the large space heating boilers during summer months.			☐	☐
o Install de-centralized water heating.			☐	☐
W-2. Drips or leaks are evident in hot water systems.	☐	☐		
Suggested O & M's:				
o Repair all leaks including those of the faucets and pumps.			☐	☐
Suggested Retrofits:				
o None Practical				
W-3. Electric water heater has no time restrictions on heating cycle.	☐	☐		
Suggested O & M's:				
* o Utilize "vacation cycle" on water heater when not needed during extended periods. **NOTE:** *Complete deactivation could cause leaks.*			☐	☐
Suggested Retrofits:				
o Limit the duty cycle with a time clock or other control devices to avoid adding the water heating load to the building during peak electrical demand periods. *(Additional hot water storage capacity may be required.)*			☐	☐
W-4. Devices to conserve heated water have not been utilized where practical.	☐	☐		
Suggested O & M's:				
o None Practical				
Suggested Retrofits:				
• Install mixing valves.			☐	☐
• Replace standard faucets with self-closing, flow restrictor types. *(Highly mineralized water or water containing sediment can cause blockages.)*			☐	☐
• Install a solar water heater to assist in meeting building hot water demand. This can reduce consumption of traditional non-renewable energy fuels in facilities that require large quantities of hot water.			☐	☐

An asterisk (*) means that the implementation of the suggested "O & M", if checked, may require special training for maintenance or operating personnel or create other overriding circumstances that make implementation impractical.

POTENTIAL ENERGY SAVINGS CALCULATIONS

CHECKLIST ITEM NO. W1

O&M REDUCING HOT WATER TEMPERATURE

ENERGY USE AND RATING INFORMATION

A. Daily per capita hot water consumption (Estimated) ________ Gal/Person Day

B. Number of days used per year (estimated) ________ days/yr

C. Average number of occupants (estimted) ________ occupants

D. Assume energy savings of 8.33 BTU/gal ^{o}F

E. Number of degrees temperature of hot water is to be reduced (estimated) ________ ^{o}F

ENERGY SAVINGS CALCULATIONS:

1. Find Annual Consumption: $\underset{A}{\_\_\_\_} \times \underset{B}{\_\_\_\_} \times \underset{C}{\_\_\_\_} = \underset{F}{\_\_\_\_}$ gal/yr

2. Determine heat load savings: $\underset{(F)}{\_\_\_\_} \times 8.33 \times \underset{E}{\_\_\_\_} = \underset{\text{(Estimated)}}{\_\_\_\_}$ BTU/yr

NOTE: If electric hot water heaters are used, multiply 11,600/3413 to obtain source BTUs.

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SOLAR APPLICATIONS POTENTIAL FOR SCHOOLS, HOSPITALS, PUBLIC BUILDINGS AND PUBLIC CARE INSTITUTIONS

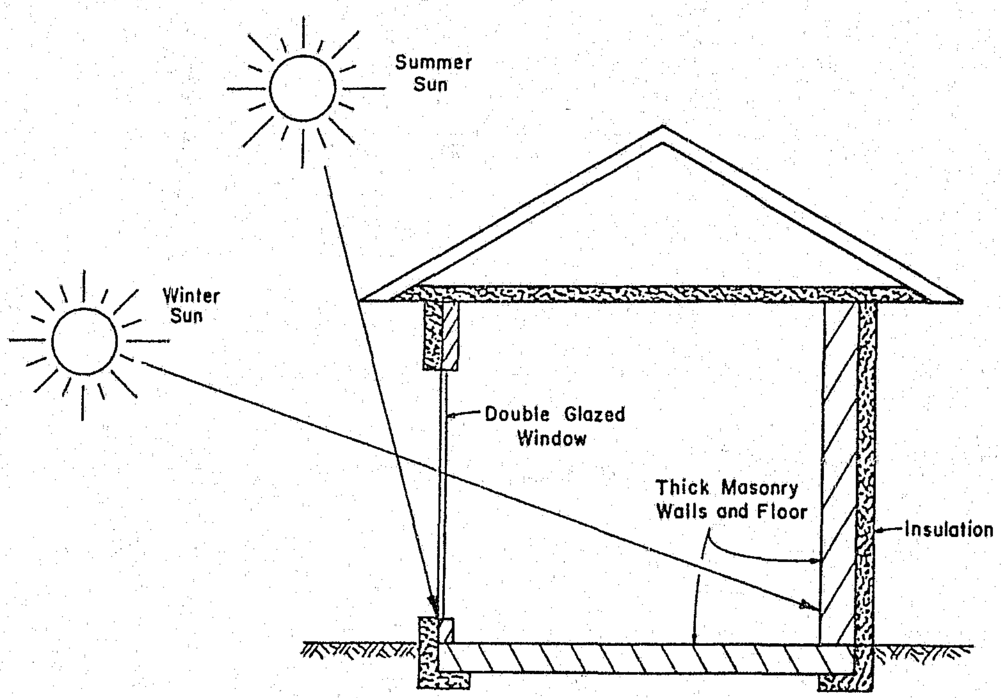
The most common solar uses to date have been solar water heating. Solar heating systems are generally grouped into two categories, "active" or "passive," depending upon the method used to collect, store and distribute solar heat within the building. Some systems are designed solely for space heating, and others are designed for both space and domestic water heating. It is usually more cost effective to integrate space and service water heating into one system because the collectors and storage unit can then be used every month of the year to provide space heating and hot water in the winter, and hot water in the summer.

Active systems rely upon pumps or blowers to transport solar heat from the collectors to the storage unit, or directly to the rooms of the building. Passive designs incorporate collectors (windows) and storage (walls) into integrated elements located in, or adjacent to, the occupied space. These elements may involve specially designed walls that absorb heat or the element may be part of the building structure itself. In passive buildings, stored heat is supplied to the rooms by radiation or natural convection.

Both active and passive designs are suitable for residential or light commercial buildings. Neither can economically supply all of the heating needs in the building. While systems are usually separated into passive or active types, "hybrid" systems have been designed to utilize solar energy to the greatest advantage for heating space and providing hot water.

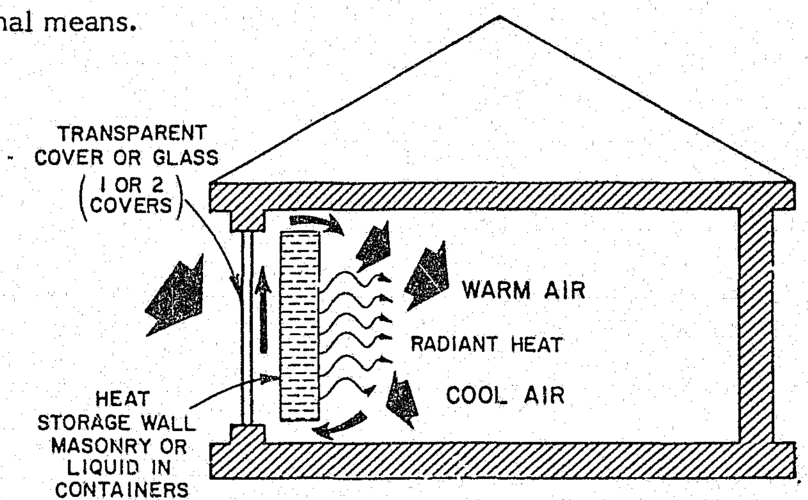
How Heating Is Accomplished By Passive Designs

The simplest type of passive solar house is one in which solar energy penetrates directly into the living space, and the building itself is used for heat storage. This method of heating is called direct gain heating, and is illustrated in the figure below.

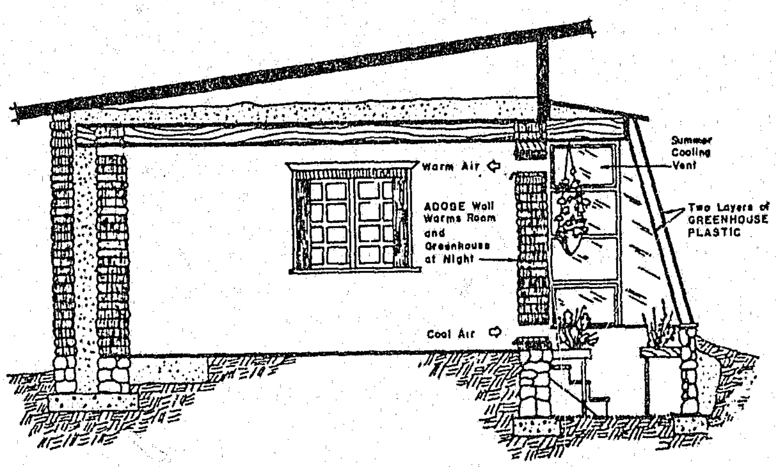


Direct Gain Heating

Some passive designs are called indirect gain systems because they employ a storage mass to collect and store heat directly from the sun before transferring this heat to the living space. The storage mass can be in the form of a masonry or concrete wall, water wall, or attached sunspace, as noted in the figure above. Heat is delivered to the occupied space from the warm storage masses (walls, ceilings, and floors) by radiation and by convective air movement. Auxiliary heat is supplied by conventional means.



Thermal Wall



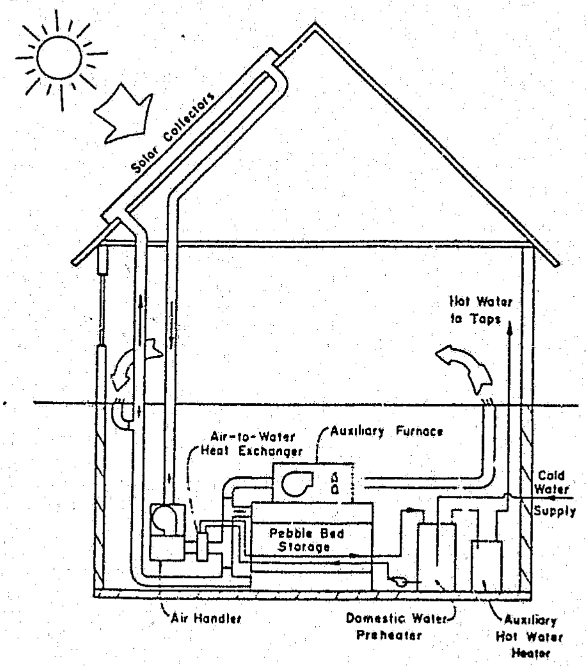
Attached Sunspace

How Heating Is Accomplished By Active Systems

An active solar heating system is typically made up of six components: the solar collector, the heat transfer medium, the heat storage unit, the heat distribution system, an auxiliary furnace, and control devices regulating heat collection, storage and distribution. Many systems also include accessories for preheating domestic water.

The collectors may be fitted to the roof of the building, mounted on a stand, placed on the ground, or attached to the wall of the building. Placement of collectors will depend primarily on convenience, economics, aesthetics and access to the sun. Heat is transferred from the collector to storage either by air or by a liquid such as water or antifreeze solution.

If heat is transferred from the collector by air, the heat can be stored by heating rocks in a bin. If the heat is transferred by liquid, heat will be stored as hot water in an insulated tank. From storage, heat will be moved through conventional systems -- such as hot water pipes of forced air ducts -- to various points in the building. To regulate the flow of heat, automatic controls are provided to direct the position of valves or dampers at the command of temperature sensors in the system or the room thermostat. Below is a diagram of a domestic water and space heating system using air collectors.



Domestic Water and Space Heating System (Air)

The economical size of most solar heating systems is limited to provide heat for overnight use during a typical winter period and with sunny days. On cloudy days there may not be enough solar heat collected to satisfy the heating requirements. Therefore, a conventional heating unit is required to ensure reliable heating regardless of weather.

Domestic Water Heating

Solar energy is used to preheat domestic water. In freezing climates either non-freezing fluid such as a solution of antifreeze or air is used to transfer heat from the collectors, and a heat exchanger is used to transfer heat to the domestic water supply. An auxiliary water heater is always provided to ensure a dependable supply of hot water. Where freezing seldom occurs, water may be heated in the collector if dependable emergency training is provided or if arrangements for supplying warm water or electric heat to the collector are made.

Comparison of Air and Liquid Systems

Air and liquid systems have roughly comparable efficiencies in terms of the annual heat they deliver per unit collector area. When comparing the relative merits of each type of system, it is wise to weigh all possible advantages and disadvantages in the context of climate, architecture, building site, expected maintenance costs and the fraction of the building heating needs to be supplied by solar energy.

Some advantages of liquid systems are as follows:

water and antifreeze are low-cost fluids with higher heat capacity than air,

storage volumes are relatively smaller than rock bins because water is an excellent heat storage material,

transport of heat over long distances in commercial buildings is less costly with water than with air,

there are a large number of liquid-type collectors from which to choose,

performance data on liquid systems are available.

Some advantages of air systems are as follows:

the collector fluid (air) will not freeze, boil or cause damage by leaking,

absorber plates, ducting and other connections in air systems are much less susceptible to corrosion than their counterparts in liquid systems,

pebbles in storage do not need to be replaced or specially treated,

solar-heated air can be circulated directly from the collectors to the rooms without the use of heat exchangers,

maintenance requirements are minimal compared to liquid systems.

ERDA has developed "Interim Performance Criteria for Solar Heating and Cooling Systems in Commercial Buildings," (NBSIR 76-1187). Copies may be obtained from Center for Building Technology Institute for Applied Technology, National Bureau of Standards, Washington, D.C., 20234.

SOLAR/WEATHER DATA

The following insolation (Btu/ft^2) and weather data should be used in completing various entries in the Energy Audit (EA) form. The insolation data is recorded in the EA form, page 2 of 4, item 4.3(A). In order to make the proper entry on the EA-2 form, item 4.3A, multiply the Btu/ft^2 figure, for the location nearest your building, for each month, times the number of days in the month. Enter this product in the appropriate month on EA-2, item 4.3(A).

The heating and cooling degree day data on pages 9-3 through 9-13 should be used for completing the Energy Audit form, page 2 of 4, item II, 1.0, Z. The data provided on page 9-19 should be used for completing the Energy Audit form, page 2 of 4, items 4.1, 4.2 and 4.3(B).

INPUT DATA FOR SOLAR SYSTEMS

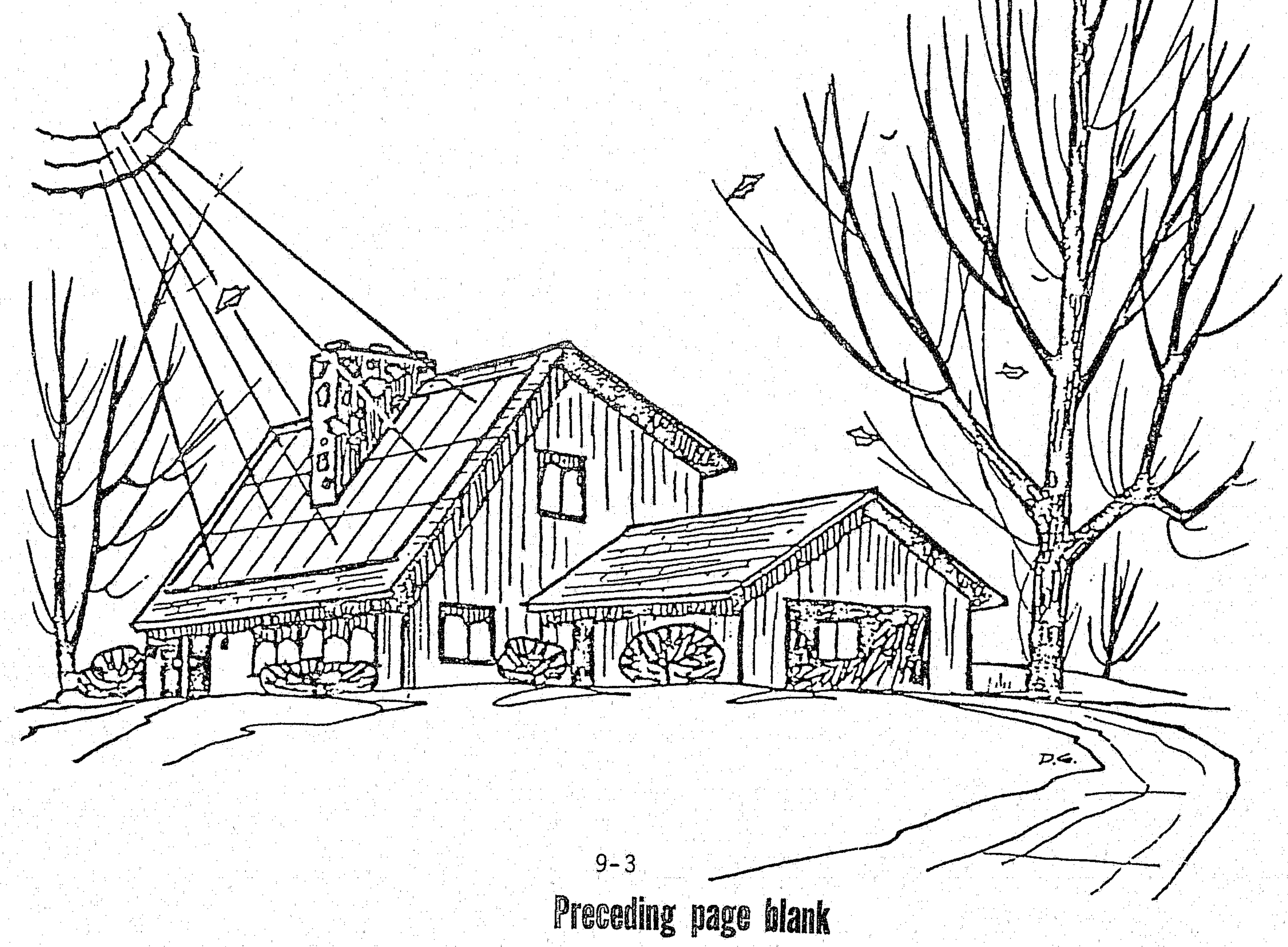
November 1978

INSOLATION DATA

Prepared For
U.S. Department of Energy
Assistant Secretary for Energy Technology
Division of Solar Technology
Environmental Resources And Assessments Branch

Under Interagency Agreement NO. E(49 - 26) - 1041

By V. Cinquemani, J.R. Owenby, Jr. and R.G. Baldwin



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STATION: ABILENE STATE: TX

STATION NUMBER: 13962 LATITUDE: 3226N LONGITUDE: 9941W ELEVATION: 534

	NORMAL TEMPERATURE (DEG F)*			NORMAL DEGREE DAYS*		TOTAL HEMISPHERIC MEAN DAILY SOLAR RADIATION#		
	DAILY	DAILY		BASE 65 DEG F				
MONTH	MAXIMUM	MINIMUM	MONTHLY	HEATING	COOLING	BTU/FT2	KJ/M2	LANGLEYS
JAN	55.7	31.7	43.7	660	0	923.8	10484.0	250.6
FEB	59.9	35.9	47.9	479	0	1182.6	13421.0	320.8
MAR	67.3	41.7	54.5	354	29	1576.1	17887.0	427.5
APR	77.7	52.7	65.2	104	110	1843.4	20921.0	500.0
MAY	83.9	60.8	72.4	11	240	2037.4	23122.0	552.6
JUN	91.6	69.0	80.3	0	459	2208.7	25066.0	599.1
JUL	95.3	72.4	83.9	0	586	2139.1	24277.0	580.2
AUG	95.3	71.9	83.6	0	577	1956.1	22200.0	530.6
SEP	87.5	64.6	76.1	0	333	1597.6	18131.0	433.3
OCT	78.0	54.2	66.1	89	123	1315.5	14930.0	356.8
NOV	66.2	42.0	54.1	336	9	1007.9	11439.0	273.4
DEC	58.2	34.5	46.4	577	0	863.3	9798.0	234.2
ANN	76.4	52.6	64.5	2610	2466	1554.3	17640.0	421.6

* BASED ON 1941-1970 PERIOD # AS NOTED IN SOLMET VOLUME 1

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STATION: AMARILLO STATE: TX

STATION NUMBER: 23047 LATITUDE: 3514N LONGITUDE: 10142W ELEVATION: 1098

	NORMAL TEMPERATURE (DEG F)*			NORMAL DEGREE DAYS*		TOTAL HEMISPHERIC MEAN DAILY SOLAR RADIATION#		
	DAILY	DAILY		BASE 65 DEG F				
MONTH	MAXIMUM	MINIMUM	MONTHLY	HEATING	COOLING	BTU/FT2	KJ/M2	LANGLEYS
JAN	49.4	22.5	36.0	899	0	960.2	10897.0	260.4
FEB	53.0	26.4	39.7	708	0	1243.5	14112.0	337.3
MAR	60.0	31.2	45.6	601	0	1630.8	18508.0	442.4
APR	70.9	42.1	56.5	275	20	2019.1	22915.0	547.7
MAY	79.2	51.9	65.6	81	99	2211.7	25100.0	599.9
JUN	88.0	61.2	74.6	10	298	2393.1	27159.0	649.1
JUL	91.4	65.9	78.7	0	425	2280.5	25881.0	618.6
AUG	90.4	64.7	77.6	0	391	2103.1	23868.0	570.5
SEP	82.9	56.7	69.8	20	164	1760.5	19980.0	477.5
OCT	72.9	46.1	59.5	206	36	1403.5	15928.0	380.7
NOV	60.0	32.5	46.3	561	0	1032.9	11722.0	280.2
DEC	51.5	25.5	38.5	822	0	871.6	9892.0	236.4
ANN	70.8	43.9	57.4	4183	1433	1659.2	18830.0	450.0

* BASED ON 1941-1970 PERIOD # AS NOTED IN SOLMET VOLUME

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STATION: AUSTIN — STATE: TX

STATION NUMBER: 13958 — LATITUDE: 3018N — LONGITUDE: 9742W — ELEVATION: 189

	NORMAL TEMPERATURE (DEG F)*			NORMAL DEGREE DAYS*		TOTAL HEMISPHERIC MEAN DAILY SOLAR RADIATION#		
				BASE 65 DEG F				
MONTH	DAILY MAXIMUM	DAILY MINIMUM	MONTHLY	HEATING	COOLING	BTU/FT2	KJ/M2	LANGLEYS
JAN	60.0	39.3	49.7	483	8	864.5	9811.0	234.5
FEB	63.8	42.8	53.3	344	16	1124.6	12763.0	305.0
MAR	70.7	48.2	59.5	223	52	1428.9	16217.0	387.6
APR	79.0	58.2	68.6	44	152	1605.1	18216.0	435.4
MAY	85.2	65.1	75.2	0	316	1833.6	20809.0	497.3
JUN	91.7	71.4	81.6	0	498	2072.0	23515.0	562.0
JUL	95.4	73.7	84.6	0	608	2105.5	23895.0	571.1
AUG	95.9	73.5	84.7	0	611	1931.3	21918.0	523.9
SEP	89.4	68.4	78.9	0	417	1606.1	18227.0	435.6
OCT	81.3	58.9	70.1	39	197	1333.3	15131.0	361.6
NOV	70.2	48.0	59.1	205	28	986.7	11198.0	267.6
DEC	63.0	41.6	52.3	399	5	825.1	9364.0	223.8
ANN	78.8	57.4	68.1	1737	2908	1476.4	16755.0	400.5

* BASED ON 1941-1970 PERIOD — # AS NOTED IN SOLMET VOLUME 1

STATION: BROWNSVILLE — STATE: TX

STATION NUMBER: 12919 — LATITUDE: 2554N — LONGITUDE: 9726W — ELEVATION: 6

	NORMAL TEMPERATURE (DEG F)*			NORMAL DEGREE DAYS*		TOTAL HEMISPHERIC MEAN DAILY SOLAR RADIATION#		
				BASE 65 DEG F				
MONTH	DAILY MAXIMUM	DAILY MINIMUM	MONTHLY	HEATING	COOLING	BTU/FT2	KJ/M2	LANGLEYS
JAN	69.5	51.0	60.3	225	79	912.8	10359.0	247.6
FEB	72.7	54.1	63.4	151	106	1135.4	12886.0	308.0
MAR	76.6	58.8	67.7	89	173	1457.8	16545.0	395.4
APR	83.1	66.7	74.9	0	297	1737.2	19715.0	471.2
MAY	87.1	71.4	79.3	0	443	1927.1	21870.0	522.7
JUN	90.6	75.0	82.8	0	534	2115.3	24006.0	573.8
JUL	92.8	75.9	84.4	0	601	2212.5	25109.0	600.1
AUG	93.0	75.7	84.4	0	601	2027.3	23008.0	549.9
SEP	89.9	73.2	81.6	0	498	1693.9	19224.0	459.5
OCT	84.7	66.6	75.7	5	337	1438.9	16330.0	390.3
NOV	77.5	58.7	68.1	35	128	1054.5	11968.0	286.0
DEC	72.3	53.3	62.8	145	77	862.4	9787.0	233.9
ANN	82.5	65.0	73.8	650	3874	1547.9	17567.0	419.9

* BASED ON 1941-1970 PERIOD — # AS NOTED IN SOLMET VOLUME 1

STATION: CORPUS CHRISTI STATE: TX

STATION NUMBER: 12924 LATITUDE: 2746N LONGITUDE: 9730W ELEVATION: [illegible]

MONTH	NORMAL TEMPERATURE (DEG F)* DAILY MAXIMUM	DAILY MINIMUM	MONTHLY	NORMAL DEGREE DAYS* BASE 65 DEG F HEATING	COOLING	TOTAL HEMISPHERIC MEAN DAILY SOLAR RADIATION# BTU/FT2	KJ/M2	LANGLEYS
JAN	66.5	46.1	56.3	304	34	898.1	10192.0	243.6
FEB	69.8	49.3	59.6	199	48	1147.4	13022.0	311.2
MAR	75.5	54.2	64.9	120	117	1429.9	16228.0	387.9
APR	82.1	63.4	72.8	0	238	1642.4	18640.0	445.5
MAY	86.6	69.1	77.9	0	400	1866.4	21182.0	506.3
JUN	91.2	73.6	82.4	0	522	2093.8	23762.0	567.9
JUL	94.4	75.2	84.8	0	614	2186.1	24810.0	593.0
AUG	94.8	75.4	85.1	0	623	1990.8	22593.0	540.0
SEP	90.0	72.0	81.0	0	480	1687.0	19146.0	457.6
OCT	84.1	63.7	73.9	7	283	1416.3	16073.0	384.2
NOV	75.2	54.6	64.9	81	78	1042.7	11833.0	282.8
DEC	69.3	48.9	59.1	219	37	844.7	9587.0	229.1
ANN	81.6	62.1	71.9	930	3474	1520.5	17256.0	412.4

* BASED ON 1941-1970 PERIOD # AS NOTED IN SOLMET VOLUME 1

STATION: DALLAS STATE: TX

STATION NUMBER: 13960 LATITUDE: 3251N LONGITUDE: 9651W ELEVATION: 149

MONTH	NORMAL TEMPERATURE (DEG F)* DAILY MAXIMUM	DAILY MINIMUM	MONTHLY	NORMAL DEGREE DAYS* BASE 65 DEG F HEATING	COOLING	TOTAL HEMISPHERIC MEAN DAILY SOLAR RADIATION# BTU/FT2	KJ/M2	LANGLEYS
JAN	55.1	35.7	45.4	608	0	821.5	9323.0	222.8
FEB	59.2	39.5	49.4	437	0	1071.1	12156.0	290.5
MAR	66.4	45.2	55.8	314	29	1421.8	16136.0	385.7
APR	76.3	56.4	66.4	71	113	1626.8	18463.0	441.3
MAY	83.1	64.4	73.8	0	273	1888.5	21433.0	512.3
JUN	90.6	72.6	81.6	0	498	2134.9	24229.0	579.1
JUL	95.1	76.3	85.7	0	642	2122.1	24083.0	575.6
AUG	95.7	75.9	85.8	0	645	1950.2	22133.0	529.0
SEP	88.0	68.3	78.2	0	396	1587.1	18012.0	430.5
OCT	78.4	57.5	68.0	55	148	1276.1	14482.0	346.1
NOV	66.4	45.4	55.9	284	11	936.4	10627.0	254.0
DEC	57.8	38.6	48.2	521	0	780.1	8853.0	211.6
ANN	76.0	56.3	66.2	2290	2755	1468.1	16661.0	398.2

* BASED ON 1941-1970 PERIOD # AS NOTED IN SOLMET VOLUME

STATION: DEL RIO   STATE: TX

STATION NUMBER: 22010   LATITUDE: 2922N   LONGITUDE: 10055W   ELEVATION: 313

	NORMAL TEMPERATURE (DEG F)*			NORMAL DEGREE DAYS*		TOTAL HEMISPHERIC MEAN DAILY SOLAR RADIATION#		
				BASE 65 DEG F				
MONTH	DAILY MAXIMUM	DAILY MINIMUM	MONTHLY	HEATING	COOLING	BTU/FT2	KJ/M2	LANGLEYS
JAN	63.4	38.1	50.8	449	8	958.3	10876.0	259.9
FEB	68.6	42.8	55.7	283	22	1205.8	13685.0	327.1
MAR	76.4	48.8	62.6	163	88	1580.0	17931.0	428.6
APR	85.1	58.9	72.0	16	226	1699.5	19287.0	461.0
MAY	90.2	66.1	78.2	0	409	1827.1	20736.0	495.6
JUN	96.1	72.4	84.3	0	579	2023.9	22969.0	549.0
JUL	99.2	74.2	86.7	0	673	2054.3	23314.0	557.2
AUG	98.5	73.6	86.1	0	654	1936.5	21977.0	525.3
SEP	91.9	68.5	80.2	0	456	1584.2	17979.0	429.7
OCT	83.1	59.2	71.2	34	226	1359.6	15430.0	368.8
NOV	72.2	46.9	59.6	184	22	1059.5	12024.0	287.4
DEC	65.0	39.5	52.3	394	0	902.6	10244.0	244.8
ANN	82.5	57.4	70.0	1523	3363	1515.9	17204.0	411.2

* BASED ON 1941-1970 PERIOD   # AS NOTED IN SOLMET VOLUME 1

STATION: EL PASO   STATE: TX

STATION NUMBER: 23044   LATITUDE: 3148N   LONGITUDE: 10624W   ELEVATION: 1194

	NORMAL TEMPERATURE (DEG F)*			NORMAL DEGREE DAYS*		TOTAL HEMISPHERIC MEAN DAILY SOLAR RADIATION#		
				BASE 65 DEG F				
MONTH	DAILY MAXIMUM	DAILY MINIMUM	MONTHLY	HEATING	COOLING	BTU/FT2	KJ/M2	LANGLEYS
JAN	57.0	30.2	43.6	663	0	1125.1	12769.0	305.2
FEB	62.5	34.3	48.4	465	0	1480.1	16798.0	401.5
MAR	68.9	40.3	54.6	328	6	1909.3	21668.0	517.9
APR	78.5	49.3	63.9	89	56	2363.5	26823.0	641.1
MAY	87.2	57.2	72.2	0	223	2600.6	29514.0	705.4
JUN	94.9	65.7	80.3	0	459	2682.5	30443.0	727.6
JUL	94.6	69.9	82.3	0	536	2450.1	27806.0	664.6
AUG	92.8	68.2	80.5	0	481	2284.5	25927.0	619.7
SEP	87.4	61.0	74.2	0	276	1987.1	22552.0	539.0
OCT	78.5	49.5	64.0	92	61	1639.0	18601.0	444.6
NOV	66.1	37.0	51.6	402	0	1243.7	14115.0	337.4
DEC	57.8	30.9	44.4	639	0	1030.7	11697.0	279.6
ANN	77.2	49.5	63.4	2678	2098	1899.7	21559.0	515.3

BASED ON 1941-1970 PERIOD   # AS NOTED IN SOLMET VOLUME 1

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STATION: FORT WORTH — STATE: TX

STATION NUMBER: 3927 — LATITUDE: 3250N — LONGITUDE: 9703W — ELEVATION: 164

MONTH	NORMAL TEMPERATURE (DEG F)* DAILY MAXIMUM	DAILY MINIMUM	MONTHLY	NORMAL DEGREE DAYS* BASE 65 DEG F HEATING	COOLING	TOTAL HEMISPHERIC MEAN DAILY SOLAR RADIATION# BTU/FT2	KJ/M2	LANGLEYS
JAN	55.7	33.9	44.8	626	0	805.3	9139.0	218.4
FEB	59.8	37.6	48.7	456	0	1069.4	12136.0	290.1
MAR	66.6	43.3	55.0	335	25	1409.2	15993.0	382.2
APR	76.3	54.1	65.2	88	94	1616.5	18345.0	438.5
MAY	82.8	62.1	72.5	0	236	1890.4	21454.0	512.8
JUN	90.8	70.3	80.6	0	468	2153.0	24434.0	584.0
JUL	95.5	74.0	84.8	0	614	2155.2	24459.0	584.6
AUG	96.1	73.7	84.9	0	617	1982.7	22502.0	537.8
SEP	88.5	66.8	77.7	0	381	1621.3	18400.0	439.8
OCT	79.2	56.0	67.6	60	141	1292.9	14673.0	350.7
NOV	67.5	44.1	55.8	287	11	938.0	10645.0	254.4
DEC	58.7	37.0	47.9	530	0	765.7	8690.0	207.7
ANN	76.5	54.4	65.5	2382	2587	1474.9	16739.0	400.1

* BASED ON 1941-1970 PERIOD

AS NOTED IN SOLMET VOLUME 1

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STATION: HOUSTON — STATE: TX

STATION NUMBER: 12960 — LATITUDE: 2959N — LONGITUDE: 9522W — ELEVATION: 33

MONTH	NORMAL TEMPERATURE (DEG F)* DAILY MAXIMUM	DAILY MINIMUM	MONTHLY	NORMAL DEGREE DAYS* BASE 65 DEG F HEATING	COOLING	TOTAL HEMISPHERIC MEAN DAILY SOLAR RADIATION# BTU/FT2	KJ/M2	LANGLEYS
JAN	62.6	41.5	52.1	416	16	772.4	8766.0	209.5
FEB	66.0	44.6	55.3	294	22	1034.2	11737.0	280.5
MAR	71.8	49.8	60.8	189	59	1297.4	14724.0	351.9
APR	79.4	59.3	69.4	23	155	1522.3	17277.0	412.9
MAY	85.9	65.6	75.8	0	335	1774.9	20143.0	481.4
JUN	91.3	70.9	81.1	0	483	1898.1	21541.0	514.8
JUL	93.8	72.8	83.3	0	567	1828.1	20747.0	495.9
AUG	94.3	72.4	83.4	0	570	1686.2	19137.0	457.4
SEP	90.1	68.2	79.2	0	426	1471.0	16694.0	399.0
OCT	83.5	58.3	70.9	24	207	1275.6	14477.0	346.0
NOV	73.0	49.1	61.1	155	38	924.0	10486.0	250.6
DEC	65.8	43.4	54.6	333	11	729.6	8280.0	197.9
ANN	79.8	58.0	68.9	1434	2889	1351.1	15334.0	366.5

* BASED ON 1941-1970 PERIOD

AS NOTED IN SOLMET VOLUME

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STATION: KINGSVILLE | STATE: TX

STATION NUMBER: 12928	LATITUDE: 2731N	LONGITUDE: 9749W	ELEVATION: 17

	NORMAL TEMPERATURE (DEG F)*			NORMAL DEGREE DAYS*		TOTAL HEMISPHERIC MEAN DAILY SOLAR RADIATION#		
	DAILY	DAILY		BASE 65 DEG F				
MONTH	MAXIMUM	MINIMUM	MONTHLY	HEATING	COOLING	BTU/FT2	KJ/M2	LANGLEYS
JAN	0.0	0.0	0.0	0	0	912.3	10354.0	247.5
FEB	0.0	0.0	0.0	0	0	1161.2	13178.0	315.0
MAR	0.0	0.0	0.0	0	0	1434.7	16282.0	389.1
APR	0.0	0.0	0.0	0	0	1662.8	18871.0	451.0
MAY	0.0	0.0	0.0	0	0	1864.1	21156.0	505.6
JUN	0.0	0.0	0.0	0	0	2035.9	23105.0	552.2
JUL	0.0	0.0	0.0	0	0	2111.5	23963.0	572.7
AUG	0.0	0.0	0.0	0	0	1921.5	21807.0	521.2
SEP	0.0	0.0	0.0	0	0	1624.6	18438.0	440.7
OCT	0.0	0.0	0.0	0	0	1389.9	15774.0	377.0
NOV	0.0	0.0	0.0	0	0	1034.3	11738.0	280.5
DEC	0.0	0.0	0.0	0	0	849.3	9639.0	230.4
ANN	0.0	0.0	0.0	0	0	1500.1	17025.0	406.9

* BASED ON 1941-1970 PERIOD   # AS NOTED IN SOLMET VOLUME 1

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STATION: LAREDO | STATE: TX

STATION NUMBER: 12907	LATITUDE: 2732N	LONGITUDE: 9928W	ELEVATION: 158

	NORMAL TEMPERATURE (DEG F)*			NORMAL DEGREE DAYS*		TOTAL HEMISPHERIC MEAN DAILY SOLAR RADIATION#		
	DAILY	DAILY		BASE 65 DEG F				
MONTH	MAXIMUM	MINIMUM	MONTHLY	HEATING	COOLING	BTU/FT2	KJ/M2	LANGLEYS
JAN	0.0	0.0	56.5	299	36	958.9	10882.0	260.1
FEB	0.0	0.0	60.9	177	62	1195.5	13568.0	324.3
MAR	0.0	0.0	67.6	87	168	1515.6	17201.0	411.1
APR	0.0	0.0	76.3	0	339	1726.9	19599.0	468.4
MAY	0.0	0.0	81.3	0	505	1951.9	22152.0	529.4
JUN	0.0	0.0	86.0	0	630	2073.1	23527.0	562.3
JUL	0.0	0.0	87.9	0	710	2131.2	24187.0	578.1
AUG	0.0	0.0	87.7	0	704	2009.1	22801.0	545.0
SEP	0.0	0.0	82.9	0	537	1705.3	19353.0	462.5
OCT	0.0	0.0	75.5	8	334	1408.2	15982.0	382.0
NOV	0.0	0.0	65.2	74	80	1040.8	11812.0	282.3
DEC	0.0	0.0	58.6	231	32	889.5	10095.0	241.3
ANN	0.0	0.0	73.9	876	4137	1550.5	17597.0	420.6

* BASED ON 1941-1970 PERIOD   # AS NOTED IN SOLMET VOLUME 1

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STATION: LUBBOCK STATE: TX

STATION NUMBER: 23042 LATITUDE: 3339N LONGITUDE: 10149W ELEVATION: 988

	NORMAL TEMPERATURE (DEG F)*			NORMAL DEGREE DAYS* BASE 65 DEG F		TOTAL HEMISPHERIC MEAN DAILY SOLAR RADIATION#		
MONTH	DAILY MAXIMUM	DAILY MINIMUM	MONTHLY	HEATING	COOLING	BTU/FT2	KJ/M2	LANGLEYS
JAN	53.4	24.8	39.1	803	0	1030.9	11700.0	279.6
FEB	57.0	28.3	42.7	624	0	1331.7	15113.0	361.2
MAR	63.8	34.0	48.9	508	9	1762.0	19997.0	477.9
APR	74.8	45.1	60.0	190	40	2167.8	24602.0	588.0
MAY	82.5	54.5	68.5	29	138	2395.9	27191.0	649.9
JUN	90.6	63.6	77.1	0	363	2544.4	28876.0	690.2
JUL	92.4	66.9	79.7	0	456	2411.8	27371.0	654.2
AUG	91.3	65.5	78.4	0	415	2208.4	25063.0	599.0
SEP	83.8	58.2	71.0	8	188	1820.1	20656.0	493.7
OCT	74.7	47.3	61.0	162	38	1468.2	16662.0	398.2
NOV	63.1	34.4	48.8	486	0	1116.1	12666.0	302.7
DEC	55.2	27.4	41.3	735	0	934.5	10606.0	253.5
ANN	73.6	45.8	59.7	3545	1647	1766.0	20042.0	479.0

* BASED ON 1941-1970 PERIOD # AS NOTED IN SOLMET VOLUME 1

STATION: LUFKIN STATE: TX

STATION NUMBER: 93987 LATITUDE: 3114N LONGITUDE: 9445W ELEVATION: 96

	NORMAL TEMPERATURE (DEG F)*			NORMAL DEGREE DAYS* BASE 65 DEG F		TOTAL HEMISPHERIC MEAN DAILY SOLAR RADIATION#		
MONTH	DAILY MAXIMUM	DAILY MINIMUM	MONTHLY	HEATING	COOLING	BTU/FT2	KJ/M2	LANGLEYS
JAN	0.0	0.0	48.8	509	7	793.9	9010.0	215.3
FEB	0.0	0.0	52.2	371	13	1069.2	12134.0	290.0
MAR	0.0	0.0	58.0	256	39	1376.1	15617.0	373.3
APR	0.0	0.0	67.3	56	125	1623.9	18429.0	440.5
MAY	0.0	0.0	74.1	0	282	1866.7	21185.0	506.3
JUN	0.0	0.0	80.3	0	459	2055.3	23326.0	557.5
JUL	0.0	0.0	83.0	0	558	2006.4	22770.0	544.2
AUG	0.0	0.0	83.1	0	561	1864.1	21155.0	505.6
SEP	0.0	0.0	77.5	0	375	1530.7	17372.0	415.2
OCT	0.0	0.0	68.2	52	151	1348.7	15306.0	365.8
NOV	0.0	0.0	57.2	256	22	963.3	10932.0	261.3
DEC	0.0	0.0	50.8	440	0	767.6	8712.0	208.2
ANN	0.0	0.0	66.7	1940	2592	1438.8	16329.0	390.3

* BASED ON 1941-1970 PERIOD # AS NOTED IN SOLMET VOLUME 1

STATION: MIDLAND-ODESSA — STATE: TX

:TATION NUMBER: 23023 — LATITUDE: 3156N — LONGITUDE: 10212W — ELEVATION: 871

	NORMAL TEMPERATURE (DEG F)*			NORMAL DEGREE DAYS*		TOTAL HEMISPHERIC MEAN DAILY SOLAR RADIATION#		
	DAILY	DAILY		BASE 65 DEG F				
IONTH	MAXIMUM	MINIMUM	MONTHLY	HEATING	COOLING	BTU/FT2	KJ/M2	LANGLEYS
JAN	57.8	29.4	43.6	663	0	1081.2	12271.0	293.3
FEB	62.1	33.5	47.8	482	0	1382.6	15691.0	375.0
MAR	69.4	39.2	54.3	349	17	1838.8	20868.0	498.8
APR	79.1	49.4	64.3	98	77	2192.3	24880.0	594.6
MAY	86.5	58.1	72.3	0	230	2430.1	27579.0	659.2
JUN	92.8	66.9	79.9	0	447	2562.4	29081.0	695.1
JUL	95.0	69.5	82.3	0	536	2389.3	27116.0	648.1
AUG	94.4	69.1	81.8	0	521	2210.1	25082.0	599.5
SEP	87.9	62.8	75.4	0	312	1843.9	20926.0	500.1
OCT	79.2	52.4	65.8	81	105	1521.6	17269.0	412.7
NOV	67.5	39.1	53.3	356	5	1176.1	13348.0	319.0
DEC	60.1	31.6	45.9	592	0	999.7	11346.0	271.2
ANN	77.7	50.1	63.9	2621	2250	1802.4	20455.0	488.9

BASED ON 1941-1970 PERIOD

AS NOTED IN SOLMET VOLUME 1

STATION: PORT ARTHUR — STATE: TX

TATION NUMBER: 12917 — LATITUDE: 2957N — LONGITUDE: 9401W — ELEVATION: 7

	NORMAL TEMPERATURE (DEG F)*			NORMAL DEGREE DAYS*		TOTAL HEMISPHERIC MEAN DAILY SOLAR RADIATION#		
	DAILY	DAILY		BASE 65 DEG F				
ONTH	MAXIMUM	MINIMUM	MONTHLY	HEATING	COOLING	BTU/FT2	KJ/M2	LANGLEYS
JAN	61.5	42.4	52.0	420	17	799.7	9076.0	216.9
FEB	65.0	45.1	55.1	302	25	1070.6	12150.0	290.4
1AR	70.5	49.7	60.1	202	51	1353.1	15356.0	367.0
APR	78.3	59.4	68.9	33	150	1609.5	18266.0	436.6
1AY	84.3	65.7	75.0	0	310	1870.8	21232.0	507.5
JUN	89.9	71.7	80.8	0	474	2011.1	22824.0	545.5
JUL	92.0	74.0	83.0	0	558	1846.2	20952.0	500.8
AUG	92.6	73.6	83.1	0	561	1736.3	19705.0	471.0
SEP	88.6	69.2	78.9	0	417	1527.0	17330.0	414.2
OCT	81.3	58.5	69.9	35	187	1321.4	14997.0	358.4
NOV	70.9	49.4	60.2	184	40	952.9	10814.0	258.5
DEC	64.2	44.1	54.2	342	8	754.4	8562.0	204.6
ANN	78.3	58.6	68.5	1518	2798	1404.4	15939.0	381.0

BASED ON 1941-1970 PERIOD

AS NOTED IN SOLMET VOLUME 1

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STATION: SAN ANGELO — STATE: TX

STATION NUMBER: 23034 — LATITUDE: 3122N — LONGITUDE: 10030W — ELEVATION: 582

	NORMAL TEMPERATURE (DEG F)*			NORMAL DEGREE DAYS*		TOTAL HEMISPHERIC MEAN DAILY SOLAR RADIATION#		
				BASE 65 DEG F				
MONTH	DAILY MAXIMUM	DAILY MINIMUM	MONTHLY	HEATING	COOLING	BTU/FT2	KJ/M2	LANGLEYS
JAN	59.1	33.6	46.4	577	0	961.8	10915.0	260.9
FEB	63.2	37.5	50.4	413	0	1208.4	13714.0	327.8
MAR	70.7	43.5	57.1	287	42	1606.1	18227.0	435.6
APR	80.4	54.0	67.2	74	140	1850.7	21004.0	502.0
MAY	86.5	62.4	74.5	0	298	2030.6	23045.0	550.8
JUN	93.4	69.8	81.6	0	498	2186.1	24810.0	593.0
JUL	96.9	72.4	84.7	0	611	2122.6	24089.0	575.7
AUG	96.9	72.0	84.5	0	605	1965.8	22310.0	533.2
SEP	88.4	65.1	76.8	0	354	1607.2	18240.0	435.9
OCT	79.6	54.7	67.2	73	141	1336.7	15170.0	362.6
NOV	68.5	42.5	55.5	298	13	1043.8	11846.0	283.1
DEC	61.4	35.2	48.3	518	0	894.7	10154.0	242.7
ANN	78.7	53.6	66.2	2240	2702	1567.9	17794.0	425.3

* BASED ON 1941-1970 PERIOD — # AS NOTED IN SOLMET VOLUME 1

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STATION: SAN ANTONIO — STATE: TX

STATION NUMBER: 12921 — LATITUDE: 2932N — LONGITUDE: 9828W — ELEVATION: 242

	NORMAL TEMPERATURE (DEG F)*			NORMAL DEGREE DAYS*		TOTAL HEMISPHERIC MEAN DAILY SOLAR RADIATION#		
				BASE 65 DEG F				
MONTH	DAILY MAXIMUM	DAILY MINIMUM	MONTHLY	HEATING	COOLING	BTU/FT2	KJ/M2	LANGLEYS
JAN	61.6	39.8	50.7	451	8	895.4	10162.0	242.9
FEB	65.6	43.4	54.5	310	16	1154.0	13097.0	313.0
MAR	72.5	49.1	60.8	194	64	1450.0	16456.0	393.3
APR	80.3	58.8	69.6	31	169	1612.3	18298.0	437.3
MAY	86.2	65.7	76.0	0	341	1894.5	21501.0	513.9
JUN	92.4	72.0	82.2	0	516	2069.0	23481.0	561.2
JUL	95.6	73.8	84.7	0	611	2121.1	24072.0	575.3
AUG	95.9	73.4	84.7	0	611	1947.1	22098.0	528.2
SEP	89.8	68.8	79.3	0	429	1638.0	18589.0	444.3
OCT	81.8	59.2	70.5	32	202	1350.1	15322.0	366.2
NOV	71.1	48.2	59.7	179	20	1008.9	11450.0	273.7
DEC	64.6	41.8	53.2	373	7	847.1	9614.0	229.8
ANN	79.8	57.8	68.8	1570	2994	1499.0	17012.0	406.6

* BASED ON 1941-1970 PERIOD — # AS NOTED IN SOLMET VOLUME 1

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STATION: SHERMAN STATE: TX

STATION NUMBER: 13923 LATITUDE: 3343N LONGITUDE: 9640W ELEVATION: 233

MONTH	NORMAL TEMPERATURE (DEG F)* DAILY MAXIMUM	DAILY MINIMUM	MONTHLY	NORMAL DEGREE DAYS* BASE 65 DEG F HEATING	COOLING	TOTAL HEMISPHERIC MEAN DAILY SOLAR RADIATION# BTU/FT2	KJ/M2	LANGLEYS
JAN	0.0	0.0	41.7	722	0	793.8	9009.0	215.3
FEB	0.0	0.0	45.9	535	0	1037.4	11773.0	281.4
MAR	0.0	0.0	52.3	411	17	1365.9	15501.0	370.5
APR	0.0	0.0	63.7	114	75	1610.4	18276.0	436.8
MAY	0.0	0.0	71.2	13	206	1851.9	21017.0	502.3
JUN	0.0	0.0	79.4	0	432	2114.2	23994.0	573.5
JUL	0.0	0.0	83.6	0	577	2076.8	23569.0	563.3
AUG	0.0	0.0	83.7	0	580	1931.6	21922.0	523.9
SEP	0.0	0.0	76.0	0	335	1580.1	17932.0	428.6
OCT	0.0	0.0	65.8	90	115	1268.1	14392.0	344.0
NOV	0.0	0.0	53.4	353	0	918.9	10428.0	249.2
DEC	0.0	0.0	44.8	626	0	743.8	8441.0	201.7
ANN	0.0	0.0	63.5	2864	2337	1441.1	16355.0	390.9

* BASED ON 1941-1970 PERIOD # AS NOTED IN SOLMET VOLUME 1

STATION: WACO STATE: TX

STATION NUMBER: 13959 LATITUDE: 3137N LONGITUDE: 9713W ELEVATION: 155

MONTH	NORMAL TEMPERATURE (DEG F)* DAILY MAXIMUM	DAILY MINIMUM	MONTHLY	NORMAL DEGREE DAYS* BASE 65 DEG F HEATING	COOLING	TOTAL HEMISPHERIC MEAN DAILY SOLAR RADIATION# BTU/FT2	KJ/M2	LANGLEYS
JAN	57.4	36.6	47.0	558	0	832.6	9449.0	225.8
FEB	61.5	40.3	50.9	401	6	1096.3	12442.0	297.4
MAR	68.4	46.0	57.2	280	38	1427.5	16201.0	387.2
APR	77.8	56.8	67.3	56	125	1612.1	18296.0	437.3
MAY	84.4	64.5	74.5	0	295	1773.6	20128.0	481.1
JUN	91.9	71.8	81.9	0	507	2112.4	23974.0	573.0
JUL	96.2	75.0	85.6	0	639	2130.3	24177.0	577.8
AUG	96.7	74.7	85.7	0	642	1958.1	22222.0	531.1
SEP	89.5	68.3	78.9	0	417	1600.9	18169.0	434.2
OCT	80.4	57.7	69.1	51	178	1301.3	14768.0	353.0
NOV	68.7	46.2	57.5	241	16	956.7	10858.0	259.5
DEC	60.5	39.1	49.8	471	0	802.8	9111.0	217.8
ANN	77.8	56.4	67.1	2058	2863	1467.1	16650.0	397.9

* BASED ON 1941-1970 PERIOD # AS NOTED IN SOLMET VOLUME 1

STATION: WICHITA FALLS STATE: TX

STATION NUMBER: 13966 LATITUDE: 3358N LONGITUDE: 9829W ELEVATION: 314

	NORMAL TEMPERATURE (DEG F)*			NORMAL DEGREE DAYS*		TOTAL HEMISPHERIC MEAN DAILY SOLAR RADIATION#		
	DAILY	DAILY		BASE 65 DEG F				
MONTH	MAXIMUM	MINIMUM	MONTHLY	HEATING	COOLING	BTU/FT2	KJ/M2	LANGLEYS
JAN	53.5	29.4	41.5	729	0	862.0	9783.0	233.8
FEB	58.1	33.6	45.9	535	0	1122.9	12744.0	304.6
MAR	65.8	39.2	52.5	409	22	1471.9	16704.0	399.2
APR	77.4	51.1	64.3	112	91	1762.8	20006.0	478.2
MAY	84.7	59.8	72.3	13	239	2017.3	22894.0	547.2
JUN	93.9	68.6	81.3	0	489	2221.4	25210.0	602.5
JUL	99.2	72.3	85.8	0	645	2166.5	24587.0	587.6
AUG	99.4	71.6	85.5	0	636	1969.2	22348.0	534.1
SEP	90.3	63.6	77.0	0	360	1601.8	18179.0	434.5
OCT	79.2	52.7	66.0	92	123	1291.4	14656.0	350.3
NOV	66.0	39.7	52.9	369	6	957.3	10864.0	259.7
DEC	56.2	32.2	44.2	645	0	798.8	9066.0	216.7
ANN	77.0	51.2	64.1	2904	2611	1520.2	17253.0	412.4

* BASED ON 1941-1970 PERIOD # AS NOTED IN SOLMET VOLUME 1

ABILENE, TEXAS

Heating Degree Days

Season	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	Total
1957-58	0	0	6	141	487	466	642	390	544	160	16	0	3052
1958-59	0	0	6	133	319	690	689	507	299	183	8	0	2834
1959-60	0	0	8	118	518	520	639	642	482	81	40	0	3048
1960-61	0	0	3	55	261	739	749	473	241	114	10	3	2648
1961-62	0	0	20	71	449	618	777	310	379	115	8	0	2747
1962-63	0	0	2	68	299	562	805	302	207	31	15	0	2511
1963-64	0	0	2	6	251	725	573	575	258	54	6	3	2453
1964-65	0	0	2	44	293	505	519	538	522	59	0	0	2482
1965-66	0	0	4	67	117	424	791	570	281	122	12	0	2418
1966-67	0	0	0	119	198	633	532	508	154	14	23	0	2181
1967-68	0	0	17	118	321	634	648	611	366	134	15	0	2884
1968-69	0	0	0	42	387	599	520	468	541	53	15	1	2626
1969-70	0	0	0	192	350	528	748	449	422	92	31	1	2813
1970-71	0	0	15	147	414	411	569	455	326	96	22	0	2455
1971-72	0	0	44	44	312	492	651	464	207	49	12	0	2275
1972-73	0	0	13	158	554	702	844	574	235	228	43	0	3351
1973-74	0	0	6	60	227	557	680	389	181	78	7	0	2185
1974-75	0	0	60	67	400	631	620	553	351	144	7	0	2833
1975-76	0	0	55	97	327	578	692	276	296	68	39	0	2428
1976-77	0	0	11	276	575	690	901	393	262	89	0	0	3197
1977-78	0	0	0	56	314	500	938	730	337	37	34	0	2946

Cooling Degree Days

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
1969	0	0	3	83	190	412	699	644	332	105	12	0	2482
1970	2	0	5	104	202	433	607	590	411	106	6	1	2467
1971	0	4	26	88	256	469	607	376	297	83	20	0	2226
1972	0	12	41	188	189	474	497	436	330	128	1	0	2296
1973	0	0	0	44	224	379	508	550	277	111	32	0	2125
1974	0	7	113	102	354	480	607	430	104	62	8	0	2267
1975	0	0	20	89	175	411	462	513	236	120	13	0	2039
1976	0	21	40	67	145	424	401	521	275	31	0	0	1925
1977	0	4	13	17	267	496	590	579	534	122	7	1	2630

AMARILLO, TEXAS

Heating Degree Days

Season	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	Total
1957-58	0	0	45	303	721	683	867	758	861	412	66	5	4721
1958-59	0	0	37	233	546	852	1008	716	584	321	74	3	4374
1959-60	0	0	46	311	671	758	1033	965	696	214	80	0	4774
1960-61	3	0	27	210	530	929	935	714	507	303	34	7	4219
1961-62	0	0	63	189	702	879	1026	540	563	254	23	15	4254
1962-63	0	0	23	159	508	741	1114	648	430	139	61	7	3850
1963-64	0	0	11	42	458	1000	855	949	618	235	53	7	4228
1964-65	0	0	48	149	517	795	740	762	820	194	56	7	4088
1965-66	0	0	73	191	376	676	1145	857	456	312	99	1	4186
1966-67	0	23	22	250	395	908	743	675	356	159	135	9	3675
1967-68	0	1	23	185	544	911	820	777	504	290	109	0	4164
1968-69	0	0	6	159	583	865	726	681	808	176	69	24	4097
1969-70	0	0	1	374	543	817	981	602	713	280	50	33	4394
1970-71	0	0	47	359	544	661	837	726	524	290	89	0	4077
1971-72	1	0	120	245	575	843	900	692	409	203	106	0	4094
1972-73	13	2	48	274	833	987	972	706	548	438	113	0	4934
1973-74	0	0	56	154	420	813	922	633	368	190	17	0	3573
1974-75	0	0	119	199	571	890	853	826	612	323	67	16	4476
1975-76	0	0	104	158	569	757	861	492	567	253	171	0	3932
1976-77	0	0	59	464	790	846	1075	592	499	215	22	0	4562
1977-78	0	0	1	150	522	768	899	708	601	275	81	10	4015

Cooling Degree Days

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
1969	0	0	0	30	147	264	550	478	190	54	0	0	1713
1970	0	0	0	14	176	327	495	446	231	24	0	0	1713
1971	0	0	13	18	94	334	381	232	189	10	0	0	1271
1972	0	0	4	44	59	265	313	285	182	60	0	0	1212
1973	0	0	0	3	53	310	414	435	173	67	1	0	1456
1974	0	0	6	52	228	306	449	274	61	20	0	0	1396
1975	0	0	0	24	61	273	330	367	134	46	0	0	1235
1976	0	0	0	13	32	223	312	318	110	5	0	0	1013
1977	0	0	0	10	100	399	493	389	287	22	0	0	1700

NOTE: See last page of this section for Items 4.1, 4.2 and 4.3 (B) in the PEA form.

AUSTIN, TEXAS

Heating Degree Days

Season	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	Total
1957-58	0	0	0	98	290	275	499	457	319	53	0	0	1999
1958-59	0	0	0	74	184	505	530	346	183	112	0	0	1934
1959-60	0	0	0	38	393	348	492	495	350	17	12	0	2145
1960-61	0	0	0	26	182	512	582	299	116	80	0	0	1797
1961-62	0	0	0	21	270	404	598	161	243	48	0	0	1745
1962-63	0	0	0	20	172	429	657	374	109	27	4	0	1792
1963-64	0	0	0	0	137	610	451	475	154	20	0	0	1847
1964-65	0	0	0	17	158	415	370	431	367	12	0	0	1770
1965-66	0	0	2	58	76	288	611	449	168	24	11	0	1687
1966-67	0	0	0	31	109	453	446	380	77	0	2	0	1498
1967-68	0	0	7	41	192	477	538	510	265	37	1	0	2068
1968-69	0	0	0	7	294	446	368	345	346	6	1	0	1813
1969-70	0	0	0	69	253	339	653	330	309	47	10	0	2010
1970-71	0	0	3	75	240	231	328	300	171	52	0	0	1400
1971-72	0	0	3	0	184	271	434	298	66	6	0	0	1262
1972-73	0	0	0	46	375	513	586	405	72	128	3	0	2128
1973-74	0	0	0	8	83	387	496	258	108	36	0	0	1376
1974-75	0	0	5	11	271	441	377	356	204	53	0	0	1718
1975-76	0	0	1	27	204	404	476	158	173	19	3	0	1465
1976-77	0	0	0	170	402	506	719	308	148	20	0	0	2273
1977-78	0	0	0	16	136	354	750	561	225	15	7	0	2064

Cooling Degree Days

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
1969	25	5	8	132	276	476	668	620	450	186	46	1	2893
1970	8	1	10	165	235	451	589	651	435	134	22	43	2744
1971	14	20	86	157	355	570	656	511	436	229	53	13	3100
1972	6	34	111	269	272	510	547	571	529	239	16	3	3107
1973	1	0	34	78	277	407	557	550	447	205	93	4	2653
1974	6	21	160	158	398	463	606	513	229	157	34	6	2751
1975	21	0	47	141	277	454	536	552	329	187	72	22	2638
1976	0	57	85	115	186	451	479	577	401	61	6	0	2418
1977	0	7	38	90	324	526	629	681	572	227	40	7	3141

BROWNSVILLE, TEXAS

Heating Degree Days

Season	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	Total
1957-58	0	0	0	18	102	94	219	117	102	0	0	0	652
1958-59	0	0	0	32	53	212	268	153	54	27	0	0	829
1959-60	0	0	0	3	169	107	173	159	104	5	0	0	720
1960-61	0	0	0	2	41	229	302	123	16	14	0	0	727
1961-62	0	0	0	1	37	138	292	23	79	7	0	0	577
1962-63	0	0	0	0	78	168	292	185	17	0	0	0	690
1963-64	0	0	0	0	48	342	204	190	39	0	0	0	823
1964-65	0	0	0	5	52	215	127	136	138	0	0	0	673
1965-66	0	0	0	8	8	76	333	239	65	1	0	0	730
1966-67	0	0	0	4	40	185	238	151	32	0	0	0	650
1967-68	0	0	1	4	8	174	262	218	126	4	0	0	797
1968-69	0	0	0	0	73	96	141	45	115	0	0	0	470
1969-70	0	0	0	0	92	69	256	72	76	4	1	0	570
1970-71	0	0	1	5	86	46	130	76	95	[illegible]	0	0	388
1971-72	0	0	0	0	16	67	112	93	[illegible]	2	0	0	301
1972-73	0	0	0	0	144	217	339	192	4	27	0	0	921
1973-74	0	0	0	0	16	130	190	102	40	[illegible]	[illegible]	0	423
1974-75	0	0	0	3	77	169	177	95	31	[illegible]	[illegible]	[illegible]	552
1975-76	0	0	0	9	74	180	215	74	22	[illegible]	[illegible]	[illegible]	[illegible]
1976-77	0	0	0	21	177	256	319	323	43	3	[illegible]	[illegible]	[illegible]
1977-78	0	0	0	0	25	101	342	285	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Cooling Degree Days

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
1969	123	71	72	335	437	570	695	624	[illegible]	[illegible]	[illegible]	87	[illegible]
1970	35	48	116	356	364	522	597	648	[illegible]	[illegible]	128	202	3880
1971	105	142	266	294	459	541	578	566	[illegible]	[illegible]	[illegible]	143	[illegible]
1972	148	91	246	302	390	475	512	542	[illegible]	[illegible]	95	53	3854
1973	19	21	178	242	404	490	585	529	[illegible]	[illegible]	209	74	[illegible]
1974	83	75	299	329	520	485	534	624	[illegible]	275	[illegible]	59	3871
1975	79	68	223	363	526	536	548	546	[illegible]	[illegible]	176	69	3857
1976	41	97	216	283	343	507	511	347	559	390	59	24	3327
1977	15	44	174	272	476	535	615	658	585	384	177	88	4023

CORPUS CHRISTI, TEXAS

Heating Degree Days

Season	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	Total
1957-58	0	0	0	31	161	157	307	232	176	7	0	0	1071
1958-59	0	0	0	38	93	292	382	227	105	39	0	0	1176
1959-60	0	0	0	5	253	190	299	286	159	10	1	0	1233
1960-61	0	0	0	12	78	330	408	186	39	35	0	0	1088
1961-62	0	0	0	4	123	220	448	51	142	10	0	0	998
1962-63	0	0	0	4	85	274	466	271	36	0	0	0	1136
1963-64	0	0	0	0	69	440	263	324	87	7	0	0	1190
1964-65	0	0	0	18	70	289	219	252	222	0	0	0	1070
1965-66	0	0	0	22	14	125	450	300	79	12	1	0	1003
1966-67	0	0	0	5	68	267	304	222	42	0	0	0	908
1967-68	0	0	0	17	63	299	373	362	202	9	0	0	1325
1968-69	0	0	0	3	144	219	237	146	226	0	0	0	975
1969-70	0	0	0	10	160	152	442	168	166	29	2	0	1129
1970-71	0	0	2	12	125	93	174	151	64	26	0	0	647
1971-72	0	0	0	0	51	112	188	166	22	2	0	0	541
1972-73	0	0	0	8	108	295	415	262	23	44	0	0	1235
1973-74	0	0	0	0	20	204	264	151	56	13	0	0	708
1974-75	0	0	0	4	117	260	227	167	77	10	0	0	862
1975-76	0	0	0	4	107	247	275	94	45	1	0	0	773
1976-77	0	0	0	59	253	311	455	192	65	6	0	0	1341
1977-78	0	0	0	4	56	160	502	382	101	17	0	0	1222

Cooling Degree Days

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
1969	62	16	11	180	332	521	677	636	496	300	103	40	3374
1970	20	8	47	287	329	466	552	599	485	235	89	160	3297
1971	98	74	187	207	423	542	625	556	489	367	121	116	3805
1972	93	61	187	360	380	520	594	588	561	368	68	28	3808
1973	13	14	149	179	381	489	629	560	511	353	265	48	3591
1974	52	60	243	276	498	486	587	637	410	289	97	32	3667
1975	70	35	154	319	486	557	608	573	422	300	161	52	3737
1976	25	84	170	265	299	505	510	563	498	136	31	3	3089
1977	4	18	104	206	435	545	616	677	621	342	136	71	3775

DALLAS/FORT WORTH, TEXAS

Heating Degree Days

Season	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	Total
1957-58	0	0	0	144	402	410	615	592	496	138	9	0	2806
1958-59	0	0	0	82	247	659	690	452	276	143	4	0	2553
1959-60	0	0	0	68	470	450	643	639	499	54	32	0	2855
1960-61	0	0	0	45	253	658	740	409	209	132	9	2	2457
1961-62	0	0	0	50	381	590	701	328	345	107	2	0	2584
1962-63	0	0	0	46	280	545	839	517	185	34	13	0	2459
1963-64	0	0	0	4	227	760	651	608	285	65	1	0	2601
1964-65	0	0	6	81	260	550	550	330	551	36	0	0	2564
1965-66	0	0	2	60	103	376	760	542	274	84	26	0	2227
1966-67	0	0	0	79	182	627	514	503	146	15	21	0	2087
1967-68	0	0	13	80	282	548	631	590	330	100	2	0	2584
1968-69	0	0	0	47	348	543	492	416	468	49	6	4	2370
1969-70	0	0	0	116	306	463	756	455	404	63	21	1	2585
1970-71	0	0	7	105	316	369	564	440	307	97	19	0	2224
1971-72	0	0	12	7	270	389	615	398	143	26	1	0	1861
1972-73	0	0	3	96	446	644	690	475	155	182	12	0	2703
1973-74	0	0	1	36	182	509	656	352	173	70	1	0	1980
1974-75	0	0	20	16	296	546	489	508	355	112	0	0	2342
1975-76	0	0	4	33	266	500	616	217	222	48	20	0	1926
1976-77	0	0	0	214	459	614	931	431	241	37	0	0	2927
1977-78	0	0	0	55	257	536	962	786	346	54	41	0	3037

Cooling Degree Days

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
1969	3	3	3	67	228	453	715	602	372	133	17	0	2596
1970	5	0	7	108	236	433	595	653	409	115	12	22	2595
1971	0	6	21	71	195	546	606	456	382	171	36	1	2491
1972	2	14	57	185	249	498	569	618	480	183	4	0	2859
1973	1	0	6	60	230	435	593	559	342	146	33	0	2405
1974	0	2	115	101	341	419	660	563	202	153	20	2	2578
1975	0	0	15	107	236	483	580	620	331	109	39	9	2609
1976	0	32	59	52	138	421	537	602	338	72	0	0	2251
1977	0	0	7	94	391	581	693	626	505	112	6	2	3017

DEL RIO, TEXAS

Heating Degree Days

Season	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	Total
1957-58	0	0	0	3	216	326	438	340	224	17	4	0	1568
1958-59	0	0	0	57	285	302	486	288	133	69	0	0	1620
1959-60	0	0	0	68	184	439	419	375	233	19	1	0	1738
1960-61	0	0	0	20	366	337	530	260	67	33	0	0	1613
1961-62	0	0	0	17	137	499	559	96	163	21	0	0	1492
1962-63	0	0	0	9	246	347	559	302	71	13	0	0	1547
1963-64	0	0	0	2	112	388	484	405	91	15	0	0	1497
1964-65	0	0	0	21	152	417	326	397	268	4	0	0	1585
1965-66	0	0	3	16	41	263	554	388	128	8	9	0	1410
1966-67	0	0	0	26	93	434	417	299	54	0	0	0	1323
1967-68	0	0	1	36	159	475	466	419	246	28	0	0	1830
1968-69	0	0	0	0	225	419	324	240	266	1	0	0	1475
1969-70	0	0	0	62	273	330	551	277	242	40	7	0	1782
1970-71	0	0	24	69	233	224	278	239	107	35	0	0	1209
1971-72	0	0	9	6	135	263	350	228	34	2	0	0	1027
1972-73	0	0	0	21	283	429	531	381	31	72	0	0	1748
1973-74	0	0	0	1	83	362	363	231	53	11	0	0	1104
1974-75	0	0	6	9	223	431	375	274	114	22	0	0	1454
1975-76	0	0	0	16	180	361	456	125	76	3	5	0	1222
1976-77	0	0	0	127	348	481	568	269	122	13	0	0	1928
1977-78	0	0	0	6	126	294	564	422	111	3	0	0	1526

Cooling Degree Days

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
1969	6	13	32	193	330	590	735	660	455	175	46	0	3235
1970	3	0	15	209	286	496	642	637	443	135	11	0	2868
1971	10	19	114	196	421	461	534	429	423	201	43	8	2859
1972	3	37	161	317	315	521	566	496	473	241	18	1	3149
1973	0	0	68	170	410	460	550	586	463	207	69	0	2983
1974	2	10	178	237	489	565	654	584	278	177	23	2	3199
1975	13	1	83	205	363	534	508	582	345	202	78	13	2927
1976	0	74	130	168	255	534	410	521	419	73	3	0	2587
1977	0	7	63	121	334	543	649	733	630	239	34	6	3359

EL PASO, TEXAS

Heating Degree Days

Season	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	Total
1957-58	0	0	4	127	476	570	677	370	422	116	3	0	2765
1958-59	0	0	16	120	343	549	523	434	335	86	3	0	2409
1959-60	0	0	0	33	439	573	691	534	176	58	10	0	2514
1960-61	0	0	0	86	357	806	735	473	266	97	1	0	2821
1961-62	0	0	0	82	513	575	754	318	433	36	3	0	2714
1962-63	0	0	0	65	333	608	753	438	279	41	0	0	2517
1963-64	0	0	0	17	341	683	789	695	354	99	3	0	2981
1964-65	0	0	0	76	391	643	521	504	397	54	7	2	2595
1965-66	0	0	4	107	240	592	769	612	264	59	4	0	2651
1966-67	0	0	2	126	307	695	718	469	173	56	25	0	2571
1967-68	0	0	2	106	352	720	691	415	377	128	0	0	2791
1968-69	0	0	0	61	414	728	503	464	477	43	24	0	2714
1969-70	0	0	0	62	371	504	556	348	286	94	33	0	2254
1970-71	0	0	39	180	388	519	625	457	254	110	6	0	2578
1971-72	0	0	31	112	381	624	607	364	126	56	3	0	2304
1972-73	0	0	3	87	480	583	679	499	384	218	31	0	2944
1973-74	0	0	7	90	336	592	636	558	178	79	5	0	2481
1974-75	0	0	41	107	445	720	672	445	309	188	13	0	2948
1975-76	0	0	20	66	399	640	696	351	278	91	26	0	2567
1976-77	0	0	7	214	601	709	623	492	459	138	3	0	3256
1977-78	0	0	0	56	326	472	603	449	200	57	22	0	2187

Cooling Degree Days

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
1969	0	0	1	71	250	501	627	647	372	155	2	0	2626
1970	0	0	2	57	263	448	559	514	321	19	0	0	2183
1971	0	0	45	45	235	492	543	375	293	43	0	0	2071
1972	0	4	15	70	159	404	543	401	247	120	0	0	1963
1973	0	0	0	7	152	355	459	448	340	44	7	0	1812
1974	0	0	19	84	338	540	459	378	181	54	0	0	2053
1975	0	0	9	35	170	482	469	302	241	41	1	0	1950
1976	0	0	4	71	170	441	418	434	179	18	0	0	1735
1977	0	0	0	39	186	500	540	552	380	43	0	0	2240

GALVESTON, TEXAS

Heating Degree Days

Season	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	Total
1957-58	0	0	0	49	145	175	401	379	220	13	0	0	1382
1958-59	0	0	0	35	102	334	418	263	134	43	0	0	1329
1959-60	0	0	0	10	253	248	384	400	264	11	3	0	1573
1960-61	0	0	0	15	74	366	484	235	51	55	1	0	1281
1961-62	0	0	0	7	148	232	461	97	166	24	0	0	1135
1962-63	0	0	0	4	99	311	494	366	75	5	0	0	1354
1963-64	0	0	0	0	80	480	393	384	154	11	0	0	1502
1964-65	0	0	0	5	102	293	254	276	249	2	0	0	1181
1965-66	0	0	0	5	12	152	447	320	138	9	0	0	1083
1966-67	0	0	0	16	63	298	356	287	61	0	0	0	1081
1967-68	0	0	3	12	78	243	381	404	233	8	0	0	1362
1968-69	0	0	0	4	142	283	296	236	281	0	0	0	1242
1969-70	0	0	0	9	127	189	490	244	185	25	3	0	1272
1970-71	0	0	0	31	161	130	250	223	143	30	0	0	968
1971-72	0	0	0	0	91	131	210	211	53	2	0	0	698
1972-73	0	0	0	23	225	289	424	329	39	73	0	0	1402
1973-74	0	0	0	1	23	249	251	181	61	10	0	0	776
1974-75	0	0	0	2	121	254	208	201	120	28	0	0	934
1975-76	0	0	0	4	126	309	355	128	82	0	0	0	1004
1976-77	0	0	0	96	313	373	563	274	102	3	0	0	1724
1977-78	0	0	0	6	63	238	606	501	204	16	2	0	1636

Cooling Degree Days

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
1969	3	4	4	145	333	500	602	609	493	289	81	11	3074
1970	0	0	3	174	292	488	557	583	456	181	36	39	2809
1971	8	5	15	130	316	500	574	549	448	340	103	49	3037
1972	30	20	91	234	360	510	540	597	540	294	48	8	3272
1973	1	0	41	93	296	454	576	533	476	354	191	15	3030
1974	10	14	94	178	385	481	561	553	335	253	68	7	2939
1975	19	11	53	132	379	483	588	599	378	254	106	11	3013
1976	0	6	40	156	259	457	516	550	445	113	7	0	2549
1977	0	4	21	160	350	488	553	555	499	254	75	21	2980

HOUSTON, TEXAS

Heating Degree Days

Season	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	Total
1957-58	0	0	0	71	185	245	449	417	234	30	0	0	1631
1958-59	0	0	0	48	145	375	452	254	163	58	0	0	1495
1959-60	0	0	0	7	309	306	416	441	260	8	1	0	1748
1960-61	0	0	0	17	104	390	473	227	56	61	0	0	1328
1961-62	0	0	0	16	184	287	480	99	209	32	0	0	1307
1962-63	0	0	0	8	157	313	515	351	88	7	0	0	1439
1963-64	0	0	0	0	108	551	413	446	158	19	0	0	1695
1964-65	0	0	0	31	114	315	300	284	250	0	0	0	1294
1965-66	0	0	2	20	23	212	516	334	144	12	0	0	1263
1966-67	0	0	0	27	99	359	342	298	68	0	0	0	1193
1967-68	0	0	3	18	99	312	390	415	229	17	0	0	1483
1968-69	0	0	0	5	199	297	284	234	281	1	0	2	1303
1969-70	0	0	0	29	238	304	579	309	252	51	12	0	1774
1970-71	0	0	0	72	274	209	298	273	219	72	3	0	1420
1971-72	0	0	2	6	195	194	315	295	85	17	0	0	1109
1972-73	0	0	2	50	320	410	540	379	75	117	5	0	1898
1973-74	0	0	0	8	74	364	330	273	95	60	0	0	1204
1974-75	0	0	0	15	196	336	290	270	179	48	0	0	1334
1975-76	0	0	0	26	217	399	441	178	155	26	7	0	1449
1976-77	0	0	0	173	398	484	687	312	166	25	0	0	2245
1977-78	0	0	0	34	150	365	752	553	250	33	17	0	2154

Cooling Degree Days

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
#1969	35	13	11	167	328	456	608	569	402	222	48	9	2868
1970	18	3	7	188	238	409	513	567	423	131	38	76	2611
1971	48	18	55	126	292	466	594	485	409	229	52	44	2818
1972	58	20	71	208	275	480	480	482	447	206	17	12	2756
1973	1	4	41	111	253	434	564	458	401	225	151	12	2655
1974	24	33	158	132	374	454	558	519	295	196	60	18	2821
1975	47	8	61	135	342	455	514	505	303	174	68	24	2656
1976	5	43	75	110	182	408	490	520	341	42	9	0	2225
1977	0	5	44	91	302	487	547	565	456	173	58	23	2751

LUBBOCK, TEXAS

Heating Degree Days

Season	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	Total
1957-58	0	0	19	228	661	640	868	677	726	295	33	0	4147
1958-59	0	0	24	197	446	779	835	622	490	246	35	1	3675
1959-60	0	0	31	223	609	695	846	833	589	142	57	0	4025
1960-61	0	0	8	135	421	872	906	653	444	210	30	5	3684
1961-62	0	0	24	150	602	790	942	457	333	176	13	3	3692
1962-63	0	0	18	143	420	692	988	627	378	92	36	0	3402
1963-64	0	0	11	27	425	872	808	821	483	139	13	4	3603
1964-65	0	0	35	111	433	677	635	683	682	107	12	0	3375
1965-66	0	0	22	94	235	551	946	677	307	166	48	0	3046
1966-67	0	8	3	170	283	827	748	652	289	85	84	3	3152
1967-68	0	4	17	190	463	866	748	762	507	293	73	4	3927
1968-69	0	1	31	151	543	770	614	601	723	126	45	7	3612
1969-70	0	0	3	312	486	673	846	539	577	198	47	21	3702
1970-71	0	0	50	286	484	608	723	618	438	186	30	0	3423
1971-72	0	0	83	124	421	656	728	549	275	94	40	0	2970
1972-73	2	0	23	220	672	831	928	688	416	312	50	0	4150
1973-74	0	0	31	99	340	703	726	536	223	127	11	0	2796
1974-75	0	0	105	166	500	753	744	664	474	233	18	4	3661
1975-76	0	0	76	122	436	680	780	397	392	116	57	0	3056
1976-77	0	0	30	333	665	760	939	520	397	153	1	0	3798
1977-78	0	0	0	80	373	611	1014	864	419	75	64	0	3500

Cooling Degree Days

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
1969	0	0	0	36	160	370	575	461	165	56	0	0	1823
1970	0	0	0	11	167	348	498	440	249	32	2	0	1747
1971	0	0	14	35	157	408	476	269	252	34	4	0	1649
1972	0	0	14	120	119	362	366	297	211	63	0	0	1552
1973	0	0	0	19	153	364	387	401	197	71	2	0	1594
1974	0	0	30	78	350	413	491	300	80	10	0	0	1740
1975	0	0	0	49	107	383	332	392	155	49	0	0	1467
1976	0	1	0	45	93	369	317	406	187	4	0	0	1422
1977	0	0	0	19	221	435	482	455	379	36	0	0	2027

MIDLAND/ODESSA, TEXAS

Heating Degree Days

Season	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	Total
1957-58	0	0	2	155	530	504	709	564	522	176	16	0	3100
1958-59	0	0	10	161	338	664	686	501	341	179	6	0	2806
1959-60	0	0	9	110	534	556	666	643	426	84	28	0	3056
1960-61	0	0	2	64	307	750	761	474	293	124	5	4	2792
1961-62	0	0	12	66	481	625	796	309	394	96	7	0	2786
1962-63	0	0	2	74	299	595	773	487	233	45	19	0	2527
1963-64	0	0	1	3	274	761	656	643	287	63	5	0	2693
1964-65	0	0	6	34	283	493	535	604	529	52	5	0	2541
1965-66	0	0	11	96	232	468	831	621	258	124	46	0	2687
1966-67	0	3	4	159	242	663	654	516	176	23	22	0	2462
1967-68	0	0	9	95	324	708	634	582	300	143	14	0	2869
1968-69	0	0	0	60	456	665	535	467	534	52	30	0	2799
1969-70	0	0	0	216	405	532	706	402	463	137	48	[illegible]	2994
1970-71	0	0	41	150	348	441	540	493	297	119	15	[illegible]	2444
1971-72	0	0	51	71	350	520	639	446	176	37	12	0	2310
1972-73	0	0	19	158	551	660	804	587	320	249	55	0	3403
1973-74	0	0	15	81	252	561	607	429	121	68	1	0	2135
1974-75	0	0	44	65	344	594	582	468	314	135	2	3	2551
1975-76	0	0	40	82	340	560	652	258	261	73	38	0	2304
1976-77	0	0	10	220	545	635	755	409	320	117	0	0	3011
1977-78	0	0	0	47	295	478	823	566	245	49	30	0	2553

Cooling Degree Days

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
1969	0	0	0	66	170	402	597	559	286	97	5	0	2182
1970	0	0	0	37	205	309	542	464	301	59	0	1	2001
1971	0	0	19	59	245	410	491	301	256	67	3	0	1851
1972	0	0	31	187	103	423	446	338	249	88	0	0	1945
1973	0	0	0	18	178	369	414	437	229	88	5	0	1737
1974	0	0	58	109	394	488	575	455	136	50	5	0	2270
1975	0	0	10	80	220	466	404	439	217	86	5	0	1927
1976	0	10	21	68	155	398	344	434	219	22	0	0	1671
1977	0	0	9	21	359	522	584	630	518	112	1	0	2764

PORT ARTHUR, TEXAS

Heating Degree Days

Season	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	Total
1957-58	0	0	0	83	181	269	478	440	232	34	0	0	1717
1958-59	0	0	0	46	170	422	469	289	183	59	0	0	1638
1959-60	0	0	0	20	313	340	454	461	304	15	6	0	1913
1960-61	0	0	0	25	122	443	542	240	81	99	0	0	1552
1961-62	0	0	0	33	198	306	543	110	230	42	0	0	1462
1962-63	0	0	0	20	193	387	573	384	102	12	0	0	1671
1963-64	0	0	0	4	141	579	447	452	172	22	0	0	1817
1964-65	0	0	0	52	135	337	322	298	270	3	0	0	1417
1965-66	0	0	0	43	34	250	529	336	180	19	0	0	1391
1966-67	0	0	0	46	115	383	417	[illegible]	111	0	2	0	1359
1967-68	0	0	10	33	133	313	435	485	244	18	0	0	1671
1968-69	0	0	0	20	207	343	334	289	317	4	0	0	1511
1969-70	0	0	0	22	212	281	545	293	180	22	3	0	1558
1970-71	0	0	0	28	213	168	263	254	167	43	0	0	1142
1971-72	0	0	0	6	208	199	317	291	109	20	0	0	1150
1972-73	0	0	0	57	340	390	532	389	77	118	2	0	1905
1973-74	0	0	0	13	83	384	288	288	85	36	0	0	1177
1974-75	0	0	0	20	230	384	297	275	180	67	0	0	1454
1975-76	0	0	0	16	209	413	464	170	128	16	0	0	1416
1976-77	0	0	0	149	375	439	626	268	110	16	0	0	1983
1977-78	0	0	0	16	112	321	662	497	184	14	0	0	1806

Cooling Degree Days

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
1969	17	4	5	139	316	484	621	569	408	247	60	6	2876
1970	13	2	23	225	309	484	617	644	518	194	49	85	3163
1971	42	24	42	167	325	317	527	451	388	223	42	43	2791
1972	21	18	52	164	262	461	449	479	440	209	17	9	2581
1973	0	2	38	84	244	440	524	459	426	242	137	6	2602
1974	27	15	130	153	362	423	524	505	305	143	58	20	2665
1975	28	9	61	130	344	454	516	508	335	186	71	18	2660
1976	2	29	66	133	226	418	512	512	404	61	0	0	2371
1977	0	4	62	125	391	562	627	621	551	235	82	28	3288

SAN ANGELO, TEXAS

Heating Degree Days

Season	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	Total
1957-58	0	0	0	138	451	424	611	546	487	142	14	0	2813
1958-59	0	0	2	143	297	616	614	458	264	156	6	0	2556
1959-60	0	0	4	87	499	512	576	580	406	69	31	0	2764
1960-61	0	0	0	39	232	662	701	411	215	85	1	1	2347
1961-62	0	0	8	66	437	575	719	265	331	83	6	0	2490
1962-63	0	0	0	36	239	526	711	451	161	34	7	0	2165
1963-64	0	0	3	4	269	747	609	562	169	30	5	2	2400
1964-65	0	0	2	65	277	492	469	514	471	31	0	0	2321
1965-66	0	0	0	76	144	416	747	538	221	55	30	0	2227
1966-67	0	0	0	127	192	614	568	459	113	2	19	0	2094
1967-68	0	0	5	76	249	608	577	550	304	127	1	0	2497
1968-69	0	0	0	38	362	542	399	372	416	33	9	0	2171
1969-70	0	0	0	122	335	441	654	391	376	92	44	0	2455
1970-71	0	0	26	126	320	326	453	359	211	81	9	0	1911
1971-72	0	0	23	33	289	450	539	382	138	26	3	0	1883
1972-73	0	0	3	97	438	577	738	514	183	191	20	0	2761
1973-74	0	0	1	33	170	476	554	352	115	53	1	0	1755
1974-75	0	0	33	37	308	560	568	470	288	101	1	0	2366
1975-76	0	0	32	75	320	519	645	251	237	48	30	0	2157
1976-77	0	0	3	220	518	595	757	377	227	45	0	0	2742
1977-78	0	0	0	44	249	390	818	588	286	31	21	0	2427

Cooling Degree Days

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
1969	6	1	6	99	213	513	707	620	311	113	23	0	2612
1970	6	1	7	135	248	422	575	639	432	101	10	9	2585
1971	0	4	49	139	332	482	557	328	308	96	23	0	2318
1972	0	20	65	232	191	488	574	468	406	140	7	2	2593
1973	0	0	6	67	274	425	573	554	314	104	49	0	2366
1974	3	4	120	147	349	481	597	460	159	87	15	0	2422
1975	3	0	18	103	220	448	427	493	238	90	18	0	2058
1976	0	12	29	66	155	449	354	491	272	27	0	0	1855
1977	0	6	14	53	333	523	621	662	562	183	17	1	2975

SAN ANTONIO, TEXAS

Heating Degree Days

Season	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	Total
1957-58	0	0	0	71	270	292	453	419	289	22	0	0	1816
1958-59	0	0	0	75	171	451	497	311	179	90	0	0	1774
1959-60	0	0	0	27	374	336	467	433	291	14	7	0	1949
1960-61	0	0	0	17	130	457	523	272	82	63	0	0	1552
1961-62	0	0	0	19	223	351	586	108	206	27	0	0	1520
1962-63	0	0	0	9	164	393	575	349	87	17	3	0	1597
1963-64	0	0	0	0	141	592	428	434	143	23	0	0	1761
1964-65	0	0	0	41	155	414	346	419	327	13	0	0	1715
1965-66	0	0	2	62	64	301	607	426	182	39	5	0	1688
1966-67	0	0	0	57	131	456	470	366	80	0	0	0	1560
1967-68	0	0	8	48	164	429	477	478	234	39	0	0	1897
1968-69	0	0	0	9	278	437	394	319	315	5	3	0	1760
1969-70	0	0	0	52	253	299	599	282	266	45	7	0	1803
1970-71	0	0	1	72	247	201	282	239	134	52	1	0	1229
1971-72	0	0	1	0	129	266	382	263	61	7	0	0	1109
1972-73	0	0	0	29	334	457	551	362	29	94	1	0	1857
1973-74	0	0	0	4	85	391	437	257	74	39	0	0	1267
1974-75	0	0	2	19	260	433	309	316	152	41	0	0	1612
1975-76	0	0	1	21	214	394	472	166	143	11	2	0	1424
1976-77	0	0	0	160	382	461	643	336	144	32	0	0	2158
1977-78	0	0	0	19	138	360	667	521	192	27	4	0	1928

Cooling Degree Days

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
1969	11	5	8	133	273	494	683	652	448	207	53	2	2969
1970	3	3	20	208	259	478	592	651	493	163	40	57	2967
1971	14	36	130	189	414	564	658	509	459	281	81	31	3366
1972	11	31	105	276	252	465	542	539	515	249	12	6	3003
1973	0	0	69	129	310	431	570	536	437	242	114	0	2846
1974	11	22	171	188	387	439	568	506	229	124	34	5	2684
1975	29	1	51	151	273	457	502	524	337	217	80	30	2652
1976	3	62	113	134	202	451	467	521	383	45	0	0	2383
1977	0	3	52	98	311	502	620	618	525	218	38	5	2990

VICTORIA, TEXAS

Heating Degree Days

Season	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	Total
1957-58	0	0	0	63	199	224	392	330	223	9	0	0	1448
1958-59	0	0	0	51	122	385	426	263	139	66	0	0	1452
1959-60	0	0	0	14	295	253	377	378	244	7	3	0	1571
1960-61	0	0	0	17	106	395	466	233	67	57	0	0	1341
1961-62	0	0	0	15	168	287	501	90	178	20	0	0	1259
1962-63	0	0	0	7	131	313	538	318	68	3	0	0	1378
1963-64	0	0	0	0	95	499	332	376	113	16	0	0	1431
1964-65	0	0	0	22	102	321	275	294	255	0	0	0	1269
1965-66	0	0	2	28	25	202	499	341	122	16	3	0	1238
1966-67	0	0	0	17	83	327	350	267	50	0	0	0	1094
1967-68	0	0	4	15	83	332	414	409	208	16	0	0	1481
1968-69	0	0	0	6	188	287	281	208	261	1	0	0	1232
1969-70	0	0	0	14	174	202	498	230	202	34	5	0	1359
1970-71	0	0	0	44	189	149	228	222	120	45	0	0	997
1971-72	0	0	2	0	96	152	270	229	50	2	0	0	801
1972-73	0	0	0	14	264	376	476	301	20	64	0	0	1515
1973-74	0	0	0	0	26	254	310	183	70	17	0	0	860
1974-75	0	0	0	7	155	286	244	206	92	14	0	0	1004
1975-76	0	0	0	6	165	316	364	120	95	2	0	0	1068
1976-77	0	0	0	111	325	398	585	246	82	8	0	0	1755
1977-78	0	0	0	8	86	261							

Cooling Degree Days

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
1969	38	10	15	184	313	512	687	659	472	263	89	14	3256
1970	19	6	23	234	269	458	561	617	452	184	55	84	2962
1971	70	35	104	172	380	540	630	548	452	303	78	58	3370
1972	58	28	134	299	350	519	562	582	541	285	37	13	3408
1973	3	10	109	138	358	477	638	556	476	313	201	15	3294
1974	20	38	207	225	458	494	613	594	346	271	75	17	3358
1975	61	19	118	223	421	535	597	591	401	240	116	29	3351
1976	7	54	107	186	263	478	505	550	414	88	16	1	2669
1977	4	8	74	144	376	517	599	625	551	259	89	37	3283

WACO, TEXAS

Heating Degree Days

Season	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	Total
1957-58	0	0	0	113	340	327	559	514	401	80	7	0	2341
1958-59	0	0	0	71	208	577	604	411	231	132	0	0	2234
1959-60	0	0	0	53	448	396	561	562	402	29	13	0	2464
1960-61	0	0	0	36	206	586	665	533	159	101	0	0	2086
1961-62	0	0	0	37	326	489	674	234	282	67	1	0	2110
1962-63	0	0	0	26	218	484	741	452	136	31	5	0	2093
1963-64	0	0	0	2	208	726	562	559	235	42	2	0	2336
1964-65	0	0	0	45	196	456	427	465	424	15	0	0	2030
1965-66	0	0	2	72	100	393	706	522	291	75	13	0	2174
1966-67	0	0	0	52	126	557	511	450	114	4	14	0	1828
1967-68	0	0	6	46	196	480	560	519	288	79	0	0	2174
1968-69	0	0	0	22	294	484	438	382	405	15	1	0	2041
1969-70	0	0	0	75	278	444	719	414	372	60	11	0	2373
1970-71	0	0	4	87	286	288	411	349	188	50	5	0	1668
1971-72	0	0	6	5	230	360	543	368	109	19	2	0	1642
1972-73	0	0	4	89	426	638	696	492	149	170	13	0	2677
1973-74	0	0	0	22	118	460	605	322	145	52	0	0	1724
1974-75	0	0	13	14	274	578	507	495	343	120	0	0	2344
1975-76	0	0	2	27	230	462	558	200	204	38	6	0	1727
1976-77	0	0	0	205	446	596	827	343	175	21	2	0	2617
1977-78	0	0	0	22	173	417	839	639	284	19	19	0	2412

Cooling Degree Days

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
1969	12	2	1	111	325	537	796	723	470	200	40	0	3217
1970	4	0	0	155	260	483	629	723	447	136	20	35	2892
1971	6	14	66	142	325	376	655	489	436	206	40	7	2962
1972	3	24	72	203	266	539	541	608	499	178	6	0	2939
1973	0	0	12	60	225	375	587	611	429	182	72	0	2553
1974	0	5	138	128	382	461	683	610	225	169	31	2	2834
1975	2	0	26	100	227	448	533	618	376	206	83	19	2638
1976	0	33	72	81	193	469	542	644	395	73	5	0	2507
1977	0	7	20	94	366	593	754	719	628	224	34	13	3452

WICHITA FALLS, TEXAS

Heating Degree Days

Season	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	Total
1957-58	0	0	4	190	491	539	608	677	630	183	18	0	3420
1958-59	0	0	4	120	308	724	818	540	329	166	4	0	3013
1959-60	0	0	9	139	551	537	744	732	606	84	52	0	3454
1960-61	0	0	1	61	294	786	790	525	300	167	16	0	2940
1961-62	0	0	4	62	499	723	875	408	427	139	3	0	3140
1962-63	0	0	2	68	315	577	914	565	281	56	22	0	2800
1963-64	0	0	1	8	278	825	655	634	366	82	6	0	2855
1964-65	0	0	12	86	352	706	679	563	647	47	2	0	3094
1965-66	0	0	13	120	241	494	929	633	275	139	33	0	2877
1966-67	0	2	0	119	247	723	593	538	167	30	41	0	2460
1967-68	0	0	14	93	366	674	699	687	357	133	23	0	3046
1968-69	0	0	0	68	431	676	646	543	609	91	14	4	3082
1969-70	0	0	1	235	411	634	891	526	534	131	19	4	3386
1970-71	0	0	20	205	474	529	749	560	395	131	15	0	3078
1971-72	0	0	37	25	364	578	787	574	273	77	12	0	2727
1972-73	0	0	8	193	571	771	839	577	213	234	47	0	3453
1973-74	0	0	10	42	248	621	752	418	212	88	1	0	2392
1974-75	0	0	36	54	398	673	644	628	430	157	0	0	3020
1975-76	0	0	52	87	338	606	690	295	318	73	40	0	2499
1976-77	0	0	7	265	552	731	1023	459	281	80	1	0	3399
1977-78	0	0	0	64	345	645	1078	881	394	73	50	0	3530

Cooling Degree Days

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
1969	0	0	0	57	206	438	742	591	320	79	3	0	2436
1970	0	0	4	85	233	452	622	627	365	76	3	0	2467
1971	0	0	14	78	226	373	672	470	357	124	11	0	2525
1972	0	4	26	145	174	517	572	543	377	147	2	0	2507
1973	0	0	3	21	155	351	559	570	298	132	35	0	2124
1974	0	0	85	80	356	454	676	512	135	73	6	0	2377
1975	0	0	10	81	210	436	529	558	237	116	13	0	2190
1976	0	21	39	54	124	395	500	601	282	44	0	0	2060
1977	0	2	2	34	254	537	652	570	502	88	3	0	2644

ENERGY AUDIT FORM EA-2

4.0 CLIMATE FACTORS

City	4.1 Annual Avg. Heating Deg. Days	4.2 Annual Avg. Cooling Deg. Days	4.3(B) Average Monthly Wind Velocity (MPH)											
			Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
Abilene	2,610	2,466	12.1	12.9	14.3	14.1	13.2	13.1	10.9	10.4	10.5	11.1	11.7	12.1
Amarillo	4,183	1,433	13.1	14.2	15.6	15.5	14.8	14.4	12.5	12.1	13.0	13.0	13.2	13.0
Austin	1,737	2,908	9.8	10.2	11.0	10.7	9.8	9.5	8.5	8.1	8.0	8.1	9.2	9.2
Brownsville	650	3,874	11.7	12.4	13.7	14.3	13.4	12.5	11.6	10.5	9.6	9.7	10.8	10.9
Corpus Christi	930	3,474	12.0	12.9	14.0	14.4	12.9	12.0	11.6	10.8	10.2	10.1	11.3	11.2
Dallas/Ft.Worth	2,382	2,587	11.3	12.1	13.2	12.8	11.2	10.9	9.5	9.1	9.5	9.7	10.8	11.1
Del Rio	1,523	3,363	8.7	9.6	10.9	11.0	10.6	11.5	11.0	10.2	9.4	9.1	8.5	8.5
El Paso	2,678	2,098	9.0	9.9	11.8	11.8	11.0	10.0	8.9	8.4	8.3	8.1	8.5	8.5
Galveston	1,224	3,004	11.6	11.8	11.9	12.1	11.5	10.7	9.8	9.4	10.1	10.3	11.2	11.3
Houston	1,434	2,889	8.1	8.7	9.5	9.2	7.9	7.4	6.4	5.3	6.5	6.4	7.7	7.7
Lubbock	3,545	1,647	12.4	13.8	15.3	15.4	14.5	14.0	11.4	10.1	10.7	11.3	11.8	12.2
Midland/Odessa	2,621	2,250	10.1	11.2	12.5	12.7	12.3	12.1	10.5	9.8	10.0	9.9	10.0	10.0
Port Arthur	1,518	2,798	11.2	11.8	12.2	12.3	10.5	9.1	7.9	7.5	8.6	9.0	10.5	10.8
San Angelo	2,240	2,702	10.3	10.9	12.4	12.2	11.4	11.3	9.7	9.1	9.0	9.2	9.9	9.9
San Antonio	1,570	2,994	9.1	9.8	10.5	10.6	10.1	10.1	9.1	8.5	8.5	8.4	8.9	8.6
Victoria	1,227	3,140	10.6	11.1	11.8	12.1	10.8	9.8	8.9	8.4	8.6	8.8	9.8	10.2
Waco	2,058	2,863	12.0	12.4	13.4	13.3	12.1	11.9	10.9	10.0	9.6	10.0	11.0	11.3
Wichita Falls	2,904	2,611	11.3	11.9	13.4	13.3	12.0	12.1	10.9	10.3	10.4	10.5	11.5	11.2

PEA AND EA FORMS AND INSTRUCTIONS
(With Sample Forms)

Examples of completed Preliminary Energy Audit (PEA) forms and Energy Audit (EA) forms are provided to further assist the energy auditor in completing the forms. The detailed instructions, which precede each set of forms, should be read carefully since the proper identification of the information is described in the instructions.

The PEA forms PEA-1, PEA-2, PEA-3 PEA-4, PEA-5, and PEA-6 are designed by the State of Texas to meet the requirements of 10 CFR 450.42 of the federal regulations. The EA forms EA-1, EA-2, EA-3, and EA-4 are designed by the State of Texas to meet the requirements of 10 CFR 450.43 of the federal regulations. The contents of the Preliminary Energy Audit and the Energy Audit were published in the Federal Register dated April 2, 1979.

STATE OF TEXAS

PRELIMINARY ENERGY AUDIT PROCEDURES

The purpose of the Preliminary Energy Audit (PEA) is to determine the energy savings potential of buildings by identifying the physical and energy-using characteristics of the buildings. The major components of the PEA include major energy using systems identified in terms of fuel source and physical characteristics, prior building energy conservation efforts, renewable energy resource potential, and energy savings potential. The PEA is to provide basic building information which will identify those large energy using buildings and systems which will become candidates for subsequent Energy Audits (EA: on-site audit, and "EA" form information), Technical Assistance (TA: detailed engineering energy analysis) and Energy Conservation Measures (ECM: funding for materials, equipment and labor).

A Preliminary Energy Audit report and an Energy Audit report must be completed for each building for which you submit a Technical Assistance and Energy Conservation Measure application. If a TA application is submitted for a building, then there must also be a PEA and EA submitted for the same building and not for the complex which the building is a part.

The PEA Forms PEA-1, PEA-2, PEA-3, PEA-4, PEA-5, and PEA-6 are designed to gather basic energy using information with a minimum of on-site effort. The PEA Auditor will complete the forms by working with the Component Institution's Physical Plant Department, the Component Institution's Energy Manager, and other personnel where necessary, and by visual observation of the building.

The numerical entries are to be obtained from Component Institution's records, Component Institution's best estimates, and by simple mathematical multiplication and division operations. All PEA Form entry blanks must have an entry. If there is no appropriate information, the entry may be noted as follows:

"NDA" - No Data Available
"NA" - Not Applicable to this Building

Draw a straight horizontal line through spaces or blanks if a particular condition does not exist to show that the space was not overlooked. All positive responses to questions should be marked with an "X."

The following procedures provide instructions for completing the PEA forms. The small case alphabet letters in parentheses key to the form entry data. All addresses are to be complete, current street addresses including ZIP Code. Provide telephone numbers if available.

FORM PEA-1

(a1) Enter the calendar date on which the PEA is completed.

(a) Enter the component institution's name as provided by the building owner, and identification number. A component institution is a university within a system, or any other sub-grouping of the "owner," (g), not designated as a building or the "owner".

(b) Enter the Building Name and Identification Number as provided by the owner.

(c) Enter the building address as provided by the owner. This will be the same as the component institution's address if the building is located within the site of the institution. Provide street address if building is located off campus or if building is leased with the intent to purchase (you must have legal documentation of intent to purchase if building is leased).

(d) Enter "school," "hospital," "local government," or "public care institution."

(e) Enter major category of building use taken from the following lists:

School:	Hospital:	Local Government:
Elementary	General	Office
Secondary	Tuberculosis	Storage
College	Other (specify)	Service
University		Library
Vocational		Police Station
LEA Admin.		Fire Station
"Other" (specify)		Other (specify)

Public Care Institution:

Nursing Home
Long-Term Care (other than nursing home)
Rehabilitation Facility
Public Health Center
Residential Child Care Center
"Other" (specify)

If the building is "other", enter a one or two word description. For example, if a hospital is neither a general hospital nor a tuberculosis hospital, you would write "other" and add "psychiatric," "obstetrics and gynecology," "eye, ear, nose, and throat," "rehabilitation," "orthopedic," "chronic disease," or other appropriate brief description.

(f) Enter name and telephone number of person directly responsible for the day-to-day physical operations of the building. This is the person who maintains the HVAC system, adjusts thermostats, cleans filters, etc.

(g) Enter name and street address of "owner" of record and indicate whether the owner is a public institution, a private non-profit institution or an Indian Tribe.

(h) Enter building size expressed in gross square feet as measured from the outside perimeter of the building excluding areas which are neither heated nor cooled such as an attached parking garage.

(i) Enter date of original building construction completion. This date should be the same as the permit of occupany of the builder. If actual date is not known, you may enter the year of construction. Buildings constructed after April 20, 1977, are not eligible for federal funding under this program.

(jj) Enter name and street address of person conducting the PEA audit.

(j) through (n) Operating Schedule:

(j) Daylight hours, 6:00 am to 6:00 pm. Enter the average daily (based on annual data) number of "hours" of occupancy (utilization)/daily average (based on annual data) number of occupants/percent of building gross square footage used, in each of the blank fields indicated for the days of M-F (Monday through Friday), SAT (Saturday), and SUN (Sunday).

(k) Evening hours, 6:00 pm to 10:00 pm. Make entries of similar data requested in (j) above as applies to the evening hours.

(l) Night hours, 10:00 pm to 6:00 am. Make entries of similar data requested in (j) above as applies to the night hours.

(m) and (n) Partial usage. If the building operates on a seasonal schedule, or has other periods of at least a week's duration when the building is only partially occupied, enter the "number" of weeks of partial use (m) by calendar quarter and the "percent" of total building gross square footage in use (n) during such period.

(q) Check "yes" or "no". Is building provided with a centralized local building control panel? The central control panel would be identified as a grouping of switches, push buttons, or gauges; and will be most often located in the boiler room or central equipment room.

(s) Indicate whether or not the building HVAC system is connected to a central Facilities Control and Monitoring System (FCMS - such as a computer system or central monitoring and control panel). Check "yes" or "no."

(u) Enter source of primary building heat and heat source; such as "steam boiler," "hot water boiler," "purchased steam," "direct gas fired," "electrical resistance," "#2 fuel oil," "propane," "butane," "central plant." Indicate type of fuel.

(v) Enter source of primary building cooling; such as "electrical centrifugal chiller," "electric-reciprocating-unitary," "absorption chiller," "purchased chilled water," "campus chiller plant." Indicate energy source.

(w) Enter Primary Terminal devices for space heating system; such as "steam/hot water radiators," "convectors," "fan & coil," "unit ventilator," "ducted warm air."

(x) Enter Primary Terminal system for space cooling; such as, "room fan coil," "double duct," "reheat," "unit ventilators," "low pressure ducted."

(y) Enter source of domestic hot water supply; such as, "gas fired storage," "gas fired instantaneous," "electric storage," "steam generator storage," "oil fired storage."

(z) Enter type of internal lighting system; "incandescent," "fluorescent," "high intensity discharge," with estimated percentage of the number of each type of lighting fixture.

(aa) Enter brief descriptive phase on special building systems and facilities; such as, "food preparation and service," "food serving only," "domestic laundry facilities," "commercial laundry facilities," "steam labs," "ceramic labs," "chemistry labs," "biology labs," "operating rooms," "100% fresh air systems."

(bb) Check "yes" or "no."

(cc) Check "yes" or "no."

(dd) Check "yes" or "no."

(ee) Check "yes" or "no."

(ff) Check "yes" or "no."

(gg) Enter building additions and square footage, building modifications and types. Enter total number of additions and major modifications.

(hh) Enter any other pertinent unique information on building such as; "lightweight envelope," "tilt-up construction," "conversion plans," "year round office type occupancy," etc.

FORM PEA-2

(b) Enter the building name and building identification number. Same as item (b) on Form PEA-1.

(b1) Enter component institution's name and ID number.

(h) Enter building size. Same entry as item (h) on Form PEA-1.

(ii) The monthly data shall be reported for the year beginning September and ending August. Indicate by "X" in appropriate side blank whether this data is "metered" or "best estimate" for this building. If this form is used in subsequent years, enter data for the most recent year ending in August.

(jj) (kk) (ll) (mm) (nn) (oo) (pp) (rr) (ss) (tt) (uu) (vv) (ww) and (xx) are to be provided by month as complete data will serve to your advantage in future consideration of energy audit grants. However, if you do not have your monthly billings to obtain monthly data, you may enter the annual totals for this time period if it is available. If actual metered values are not available for buildings in a complex, all centrally metered, then these values are to be the best estimate based on your knowledge of the building construction, function, and use. If Purchased Thermal Energy Cost Billings combine both MMBTU heat and Ton-Hrs cooling energy, then enter total purchased thermal costs under Col. (ww) and draw a horizontal line through blank at Col. (uu). "If this building is included in a group of central complex metered buildings, then make the best estimate of the weighted building individual totals as a part of the total campus-wide billings and quantities. Dollar values in Columns (kk), (nn), (rr), (uu), (ww), and (xx) are to be rounded off to the nearest whole dollar. Under "Annual Totals" entries, items (ll), (oo), and (ss) will be the average value for the year in cost per unit of energy; thus divide the annual total cost by the annual total energy unit (KWH, MCF, etc.). All other "Annual Totals" entries to be numerical totals of columnar values."

(yy) through (fff). If fuels are used other than the ones indicated in the above chart, you should mark out fuels not used and write in other fuels designating each name on the chart along with the appropriate monthly data.

(yy) Enter total annual "KWH" value from table above and multiply by factor on form.

(zz) Enter total annual "MCF" value from table above. Enter "N.A." if natural gas not used. Multiply by factor on form.

(aaa) Enter total annual "gallons" value from table above. Enter "N.A." if #2 fuel oil is not used. Multiply value by factor on form.

(bbb) Enter total annual "gallons" value from table above. Enter "N.A." if #6 fuel oil not used. Multiply value by factor on form.

(ccc1) or (ccc2) Enter total annual steam or high temperature hot water "MMBTU" or "LBS" value from table above. Cross out the MMBTU or LBS unit on the chart above if not used on your billing. Use either (ccc1) or (ccc2). Enter "N.A." if purchased steam or hot water not utilized. Multiply value by factor on form.

(ddd) Enter total annual Chilled Water "Ton Hours" from table above. Enter "N.A." if chilled water is not purchased. Multiply value by factor on form.

(eee) Enter total annual use of liquified petroleum gases including butane and propane and "other" fuels such as bituminous coal (use conversion factor of 24,500,000). Enter "N.A." if "other fuel not used.

(fff) Enter heat content per unit of "other" fuel used expressed in BTU per unit. Obtain "other" fuel conversion factors (not mentioned above) from standard engineering reference manuals.

(ggg) Enter arithmetical total of the column of figures above.

(h) Enter (h) from (h) at top of page.

(hhh) Determine by dividing the value of (ggg) by the value of (h) above.

(xx) Enter (xx) from Annual Total of (xx) above.

(iii) Determine by dividing the value of (xx) "Annual Total" by the value of (h) above.

FORM PEA-3

(b) Enter the building name and building identification number. Same as item (b) on form PEA-1.

(b1) Enter component institution's name and ID number.

(jjj) Enter full name of designated Building Energy Manager if there is a person designated to monitor and evaluate energy use. If there is no Energy Manager, write "N.A."

(kkk) Place an "X" in the appropriate response blank. Draw a horizontal line through the other response.

(lll) Place an "X" in the appropriate response blank. Draw a horizontal line through the other response.

(mmm) Enter descriptive phrase for each system studied; such as, "lighting system," "ventilation system," "chilled water system," "air distribution system," "hydraulic system," "piping insulation system," etc.

(nnn) Place an "X" in the appropriate response blank. Draw a horizontal line through the other response.

(ooo) Enter descriptive phrase for each energy conservation measure considered or implemented; such as, "local light switch decals," "thermostat adjustment," "reset air delivery temperatures," "reset chilled water temperatures," "automatic duty-cycling of equipment," "unoccupied hours shut down," "reduced lighting levels," "added more local control switching," "increased filter maintenance schedule," "reduced outside air quantities," "installed electric metering," "installed fuel metering," "changed use schedules," "adjusted housekeeping schedules," "increased routine maintenance," "scheduled control system checkout, " etc.

(ppp) Enter general comments and observations which contribute to further definition of energy using character of building.

(rrr) Place an "X" in the appropriate response blank.

FORM PEA-4

(b) Enter the building name and building identification number. Same as (b) on PEA-1.

(b1) Enter component institution's name and ID number.

Items 1 through 11 are information requests regarding the building site, construction, and heating and domestic water systems as related to solar energy application potential. Item 12 refers to other potential renewable resource energy source applications. Auditor to mark all positive responses in various blank spaces with an "X". Draw a single, horizontal dash line through all other blank spaces not applicable to building audited.

FORM PEA-5

(b) Enter the building name and building identification number. Same as Item (b) on Form PEA-1.

(b1) Enter component institution's name and ID number.

(ttt) Chart of Potential Energy Savings. This information is optional; and it may be used by you to determine the energy savings potential of your buildings. The sum of all the circled weighting factors may be used for the comparison of buildings. The highest total of the weighting factors will have the highest potential for saving energy. With the assistance of a set of building construction blueprints and other personnel in the physical plant department, school district office, etc., the Auditor shall locate the appropriate "Range" of values for each of the thirteen "building characteristics" and circle the appropriate weight. Since some of the following data may not be readily available, it may be necessary in some cases to provide a best estimate based on your knowledge of the building. The following instructions apply to each numbered "building characteristics":

1.0 Refer to the value of EUI, expressed as BTU/FT^2/YR on Form PEA-2.

2.0 Total the "Occupied" or "Utilized" hours, Items (j) plus (k) on Form PEA-1, and divide that value by the total annual operating hours of the HVAC system.

3.0 Add together the BTUH heating output rating of all boilers, or heat exchangers, or heating coils and the BTUH cooling rating of all chillers, or cooling coils. If building is served on a central plant add only the heat exchanger and total cooling coil capacities. The object is to obtain the actual net capacity of the heating and cooling equipment serving this building. Divide the above net total capacity by 1,000,000 to obtain the combined rated heating and cooling capacity in millions BTUH. Do not include any equipment used or designed strictly for standby service. Circle the appropriate BTUH "WF".

4.1 Determine building age category bracket and estimate remaining useful life remaining. If building has less than a 5 year life expectancy (either new or old) audits should not proceed past the PEA.

4.2 From building blueprints or estimate, determine the percent glass of the exterior building envelope wall area within the broad range of over or under 40% glass or under 15% glass. Make a judgement as to large infiltration (light wall construction without good caulking. large amount of fixed wall louvers, etc.) or low filtration (tight wall construction, good caulking, low number of wall openings). Mark only one value which best describes this building condition.

4.3 From building electrical lighting plans or estimate, determine the present building lighting load expressed as average watts per gross square foot of building area. For example, if you circle the weight "6.3" for the value, "Reduced to 3.0 w/sq. ft.", it means that you have already reduced the present building lighting load to about 3.0 w/sq. ft. and there is further potential for reducing the lighting load.

4.4 From building HVAC plans, other documents, or quick inspection, identify the predominant building HVAC system type. Many buildings have more than one single type of HVAC system. This PEA needs the predominant type information. Circle only one "WF" which applies.

4.5 From HVAC schedules on plans or other documents determine the normal design percentage of outside air for this building. This value should be an average for the building. Some building fan-coil units may have 100% O.A. and others in building may have other percentages. Estimate or calculate the average O.A. percentage for the entire building and circle the appropriate "WF".

4.6 Air distribution energy consumption is primarily a function of fan operating static pressure. If these values are not readily available, installed fan horsepower may be a good indicator. Again, consider this value on the basis of average fan conditions for the entire building. Determine either "Static Pressure" range or "Gross Sq.Ft./Fan HP" range and circle only one "WF".

FORM PEA-6

(b) Enter the building name and building identification number. Same as item (b) on Form PEA-1.

(b1) Enter component institution's name & ID number.

4.7 This is a judgement of the present operating conditions of the HVAC temperature control systems. Circle most applicable "WF".

4.8 Estimate the percentage of the building's total energy consumption which is used for base functional process loads such as lab equipment, domestic hot water, sterilizers, kilns, shop equipment, data processors, etc. Circle most applicable "WF".

4.9 This refers to the feasibility of recovering energy from "high outside air" building systems. Will indicate application for "Air Heat Recovery Wheels," "Heat Pipe Coils," or "Run-Around Cycle" coils. Circle most applicable "WF".

4.10 The functional use of the building may or may not be able to tolerate the disruptions caused by the installation of major systems retrofit projects. Encircle the most applicable "WF".

uuu Indicate the appropriate "WF" for each "ITEM" and add them to obtain a "TOTAL". The maximum possible score is 90 and the minimum possible score is 50. The higher the score, the higher the potential for saving energy in the building.

CONTINUED

3 OF 5

(SAMPLE) PRELIMINARY ENERGY AUDIT

AUDIT DATE: (a1) 13 Jan. 1980

FORM PEA-1

U.T. HEALTH SCIENCE CENTER-S.A.-402 — (a) COMPONENT INSTITUTION NAME & I.D. NO.

DENTAL SCHOOL - 016 — (b) BUILDING

7703 FLOYD CURL DR., SAN ANTONIO, TEXAS 78284 — (c) BUILDING ADDRESS

HOSPITAL — (d) CATEGORY OF BLDG.

OTHER (DENTAL) — (e) BUILDING USE CATEGORY

JAMES WILLIAMSON, 7703 FLOYD CURL DR., SAN ANTONIO, TEXAS 78284 (512) 651-6639 — (f) BUILDING OPERATOR NAME, ADDRESS & TELEPHONE (WORK)

UT SYSTEM, 210 W. 6TH ST., AUSTIN, TEX 78701 — (g) NAME AND ADDRESS OF OWNER — PUBLIC (X) PRIVATE NON-PROFIT ( ) INDIAN TRIBE ( )

(jj) PEA AUDITOR NAME, ADDRESS & TELEPHONE: (WORK) GORDON C. JONES, 8031 BROADWAY, SAN ANTONIO, TEX. 78209 (512) 978-4317

I BASIC BUILDING DATA

BUILDING SIZE (h)	OPERATING SCHEDULE				(m) PARTIAL USAGE (n)		
	DAYS	TIME PERIOD: HRS/OCCUPANTS/% GSF (j) DAYLIGHT	(k) EVE	(l) NITE	QTR	WEEKS	% GSF
453,770	M-F	10/1400/100	4/200/50	8/25/10	1st	N.A.	—
DATE (i) CONSTRUCTED	SAT	10/150/75	4/25/10	8/25/10	2nd	N.A.	—
1975	SUN	12/25/10	4/25/10	8/25/10	3rd	12	75
					4th	N.A.	—

BASIC HVAC CONTROL DATA

CENTRAL BLDG. PANEL (q) YES — NO X

"FCMS" CONNX (s) YES X NO —

II MAJOR ENERGY USING SYSTEMS

PRIMARY HEAT SOURCE (u)	PRIMARY COOLING SOURCE (v)	SPACE TERMINAL HEAT (w)	SPACE TERMINAL COOLING (x)	DOMESTIC HOT WATER SOURCE (y)	INTERIOR LIGHTING SYSTEM (z)	SPECIAL BUILDING SYSTEMS & FACILITIES (aa)
PURCHASED STEAM	PURCHASED CHILLED WATER	DOUBLE DUCT	DOUBLE DUCT	STEAM GENERATOR STORAGE	INCAN. 5 % FLUOR. 80 % H.I.D. 15 %	(1) CHEMISTRY LABS (2) BIOLOGY LABS (3) ANIMAL RESOURCE LAB (4) OPERATING ROOMS

III UNIQUE BUILDING CHARACTERISTICS

1. YEAR ROUND, 24 HR. PER DAY OPERATION YES — NO X (bb)
2. 9 MONTH PER YEAR OPERATION YES X NO — (cc)
3. SUMMER PROGRAM USE YES X NO — (dd)
4. EVENING CLASS SCHEDULE YES X NO — (ee)
5. BUILDING HAS EXTERIOR FLOODLIGHTING YES — NO X (ff)
6. LIST YEAR & TYPE OF MAJOR BUILDING MODIFICATIONS AND ADDITIONS — TOTAL # OF MAJOR MOD. & ADD. 4
   (gg) (1) 1976 - ADDED A/C TONNAGE TO OPERATING ROOMS
   (2) 1977 - INCREASED EXHAUST AIR IN ANIMAL RESOURCE LAB
   (3) 1978 - ADDED 43,661 SQ. FT. TO FACILITY
7. OTHER: (hh) 1978 - ADDED "FCMS" CONNX TO FACILITY

10-13

4-79 Revised 4/23/79

(SAMPLE) PRELIMINARY ENERGY AUDIT

FORM PEA-2

DENTAL SCHOOL - 016
(b) BUILDING NAME & I.D. NUMBER

453,770
(h) BUILDING SIZE (GROSS SQ.FT.)

UTHSC - S.A. - 402
(b1) COMPONENT INSTITUTION NAME & I.D. NUMBER

IV ENERGY USE & COST DATA (ii) FOR YEAR ENDING AUG. 31, 1979 METERED X BEST ESTIMATE

MONTH	ELECTRICITY			NATURAL GAS			OIL - #2 or # ____			PURCHASED THERMAL				TOTAL ENERGY COSTS $ (xx)
										STEAM-HOT WATER		CHILLED WATER		
	KWH (jj)	COST $ (kk)	$/KWH (ll)	MCF (mm)	COST $ (nn)	$/MCF (oo)	GAL (pp)	COST $ (rr)	$/GAL (ss)	MMBTU ~~OR LBS~~ (tt)	COST $ (uu)	TON HRS (vv)	COST $ (ww)	
SEPTEMBER	1,001,716	28,580	.0285	13	38	2.88	N.A.	N.A.	N.A.	808	→ (ww)	677,876	57,271	85,889
OCTOBER	1,085,621	31,906	.0294	26	65	2.52				1,425		395,472	49,165	81,136
NOVEMBER	1,011,990	34,060	.0337	24	59	2.42				1,936		188,814	42,573	76,712
DECEMBER	960,620	26,698	.0278	16	39	2.40				2,062		87,741	40,264	67,001
JANUARY	970,894	24,790	.0255	19	53	2.73				5,587		78,811	47,357	72,200
FEBRUARY	996,579	27,899	.0280	30	72	2.37				4951		79,754	46,530	74,501
MARCH	989,730	27,565	.0279	25	54	2.19				3,151		191,924	50,034	77,653
APRIL	1,071,922	30,491	.0284	30	73	2.40				1,548		275,682	46,999	74,463
MAY	1,042,813	28,487	.0273	27	64	2.38				953		544,971	55,233	83,784
JUNE	1,015,415	28,003	.0276	48	118	2.46				979		633,540	58,321	86,442
JULY	1,104,457	29,871	.0270	34	154	2.57				986		688,306	61,820	91,845
AUGUST	1,039,388	27,195	.0260	63	156	2.48				1,031		685,488	61,892	89,243
ANNUAL TOTALS	① 12,291,146	345,547	AVG. .0281	② 364	944	AVG. 2.57	③		AVG.	④ 25,418		⑤ 4,528,359	617,379	960,865

ANNUAL ENERGY CONSUMPTION IN BTU'S: (10^6 identifies the number in millions)

(1) (yy) Electricity 12,291,146 KWH X 0.0116 = 142,577 $\times 10^6$ BTU
(2) (zz) Nat. Gas 364 MCF x 1.03 = 374 $\times 10^6$ BTU
(3) (aaa) Fuel Oil #2 N.A. GAL X 0.138690 = N.A. $\times 10^6$ BTU
(4) (bbb) Fuel Oil #6 N.A. GAL X 0.149690 = N.A. $\times 10^6$ BTU
(5) (ccc1) Steam/Hot Water 25,418 MMBTU X 1.0 = 25,418 $\times 10^6$ BTU
or
(6) (ccc2) Steam N.A. LBS X 0.001390 = N.A. $\times 10^6$ BTU
(7) (ddd) Chilled Water 4,528,359 TON HRS X 0.012 = 54,340 $\times 10^6$ BTU
(8) (eee) Propane or Butane N.A. GAL X 0.095475 = N.A. $\times 10^6$ BTU

N.A. X(fff)____ = N.A. $\times 10^6$ BTU
Other Fuel

(ggg) TOTAL ANNUAL BTU'S = 222,709 $\times 10^6$ BTU

ENERGY UTILIZATION INDEX (EUI)

EUI = TOTAL ANNUAL BTU'S / BUILDING GROSS SQ. FT. = BTU's/FT^2/YR

EUI = (ggg) 222,709,000,000 / (h) 453,770

EUI = (hhh) 490,797 BTU's/FT^2/YR

ENERGY COST INDEX (ECI)

ECI = TOTAL ANNUAL ENERGY COSTS / BUILDING GROSS SQ. FT. = $/FT^2/YR

ECI = (xx) TOTAL 960,865 / (h) 453,770

ECI = (iii) $ 2.12 $/FT^2/YR

10-74 Revised 5/1/79 4-79

(SAMPLE) PRELIMINARY ENERGY AUDIT

DENTAL SCHOOL -016
(b) BUILDING NAME & I.D. NUMBER

U.T.H.S.C.-S.A. - 402
(b1) COMPONENT INSTITUTION NAME & I.D. NUMBER

FORM PEA-3

V ENERGY CONSERVATION ACTIVITIES

1. NAME OF ENERGY MANAGER FOR BUILDING: (jjj) JACK ARMSTRONG
2. HAS WORK WHICH PARTIALLY OR FULLY SATISFIES THE REQUIREMENTS OF AN ENERGY AUDIT ON THIS BUILDING BEEN ACCOMPLISHED PRIOR TO THIS "PEA" DATE? — YES, X NO. (kkk)
3. HAVE ANY DETAILED ENGINEERING STUDIES BEEN CONDUCTED ON THIS BUILDING OR ITS SYSTEMS PRIOR TO THIS "PEA" DATE? X YES — NO. (lll) IF "YES" NAME SYSTEMS STUDIED. (mmm) (1) HEAT RECOVERY SYS. IN ANIMAL RESOURCE LAB (2) STATIC PRESSURE BALANCING HVAC.
4. HAVE ANY ENERGY CONSERVATION MEASURES BEEN CONSIDERED OR IMPLEMENTED ON THIS BUILDING PRIOR TO THIS "PEA" DATE? X YES — NO. (nnn) IF "YES" LIST THESE MEASURES BELOW WITH ESTIMATES OF THEIR COSTS & ENERGY SAVINGS, IF AVAILABLE:

10-15

(ooo) (1) UNOCCUPIED AREA VENT. SYS. SHUT DOWN/ $0.00/ 2500 MMBTU/YR

(2) BALANCED HVAC SYS. STATIC PRESS/ $1200.00/ N.D.A.

(3) TIME SCHEDULING HVAC SYS./ $3500.00/ 1500 MMBTU/YR

(4) LOAD SHED PROGRAM HVAC CONTROL/ $11,500.00/ 3300 MMBTU/YR

(5) ECONOMY CYCLE HVAC SYS./ $18,000.00/ 5000 MMBTU/YR

4-79

5. GENERAL AUDIT COMMENTS: (ppp) —NONE—

6. DO YOU INTEND TO CONDUCT AN "ENERGY AUDIT" OF THIS BUILDING? (rrr) YES X NO —

DENTAL SCHOOL - 016
(b) BUILDING NAME & I.D. NUMBER

U.T.H.S.C. - S.A. - 402
(b1) COMPONENT INSTITUTION NAME & I.D. NUMBER

FORM PEA-4 4-79

VI RENEWABLE ENERGY RESOURCE POTENTIAL

1. BUILDING LOCATION: — URBAN, X SUBURBAN, — RURAL AREA. 2. BUILDING HEIGHT: 5 STORIES.
3. IS OPEN LAND SUCH AS FIELDS, YARDS, PARKING AREAS, WHICH IS NOT HEAVILY SHADED BY TALL BUILDINGS, TREES, OR OTHER OBSTRUCTIONS AVAILABLE IN THE IMMEDIATE VICINITY OF THE BUILDING? — YES X NO.
4. IS APPROXIMATELY ONE-HALF OR MORE OF THE BUILDING'S ROOF AREA OR SOUTHERN ORIENTED WALL SURFACES HEAVILY SHADED BY TREES, SHRUBS, BUILDINGS OR OTHER OBSTRUCTIONS? — YES X NO.
5. GENERAL DESCRIPTION OF BUILDING SHAPE: — SQUARE, X RECTANGULAR, — H-SHAPED, — E-SHAPED. — T-SHAPED, — L-SHAPED, — X-SHAPED, — Y-SHAPED, — O-SHAPED.
6. ROOF DATA: X FLAT, — PITCHED. IF PITCHED, IS PITCH ORIENTED TO SOUTH? N.A. YES N.A. NO.
7. EXISTING ROOF OBSTRUCTIONS: — NONE, — CHIMNEYS, — SPACE CONDITIONING UNITS, — WATER TOWERS, X EQUIPMENT PENTHOUSES, X STAIRWELLS, — OTHER PERMANENT ROOF MOUNTED STRUCTURES.
8. SOUTH FACING WALL MATERIALS: X MASONRY, — WOOD, — ALUMINUM, — GLASS, — STEEL, — COMBINATION.
9. SOUTH FACING WALL GLASS AREA: X LESS THAN 25%, — 25-75%, — MORE THAN 75%.
10. PRIMARY SPACE HEATING SYSTEM: — OUTSIDE BUILDING, X INSIDE BUILDING; IF INSIDE BUILDING, IS IT LOCATED — IN BASEMENT, X ON GROUND FLOOR, — ON ROOF? IS INSIDE BUILDING HEATING SYSTEM OF — CENTRAL TYPE, X MULTIPLE UNITS, OR — COMBINATION OF BOTH?
11. PRIMARY DOMESTIC HOT WATER SYSTEM: — OUTSIDE BUILDING, X INSIDE BUILDING: IF INSIDE BUILDING IS IT LOCATED X IN BASEMENT, — ON GROUND FLOOR, — ON ROOF? IS INSIDE BUILDING DOMESTIC HOT WATER SYSTEM OF X CENTRAL TYPE, — MULTIPLE UNITS, OR — COMBINATION OF BOTH?
12. ARE ANY OF FOLLOWING ENERGY SOURCES AVAILABLE TO THIS IMMEDIATE BUILDING LOCATION? (a) YEAR AROUND STEADY, CONSTANT WIND VELOCITIES, 10 MPH MINIMUM — YES X NO. (b) NATURAL WATER STREAM OF MINIMUM 10 FOOT HEAD, CONSTANT YEAR AROUND FLOW — YES X NO. (c) NATURAL HOT GROUND WATER WELLS (GEOTHERMAL WELLS) — YES X NO. (d) SEACOAST TIDES OF 8 FOOT OR GREATER — YES X NO. (e) SOURCE OF LOW COST FOREST TIMBER BY-PRODUCTS — YES X NO. (f) ANY OTHER RENEWABLE ENERGY SOURCE — YES X NO; IF YES, DESCRIBE N.A.

10-16

(SAMPLE) PRELIMINARY ENERGY AUDIT

DENTAL SCHOOL - 016
(b) BUILDING NAME & I.D. NUMBER

U.T. H.S.C. - SA - 402
(b1) COMPONENT INSTITUTION NAME & I.D. NUMBER

VII BUILDING ENERGY SAVING POTENTIAL

(ttt) CHART OF POTENTIAL ENERGY SAVINGS

1.0 ANNUAL ENERGY USE: (SEE EUI PAGE PEA-2)

BTU/SQ.FT./YR.	WF
400,000 AND ABOVE	9
300,000 TO 400,000	8
200,000 TO 300,000	7
100,000 TO 200,000	6
LESS THAN 100,000	5

2.0 RATIO OF OCCUPANCY/SPACE UTILIZATION HOURS TO HVAC EQUIPMENT OPERATING HOURS:

$\frac{\text{OCCUPANCY/UTILIZATION HRS.}}{\text{HVAC OPERATING HOURS}}$ = RATIO

UNDER 0.20	14.4
0.2 TO 0.4	12.8
0.4 TO 0.6	11.2
0.6 TO 0.8	9.6
0.8 TO 1.0	8.0

3.0 RATED CAPACITY OF HEATING & COOLING EQUIPMENT:

COMBINED HVAC CAPACITY IN BTUH X 10^6	
40 AND ABOVE	9
25 TO 40	8
15 TO 25	7
5 TO 15	6
BELOW 5	5

BUILDING MODIFICATION POTENTIAL:

4.1 BUILDING AGE & REMAINING LIFE (R.L.)

	WF
NEW (1-5 YRS) OVER 40 YR. R.L.	3.6
NEW (1-5 YRS) UNDER 40 YR. R.L.	3.2
RECENT (5-15 YRS) OVER 40 YR. R.L.	2.8
RECENT (5-15 YRS) UNDER 40 YR. R.L.	2.4
OLD (OVER 15 YRS)	2.0
OLD (OVER 15 YRS) LESS THAN 5 YR. R.L.	0.0

4.2 TOTAL WALL AREA PERCENT GLASS & INFILTRATION:

% GLASS RANGE	
OVER 40% GLASS	4.5
LARGE INFILTRATION	4.0
UNDER 40% GLASS	3.5
LOW INFILTRATION	3.0
UNDER 15% GLASS	2.5

4.3 LIGHTING LEVELS POTENTIAL REDUCTION:

RANGE	
REDUCED TO 3.0 W/SQ.FT.	6.3
REDUCED TO 2.0 - 3.0 W/SQ.FT.	5.6
REDUCED TO 1.0 - 2.0 W/SQ.FT.	4.9
CAN REDUCE BY SWITCHING CHANGES	4.2
LIGHTING LEVELS CANNOT BE REDUCED	3.5

4.4 PREDOMINANT HVAC SYSTEM:

TYPE	WF
DUAL DUCT OR REHEAT	12.6
MULTIZONE OR INDUCTION UNITS	11.2
ROOFTOP, PACKAGED WALL UNITS, OR UNIT VENTILATION	9.8
FAN-COIL, VAV, OR HEAT/VENT ONLY UNITS	8.4
RADIATION, UNIT HEATERS (NO FAN SYS.)	7.0

4.5 NORMAL OUTSIDE AIR SUPPLY PERCENTAGE:

RANGE	WF
75 TO 100%	8.1
50 TO 75%	7.2
25 TO 50%	6.3
10 TO 25%	5.4
INFILTRATION ONLY WITH TOILET EXHAUST	4.5

4.6 FAN ENERGY:

FAN STATIC PRESS.	GROSS BLDG. SQ.FT./FAN HP	WF
10" OR ABOVE	≅ 200 SQ.FT./HP	5.4
8" SP TO 10" SP	≅ 600 SQ.FT./HP	4.8
6" SP TO 8" SP	≅ 1000 SQ.FT./HP	4.2
4" SP TO 6" SP	≅ 1500 SQ.FT./HP	3.6
UNDER 4" SP	≅ 2000 SQ.FT./HP	3.0

FORM PEA-5 4-79 Revised 5/1/79

(SAMPLE) PRELIMINARY ENERGY AUDIT

FORM PEA-6 4-79 Revised 5/1/79

DENTAL SCHOOL - 016
(b) BUILDING NAME & I.D. NUMBER

U.T.H.S.C. - SA - 402
(b1) COMPONENT INSTITUTION NAME & I.D. NUMBER

VII BUILDING ENERGY SAVING POTENTIAL (CONT'D)

CHART OF POTENTIAL ENERGY SAVINGS (Continued)

4.7 HVAC CONTROL SYSTEM:

CONDITION	WF
OUTSIDE AIR & RELIEF DAMPERS HANG OPEN	5.4
INOPERATIVE CONTROLS	4.8
NO WRITTEN PREVENTIVE MAINT. PROGRAM	4.2
CONTROLS ARE SERVICED REGULARLY	3.6
CONTROLS UNDER MAINTENANCE CONTRACT	3.0

4.8 BUILDING PROCESS ENERGY BASE LOAD:

% OF TOTAL LOAD	WF
20% BASE LOAD - COULD REDUCE	2.7
15% BASE LOAD - COULD REDUCE	2.4
10% BASE LOAD - COULD REDUCE	2.1
5% BASE LOAD - COULD REDUCE	1.8
NO REDUCTION OF BASE LOADS POSSIBLE	1.5

4.9 HVAC HEAT RECOVERY:

RANGE	WF
100% O.A., RECOVERY FEASIBLE	4.5
75% O.A., RECOVERY FEASIBLE	4.0
50% O.A., RECOVERY FEASIBLE	3.5
100% O.A., RECOVERY DIFFICULT	3.0
HEAT RECOVERY NOT FEASIBLE	2.5

4.10 USER RETROFIT TOLERANCE:

RANGE	WF
USER CAN TOLERATE MAJOR RETROFIT	4.5
USER CAN TOLERATE MINOR RETORFIT	3.5
USER CANNOT TOLERATE ANY DISRUPTIONS	2.5

ENERGY SAVING POTENTIAL TABULATION (uuu)

ITEM	WF
1.0 ANNUAL ENERGY USE	9.0
2.0 RATIO UTILIZ. HRS. TO OPER. HRS.	11.2
3.0 RATED CAP. OF HVAC EQUIP.	9.0
4.1 BUILDING AGE & LIFE EXPECT.	3.6
4.2 PERCENT GLASS & INFILTRATION	2.5
4.3 LIGHTING LEVELS	5.6
4.4 HVAC SYSTEM TYPE	12.6
4.5 OUTSIDE AIR RATIO	8.1
4.6 FAN ENERGY	3.6
4.7 HVAC CONTROL SYSTEM	3.6
4.8 BUILDING BASE LOAD	2.4
4.9 HVAC HEAT RECOVERY	3.0
4.10 USER RETROFIT TOLERANCE	3.5
TOTAL	77.7

5/11/80
4/23/79
Revised

ENERGY AUDIT PROCEDURES

The purpose of the Energy Audit (EA) is to provide a survey of the building audited which:

(1) Identifies the type, size, energy use level and major energy using systems;

(2) Determines appropriate energy conservation maintenance and operating procedures; and

(3) Indicates the need, if any, for the acquisition and installation of energy conservation measures.

These forms; EA-1, EA-2, EA-3, and EA-4, are designed to gather this basic information with a minimum of on-site effort. The EA Auditor will complete these forms by working with the Component Institution's Physical Plant Department, the Component Institution's Energy Manager, and by visual observation of the building.

The numerical entries are to be obtained from Component Institution's records, Component Institution's best estimates, and by simple mathematical multiplication and division operations. All EA form entry blanks must have an entry. If there is no appropriate information, the entry may be noted as follows:

"[illegible]A" No Data Available
"NA" Not Applicable to This Building

Draw a straight horizontal line through spaces or blanks if a particular condition does not exist to show that the space was not overlooked. All check marks will be made with an "X" indicating positive response to question.

The following procedures provide instructions for completing the EA Forms: The small case alphabet letters in parentheses key to the form entry data. All addresses called for to be complete, current street addresses including ZIP code. Provide telephone numbers if available.

Forms EA-1, EA-2, EA-3, and EA-4, dated 4/79 are designed to meet requirements of Federal Register dated April 2, 1979, Vol. 44, No. 64, paragraph 450.43.

As the Forms PEA-1, PEA-2, PEA-3, and PEA-4 are requirements of the Energy Audit, they must be attached to the Energy Audit Forms. The Energy Audit (EA) Forms and Preliminary Energy Audit (PEA) Forms must be attached to any applications for Technical Assistance (TA) and Energy Conservation Measures (ECM).

FORM EA-1 INSTRUCTIONS

(a) Enter the calendar date on which the EA is completed.

(b) Enter the Building and Identification Number as provided by the owner.

(b1) Enter Component Institution's Name and I.D. Number. The Component Institution should be the same as identified on the PEA forms.

(c) Enter Building Size expressed in gross square feet as measured from the outside perimeter of the building, excluding major areas which are neither heated nor cooled such as attached parking garages.

(c1) Enter name and street address of "Owner."

(d) thru
(f1) Place an "X" in these blank spaces upon completion of Forms PEA-1, PEA-2, PEA-3, PEA-4, PEA-5, and PEA-6.

(g) Enter general description of planned changes for the next fifteen years such as "building to be demolished in 3 years," "major rehabilitation planned," "change from classroom use to dormitory use," "change from teaching space to office space," etc.

(h) thru
(x) On this form to be completed only for buildings over 200,000 gross square feet in size. Enter "N.A." in all blank spaces if building is less than 200,000 square feet gross area.

(h) Enter annual peak electrical demand in KW, if available. Enter "NDA" if data is not available.

(h1) Enter months during annual period when monthly peak electrical demand within $\pm$ 10% of maximum demand occurs. Enter "NDA" if data is not available.

(j) Enter days of weekly cycle (Mon., Tues., etc.) when peak electric demand occurs. Enter "NDA" if data is not available.

(k) Enter hour of day (9:00 a.m., 2:30 p.m., etc.) when peak electric demand occurs. Enter "NDA" if data is not available.

(l) Enter name of the major mechanical or electrical building systems such as "HVAC," "Food Prep.," "Data Processing," "Lighting," "Elec. Htg.," etc.

(m) Enter electrical KWH consumption, if applicable, of the major systems entered in (l) above.

(n) Convert KWH to BTU by use of conversion factor in (x) below and enter value in table.

(o) Enter "MCF" natural gas consumption, if applicable, of the major systems entered in (l) above.

(p) Convert MCF to BTU by use of conversion factor in (x) below and enter value in table.

(r) Enter "Gallons" of fuel oil (note Fuel Oil Grade if different from #2 grade) consumption, if applicable, of the major systems entered in (l) above.

(s) Convert "Gal" to BTU by use of conversion factor in (x) below and enter value in table.

(t) Enter "BTU value" of Steam/Hot Water (strike through inapplicable energy source) consumption, if used, by the major systems entered in (l) above. If metered on MMBTU unit basis, enter MMBTU by use of conversion factor in (x) below and enter value in table.

(u) Enter "Ton-Hours" of chilled water consumption, if applicable, of the major systems entered in (l) above.

(v) Convert "Ton-Hours" to BTU by use of conversion factor in (x) below and enter value in table.

(w) Enter the total of BTU values developed in (n), (p), (s), (t), and (v).

(x) BTU conversion factor table for use in determining above table entries. These blanks are to be used to convert only the values for table 2.2 above or other major energy fuel types and are not intended to account for entire building consumption. If major fuel types other than those mentioned in table 2.2 above are used, cross out the unused fuel types and insert the appropriate fuel types.

3.0

(y) Describe general building conditions, such as age and condition of lighting fixtures, building envelope and window condition, equipment repair and condition, piping and electrical feeder conditions, thermal insulation condition, etc.

FORM EA-2 INSTRUCTIONS

(b) Enter the Building Name and Identification Number.

(b1) Enter Component Institution's Name and I.D. Number.

(c) Enter building size expressed in gross square feet as measured from the outside perimeter of the building, excluding areas which are neither heated nor cooled.

(4.1)&(4.2)&(4.3)B Enter average annual heating degree days and cooling degree days, and average monthly wind velocity in mph taken from 1978 Annual Summary of Climatological Data for the geographic location of the building as published by the National Oceanic and Atmospheric Administration, National Weather Service.

(4.3)A Enter Average Solar Insolation by month for nearest reporting city to building being audited. See "Input Data for Solar Systems" by Cinquemani, Owenby & Baldwin, published by the National Climatic Center, 1978, National Weather Service, Asheville, N.C. included in Energy Auditor Training Manual. In order to obtain the monthly insolation figure to be entered in 4.3A, multiply the mean daily Btu/Ft^2 by month times the number of days in the month.

(z) thru
(ff) The purpose of this data is to illustrate, if possible, the percentage reduction in energy consumption in this building due to changes in maintenance and operating procedures which have been implemented in the past. It is intended that the reduced energy consumption be a result of changes in maintenance and operating procedures and not as a result of weather variances, retrofit actions, or changes in occupancy patterns. If it can be illustrated that energy consumption (BTU/SQ.FT.) has been reduced by not less than 20 percent from a base year in the past to a subsequent year, then it will not be necessary to conduct an on-site energy audit identifying further maintenance and operating procedures; otherwise, an on-site energy audit is required. However, the maintenance and operating procedures which were implemented and resulted in the 20 percent or greater reduction in energy consumption must be listed in (gg) below; if additional space is required beyond the space provided in (gg), attach additional pages. If (ll), "% REDUCTION FROM BASE YEAR" is 20% or greater, it is not necessary to complete Form EA-3 except for instruction (gg) on following page; instead, you may proceed to complete Form EA-4. If an on-site audit is not conducted because of a past 20% or greater energy reduction, it is highly likely that an on-site review of the building's utility billings, occupancy records, and past retrofit actions will be a part of the sample followup review process required of the Governor's Office of Energy Resources by Federal rules.

(z) Enter fiscal years applicable to data entered in table. The last year in the table should be the most recent full year. The first year in the table should be the Base Year from which the energy reduction is measured. The Base Year would be the year just prior to the maintenance and operating procedures changes you are identifying as the cause for the energy reduction. The second fiscal year entry will be the Comparison Year which must be a year subsequent to the Base Year. Also, there must be a variance of less than 10 percent between the total number of annual degree days (heating plus cooling) of the Comparison Year and the total annual degree days of the Base Year. The Last Full Year may also be used as the Comparison Year. Enter the total degree days for each appropriate fiscal year in the same entry space just below the fiscal year to which it relates.

(aa) thru
(dd) If major fuel types other than those listed in (aa) through (dd) are used, cross out the unused fuel types and insert the appropriate fuel types. The conversion factors used on page EA-1, table(x), should be used for calculating the BTU for each fiscal year.

(aa) Enter Annual Total electrical KWH consumption. Convert to BTU value using table(x) on Form EA-1. Enter BTU value.

(bb) Enter Annual Total natural gas MCF consumption. Convert to BTU value using table(x) on Form EA-1. Enter BTU value.

(cc) Enter Annual Total gallons of oil consumption. Convert to BTU value using table(x) on Form EA-1. Enter BTU value. Note fuel oil number if different than number 2 grade.

(dd) Enter Annual Total of Central Plant Thermal energy consumption. Convert to BTU value using table(x) on Form EA-1. Enter BTU value. If you are metered on MMBTU basis, remember to convert to BTU before entering the value on (dd).

(ee) Calculate total BTU per Gross Square Foot values for each fiscal year. Divide total BTU (ff) by Building Size (c), and enter at (ee).

(ff) Enter total BTU consumption as total of all horizontal entries for BTU for each fiscal year.

(gg) Enter brief description of "Maintenance Procedures" and "Operating Procedures" changes implemented during the above time span between the Base Year and the Comparison Year. Place small "✓" to left of each M & O change on Form EA-3 which has already been implemented on this building.

(hh) Enter the BTU per square foot (ee) for the Base Year.

(jj) Enter the lesser BTU per square foot (ee) of either the Comparison Year or the Last FullYear.

(kk) Subtract (jj) from (hh) and enter this value in both blanks marked (kk).

(ll) Enter (kk) divided by (hh) and place this value in blank (ll), % Reduction from Base Year.

FORM EA-3 INSTRUCTIONS

(b) Enter the Building Name and Identification Number.

(bl) Enter Component Institution's Name & I.D. Number.

(c) Enter Building Size expressed in gross square feet as measured from the outside perimeter of the building, excluding major space which is neither heated nor cooled.

Note: Part III, Blanks (mm) through (aaa) are to be completed only if the value of (ll), Form EA-2 is less than 0.20.

(mm) Indicate whether or not you recommend and support the established preventative maintenance plan by checking "Yes" or "No".

(nn) Indicate whether or not there is a scheduled preventative maintenance plan for the building by checking "Yes" or "No".

(oo) (rr) (tt) (vv) (xx) (zz) Circle the appropriate "VALUES" for percent of energy savings related to each "system change" recommended in the left-hand column. Total all circled "VALUES" for each category (e.g. VENTILATION SYSTEM OPERATION) and enter in the appropriate Subtotal line, oo, rr, tt, vv, xx, and zz.

(pp) (ss) (uu) (ww) (yy) (aaa) Enter Auditor's best estimate of the range of annual energy cost savings which could be realized if all of the listed "system changes" are implemented for this building. Enter the total of estimated cost savings in (pp) through (aaa) of each system change which was circled. This should be expressed as a range such as "2-6%", "8-12%", etc. The % cost will vary somewhat from % energy savings in that % cost will depend on which energy source is affected by the "system changes." That is, an electrical energy intensive savings will result in a greater cost savings than a natural gas energy savings change.

(zz) & (aaa) are applicable to Auditor's Entries of "Other" Maintenance and Operating Procedures.

NOTE: The primary purpose of the on-site energy audit is to identify maintenance and operating procedures which may be used to reduce energy consumption. All specific recommended maintenance and operating procedures changes relating to the System Changes on Form EA-3 which are to be initiated in this building or complex for the purpose of reducing energy consumption are to be recorded and kept on file at the institution for the purpose of establishing and monitoring an effective energy maintenance and operating procedures program.

FORM EA-4 INSTRUCTIONS

NOTE: Form EA-4, including Parts IV & V, is to be completed for all buildings regardless of identification of previous reductions in energy consumption.

(b) Enter the Building Name and Identification Number.

(b1) Enter Component Institution's Name and I.D. Number.

(c) Enter the Building Size expressed in gross square feet. Same as (c) on Form EA-1.

(bbb) Enter value of Annual BTU per gross square foot taken from entry (hhh), E.U.I., on Form PEA-2.

(ccc) Enter value of Annual Energy Cost per gross square foot taken from entry (iii), E.C.I., on Form PEA-2.

(ddd) Enter brief description of the physical condition of the Building Envelope. Such as "bad caulking & sealant condition;" "good tight construction;" "new, 3 yrs. old;" "single glaze, clear windows;" "needs masonry repainting;" "louvers in bad shape;" etc.

(eee) Enter brief description of the physical condition of the Building Energy Using Systems. Such as "thermal insulation in bad condition;" "pump seals are leaking;" "controls are malfunctioning;" "hot water generator needs replacement;" "controls are outdated;" "electrical switchgear is marginal;" "electrical service entrance is too small;" etc.

(fff) Auditor to enter brief description of his/her opinion as to need and potential for retrofit. Such as "large window areas could produce savings with new double glazing;" "temperature control system should be replaced;" "building is a good candidate for 100% O.A. economizer cycle retrofit;" "lighting system retrofit would reduce wattage input and increase lighting efficiency;" "the above E.U.I. is excessive for this building category, retrofit to reduce same;" "the above E.C.I. is below average for this building category - first level retrofit would not be cost effective;" etc.

3.0 Auditor to indicate "yes" or "no" whether or not the particular building site, building construction, existing equipment location, type of mechanical systems, etc., present an opportunity for solar system application to the building heating or cooling or domestic hot water systems.

(ggg) Auditor is to select the most obvious, cost effective, energy conservation retrofit project and enter description of same here.

(hhh) Enter an estimate of installed cost of ECP noted in (ggg) above.

(iii) Enter an estimate of annual energy cost savings which would result from the installation of the ECP noted in (ggg) above.

(jjj) Enter the mathematical dividend of (hhh), cost, divided by (iii), savings per year.

E N E R G Y   A U D I T

Energy Auditor Certification: I hereby certify that I, JOHN DOE (name of auditor), have participated fully in the Energy Auditor Training Program developed by the Governor's Office of Energy Resources conducted at UT-AUSTIN (address of training site) by UNIVERSITY OF TEXAS-JACK ALAN (Sponsoring Agency-Instructor) on MAY 7,8, 1979 (date), or in lieu of attending the training session, have completed — (# of classroom hrs) hours of educational courses and/or on-the-job experience in analyzing and/or operating the mechanical and electrical and other energy using systems of the type of building or complex being audited. I have attached a copy of official educational transcripts and/or resumes of previous applicable work experience including the address and telephone numbers of such employers if I have claimed past education and/or work experience in lieu of attending the official training program. I further certify that I am not responsible for the day-to-day operations of the building and that a full disclosure of any financial interest which I might have relating to this energy audit or any energy conservation measure is attached hereto. I also certify that the energy audit was conducted in accordance with the requirements set forth under 10 CFR Part 450, paragraph 450.43 of the regulation which was published in the Federal Register dated April 2, 1979.

John Doe	80-1-001	U.T. SAN ANTONIO	(a) 12 Feb. 1980
Signature of Energy Auditor	Energy Auditor Certificate Number	Organization of Auditor	Date

(SAMPLE)

FORM EA-1

(b) JOHN PEACE LIBRARY-0542
BUILDING

(c) 225,890
BUILDING SIZE (GROSS SQ.FT.)

FOLLOWING PEA FORMS COMPLETED ATTACHED HERETO:

(d) X PEA-1, (d1) X PEA-2, (e) X PEA-3, (e1) X PEA-4, (f) X PEA-5, (f1) X PEA-6

(b1) UT-SAN ANTONIO-401
COMPONENT INSTITUTION NAME & I.D. NUMBER

UNIVERSITY OF TEXAS SYS., 210 W. 6TH ST., AUSTIN, TEX 78701
NAME AND ADDRESS OF OWNER

THE CONTENT OF THIS AUDIT FORM IS DESIGNED TO MEET THE REQUIREMENTS OF FEDERAL REGISTER, APRIL 2, 1979. VOL. 44, No. 64, PARA. 450.43

I DESCRIPTIVE BUILDING DATA

1.0 LIST MAJOR CHANGES IN "FUNCTIONAL USE" OR "MODE OF OPERATION" PLANNED FOR NEXT 15 YEARS:

(g) CONVERT ONE-HALF OF FLOOR SPACE TO CLASSROOMS WITHIN NEXT FIVE YEARS

2.0 FOR BUILDINGS OVER 200,000 GROSS SQUARE FEET AREA, PROVIDE THE FOLLOWING FROM AVAILABLE DATA (AD) OR BY REASONABLE ESTIMATE (BE) IDENTIFY SOURCE IN ALL BLANKS.

2.1 PEAK ELECTRICAL DEMAND IN KW: (h) 461 KW

MONTHS (h1) JUNE, JULY, AUGUST. DAY (j) TUES, WED, THURS.

HOUR OF DAY (k) 4:30 PM, —, —.

2.2 PROVIDE BELOW THE ANNUAL ENERGY USE OF THE MAJOR BUILDING SYSTEM BY FUEL TYPE:

3.0 GENERAL BUILDING & SYSTEMS CONDITION:

(y) BUILDING IS THREE YEARS OLD AND IS IN EXCELLENT CONDITION

MAJOR SYSTEM (l)	ELECTRICITY KWH (m)	ELECTRICITY 10^6 BTU (n)	NATURAL GAS MCF (o)	NATURAL GAS 10^6 BTU (p)	#2 OIL GAL (r)	#2 OIL 10^6 BTU (s)	CENTRAL PLANT THERMAL STEAM-HOT WATER (t) 10^6 BTU	CHILLED WATER TON HRS.	CHILLED WATER 10^6 BTU	10^6 TOTAL BTU
HVAC	3,062,777	35,528	N.A.	N.A.	N.A.	N.A.	14,130	(u) 3,248,575	(v) 38,983	(w) 88,641
LIGHTING	1,814,350	21,046	N.A.	N.A.	N.A.	N.A.	—	—	—	21,046

BTU CONVERSION FACTORS (x) (10^6 identifies the number in millions)

ELEC.	3,062,777 KWH	x 0.011,600 =	35,528 10^6 BTU	STEAM/HW	14,130	MMBTU x 1.0	=	14,130	10^6 BTU
NAT.GAS.	N.A. MCF	x 1.03 =	N.A. 10^6 BTU	STEAM	N.A.	LBS x 0.001,390	=	N.A.	10^6 BTU
OIL #2	N.A. GAL	x 0.138,690 =	N.A. 10^6 BTU	CH.WATER	3,248,575	TON HR x 0.012,000	=	38,983	10^6 BTU
OIL #6	N.A. GAL	x 0.149,690 =	N.A. 10^6 BTU	OTHER		x	=		10^6 BTU
				OTHER		x	=		10^6 BTU

4/79 Revised 4/23/79 Revised 5/1/79

(SAMPLE)

E N E R G Y   A U D I T

(b) JOHN PEACE LIBRARY - 0542
BUILDING NAME

(c) 225,890
BUILDING SIZE (GROSS SQ. FT.)

(b1) U.T. SAN ANTONIO - 401
COMPONENT INSTITUTION NAME & I.D. NUMBER

I DESCRIPTIVE BUILDING DATA (CONTINUED)

4.0 CLIMATIC FACTORS:

4.1 AVERAGE ANNUAL HEATING DEGREE DAYS 1570

4.2 AVERAGE ANNUAL COOLING DEGREE DAYS 2994

4.3 AVERAGE MONTHLY SOLAR INSOLATION, HORIZONTAL SURFACES IN BTU/SQ.FOOT AND WIND VELOCITY IN MPH

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
SOLAR (A)	27,757	33,466	44,950	48,369	58,730	62,070	65,754	60,360	49,140	41,853	30,267	26,260
WIND VEL.(B)	9.1	9.8	10.5	10.6	10.1	10.1	9.1	8.5	8.5	8.4	8.9	8.6

5.0 ROOF CHARACTERISTICS:

5.1 PRIMARY STRUCTURAL COMPONENT: — STEEL, — WOOD, X REINF. CONC., — OTHER, SPECIFY —

5.2 ROOF SURFACE: X BUILT UP, — SLATE, — TILE, — WOOD SHINGLES, — COMP. SHINGLES, — OTHER —

II ENERGY CONSERVATION MAINTENANCE & OPERATION PROCEDURES

1.0 COMPLETE FOLLOWING TABLE USING ANNUAL TOTALS FOR FISCAL YEARS ENTERED, CONVERSION FACTORS LISTED ON FORM EA-1, & TOTALS OF BTU CONSUMPTION PER YEAR. PROVIDE INFORMATION FOR INDIVIDUALLY METERED BUILDINGS ONLY, USE ACTUAL DATA. (10^6 identifies the number in millions)

FISCAL YEAR (z)	ELECTRICITY (aa)		NATURAL GAS (bb)		#2 OIL (cc)		CENTRAL PLANT THERMAL (dd)			(ee)	TOTAL BTU/GROSS SQ. FT.*
	KWH	BTU × 10^6	MCF	BTU × 10^6	GAL	BTU × 10^6	STEAM-HOT WATER MMBTU	CHILLED WATER TON HRS.	CHILLED WATER BTU × 10^6	(ff)	TOTAL BTU × 10^6
BASE YEAR 1975-76	6,121,958	X X X	66.6	X X X	N.A.	X X X	X X X X X	3,391,866	X X X	(ee)	565,982 Btu/GSF
(H) 1996 (C) 3160	X X X	70,015	X X X	68.6	X X X	N.A.	17,064	X X X	40,702	(ff)	127,850 x 10^6 Btu
COMPARISON YR. 1976-77	5,603,667	X X X	60.1	X X X	N.A.	X X X	X X X X X	3,366,781	X X X	(ee)	536,323 Btu/GSF
(H) 2158 (C) 2990	X X X	65,003	X X X	62.0	X X X	N.A.	15,694	X X X	40,401	(ff)	121,150 x 10^6 Btu
LAST FULL YR 1977-78	5,188,100	X X X	55.1	X X X	N.A.	X X X	X X X X X	3,248,575	X X X	(ee)	501,801 Btu/GSF
(H) 2056 (C) 3003	X X X	60,182	X X X	56.8	X X X	N.A.	14,130	X X X	38,983	(ff)	113,352 x 10^6 Btu

2.0 LIST OF MAINTENANCE PROCEDURES AND OPERATING PROCEDURES WHICH HAVE BEEN IMPLEMENTED OVER ABOVE TIME SPAN OF YEARS TO REDUCE ENERGY CONSUMPTION.

(gg) (1) REDUCE VENTILATION RATE (2) UNOCCUPIED AREA VENT SHUT DOWN (3) REPAIR OF CAULKING & WEATHER-STRIPPING (4) CONTROLS MAINT. & REPAIR (5) CHANGE THERMOSTAT SET POINTS (6) PUT LOCK COVERS ON STATS (7) RESET AIR & WATER TEMP. (8) REDUCE DOM. H.W. TEMP. (9) REPAIR LEAKS

(BASE YEAR: BTU/SQ. FT.) (hh) 565,982 — (LESSER COMPARISON YEAR: BTU/SQ. FT.) (jj) 501,801 = (kk) 64,181
BTU/SQ. FT. REDUCTION

(kk) 64,181 ÷ (hh) 565,982 = (ll) 11.3
BTU/SQ. FT. REDUCTION — BASE YEAR: BTU/SQ. FT. — % REDUCTION FROM BASE YEAR

*Move Btu decimal point six places to the right before dividing by GSF since Btu is expressed in millions.

(SAMPLE)

E N E R G Y   A U D I T

(b) JOHN PEACE LIBRARY—0542 BUILDING | (c) 225,890 BUILDING SIZE (GROSS SQ. FT.) | (b1) U.T. SAN ANTONIO – 401 COMPONENT INSTITUTION NAME & I.D. NUMBER

FORM EA-3

4-79 REVISED 4-23-79

III RECOMMENDED ENERGY CONSERVATION MAINTENANCE & OPERATION PROCEDURES

PROVIDE FOLLOWING RECOMMENDATIONS BASED ON AN ON-SITE INSPECTION OF BUILDING:

1. SCHEDULED PREVENTIVE MAINTENANCE PLAN. RECOMMEND (mm) X YES — NO; IN EXISTENCE (nn) X YES — NO

2. PROVIDE A GENERAL ESTIMATE, EXPRESSED AS A RANGE, OF ANNUAL ENERGY SAVINGS & ANNUAL ENERGY COST SAVINGS WHICH COULD RESULT FROM IMPLEMENTING THE FOLLOWING MAINTENANCE & OPERATING PROCEDURES.

SYSTEM CHANGES	VALUES	% ENERGY	% COST
VENTILATION SYSTEM OPERATION	% SUB-TOTAL	1.0 (oo)	0.5-1.0 (pp)
✓ REDUCED VENTILATION (V-1)*	2.0		
VARIABLE VENTILATION (V-3)*	1.0		
✓ UNOCCUPIED AREA VENTILATION SHUT DOWN (A-3)*	0.5		
✓ REPAIR OF CAULKING & WEATHER STRIPPING (B-3)*	0.5		
✓ MAINTENANCE & REPAIR OF OPERATING CONTROLS (A-10)*	1.0		
HEATING & COOLING SYSTEM OPERATION	SUB-TOTAL	3.0 (rr)	1.0-2.0 (ss)
✓ CHANGE IN THERMOSTAT CONTROL SET POINTS (A-1)*	2.0		
✓ PROVIDE LOCKING THERMOSTAT COVERS (A-1)*	1.0		
✓ RESET OF AIR & WATER TEMPERATURES (H-5) (C-3)*	2.0		
UNOCCUPIED RESET OR SHUT DOWN OF SYSTEM (A-3)*	2.0		
SHUT DOWN NON-CRITICAL EXHAUST SYSTEMS (V-4)*	1.0		
LIGHTING SYSTEMS OPERATING	SUB-TOTAL	5.0 (tt)	6.0-7.0 (uu)
REDUCE ILLUMINATION LEVELS (L-8)*	3.0		
MAXIMIZE USE OF DAYLIGHT (L-7)*	1.0		
INSTALL HIGH EFFICIENCY LAMPS (L-1)*	1.0		
✓ REDUCE OR DELETE EVENING CLEANING HOURS (A-4)*	2.0		

SYSTEM CHANGES	VALUES	% ENERGY	% COST
WATER SYSTEMS OPERATIONS	% SUB-TOTAL	1.5 (vv)	0.5-1.0 (ww)
✓ REPAIR ALL LEAKS (H-8) (W-2)*	0.5		
REDUCTION OF WATER CONSUMPTION (FLOW RESTRICTION)	0.5		
✓ REDUCE HOT WATER TEMPERATURE (W-1) (H-5)*	1.0		
INCREASE CHILLED WATER TEMPERATURE (C-3)*	1.0		
UTILITY PLANT & DISTRIBUTION SYSTEM OPERATION	SUB-TOTAL	3.5 (xx)	1.0-1.5 (yy)
EQUIPMENT CLEANING (C-1)*	0.5		
ADJUSTMENT OF AIR/FUEL RATIO (H-2)*	0.5		
COMBUSTION MONITORING & CONTROL (H-2)*	0.5		
ADJUSTMENT OF DRIVES, FANS, MOTORS, ETC. (A-10)*	1.0		
STEAM TRAP MAINTENANCE (H-8)*	1.5		
PIPE INSULATION REPAIR (H-8)*	1.0		
OTHER MAINTENANCE & OPERATION PROCEDURES	SUB-TOTAL	NA (zz)	NA (aaa)
TOTALS		14.0	9.0-12.5

* The energy audit checklist included in each energy system section of the <u>Energy Auditor Training II</u> workbook is referenced to the appropriate general maintenance and operating (M&O) procedure identified above. The M&O checklist references in parentheses are not intended to include all possible M&O procedures.

10-29

(SAMPLE)

ENERGY AUDIT

(b) JOHN PEACE LIBRARY - 0542
BUILDING

(c) 225,890
BUILDING SIZE (GROSS SQ. FT.)

(b1) U.T. SAN ANTONIO - 401
COMPONENT INSTITUTION NAME & I.D. NUMBER

IV ENERGY CONSERVATION RETROFIT RECOMMENDATIONS

1.0 BASIC BUILDING DATA: 1.1 ANNUAL ENERGY USE (bbb) 501,801 BTU/GROSS SQ. FT. PER YEAR

1.2 ANNUAL ENERGY COST (ccc) $2.51 $/GROSS SQ. FT. PER YEAR

1.3 DESCRIBE PHYSICAL CONDITION OF BUILDING ENVELOPE: (ddd) BUILDING IS 3 YEARS OLD - OVERALL CONDITION IS EXCELLENT

1.4 DESCRIBE PHYSICAL CONDITION OF BUILDING ENERGY USING SYSTEMS: (eee) GOOD OPERATIONAL CONDITION

2.0 BASED ON 1.1, 1.2, 1.3, AND/OR 1.4 ABOVE INDICATE THE NEED & POTENTIAL FOR ENERGY CONSERVATION RETROFIT IMPLEMENTATION. BRIEFLY OUTLINE RECOMMENDED RETROFIT OPTIONS:

(fff) (1) PROVIDE SEPARATE A/C UNIT FOR DATA PROCESSOR AREA & SHUT DOWN LARGE AIR HANDLING SYS. FOR EVE. & NITE HRS. (2) PROVIDE 100% O.A. VENT CYCLES, (3) DOUBLE GLAZING OF WINDOWS

3.0 BASED ON DATA NOTED IN SECTION VI, FORM PEA-4 & ITEMS 4.0 & 5.0, FORM EA-2 THE AUDITOR SHALL INDICATE WHETHER OR NOT THE BUILDING CONDITIONS AND/OR SITE CHARACTERISTICS PRESENT AN OPPORTUNITY TO APPLY SOLAR HEATING AND/OR COOLING SYSTEMS, OR SOLAR DOMESTIC HOT WATER HEATING SYSTEMS. ___ YES, X NO

V ENERGY CONSERVATION RETROFIT ASSESSMENT

1.0 DESCRIBE PROPOSED ENERGY CONSERVATION PROCEDURE (ECP): (ggg) PROVIDE SMALL A/C UNIT FOR THE DATA PROCESSOR CENTER TO BE UTILIZED AFTER NORMAL SCHOOL HOURS, WEEK-ENDS & HOLIDAYS. THUS AVOIDING NEED FOR 24-HR OPERATION OF A 200 H.P. AIR HANDLER SYS. & A 75 H.P. CH. W. PUMP

2.0 ESTIMATE OF INSTALLED COST OF ABOVE ECP: (hhh) $ $30,000.00

3.0 ESTIMATE OF ANNUAL ENERGY COST SAVINGS FOR ABOVE ECP: (iii) $ 21,500.00

4.0 PROJECTED SIMPLE PAYBACK PERIOD FOR ABOVE ECP IN YEARS:

ITEM 2.0 $ 30,000.00 XX (hhh) ÷ ITEM 3.0 $ 21,500.00 XX (iii) = 1.4 (jjj) YEARS

THE IMPLEMENTATION OF ENERGY CONSERVATION MAINTENANCE AND OPERATING PROCEDURES ARE A PREREQUISITE CONDITION FOR ELIGIBILITY FOR RECEIVING FEDERAL ASSISTANCE UNDER THE TECHNICAL ASSISTANCE PROGRAM AS DESCRIBED IN 10 CRF PART 455, D.O.E. RULES & REGULATIONS.

FORM EA-4 4-79 REVISED 4-23-79

TECHNICAL ASSISTANCE (TA) AND ENERGY CONSERVATION MEASURES (ECM) APPLICATIONS

The following Technical Assistance (TA) and Energy Conservation Measures (ECM) application guidelines and application forms were developed by the Texas Energy and Natural Resources Advisory Council (TENRAC) for the second grant program cycle. These guidelines and forms supersede the instructions and forms developed for the first grant program cycle.

TEXAS ENERGY AND NATURAL RESOURCES ADVISORY COUNCIL
800 EXECUTIVE OFFICE BUILDING, 411 WEST 13TH STREET, AUSTIN, TEXAS 78701

Co-Chairmen:
William P. Clements, Jr.
Governor

William P. Hobby
Lieutenant Governor

Vice-Chairman.
Bill Clayton
Speaker of the House

Executive Director:
Edward O. Vetter

February 18, 1980

MEMORANDUM

TO: Schools, Hospitals, Units of Local Government, and Public Care Institutions

FROM: Duane Keeran, Program Director for Institutional Buildings Grants, Conservation Division

SUBJECT: 1980 Applications for Technical Assistance and Energy Conservation Measures: Guidelines

The purpose of this memorandum is to announce that the Texas Energy and Natural Resources Advisory Council (TENRAC) is accepting grant applications for technical assistance and energy conservation measures for the second grant program cycle. The deadline for submission of the grant applications is May 30, 1980.

Participation and Funding During First Grant Program Cycle

During the first grant program cycle, TENRAC recommended that $5,651,042 be awarded for technical assistance and energy conservation measures for schools, hospitals, units of local government, and public care institutions. The funding was recommended for 398 applications out of a total of 425 applications which were submitted to TENRAC. Therefore, funding was recommended for more than 93% of the grant applications submitted during the first grant program cycle. Because of low participation by local governments and public care institutions, $642,233 had to be returned to the Department of Energy.

Use of Grant Funds

The technical assistance grants will be available to assist institutions purchase the services of registered professional engineers or an architect/engineer team to conduct a detailed energy analysis of buildings. The technical assistance, which must be conducted in accordance with the standard Technical Assistance Report Format, will result in recommendations for energy conservation measures. The energy conservation measures grants will provide assistance for the purchase of equipment, materials, labor, and project design for saving energy and related costs. The program will provide for 50 percent matching federal grants or federal funding up to 90 percent in cases of severe hardship.

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Procedure for Submission of Grant Applications

Technical Assistance Applications

Institutions interested in submitting a technical assistance application must first complete the preliminary energy audit report and the energy audit report. An on-site energy audit of the facility must be conducted by a person trained in the state energy auditor training program or by a person, such as an engineer, who can demonstrate appropriate skills and experience. The primary purpose of the on-site energy audit is to identify maintenance and operating procedures for saving energy. The maintenance and operating procedures must be initiated in the facility prior to the submission of the technical assistance application. The technical assistance application would then be submitted in duplicate with the preliminary energy audit report and the energy audit report.

Energy Conservation Measures Applications

If an institution has already completed the technical assistance report in accordance with the standard Technical Assistance Report Format (GOER, July 27, 1979), the institution may submit an Energy Conservation Measure application. The application would be submitted in duplicate with the preliminary energy audit report (PEA), the energy audit report (EA), and the technical assistance report (TA). If the institution conducted the technical assistance at its own expense (without the use of federal funding), it may claim the cost of the technical assistance as applicant match on the energy conservation measures application (See pages 7, 11, and 12 of grant application for details). The federal share of such TA costs will be provided to the grantee if the ECM is ranked for funding and if there are sufficient TA funds after all eligible TA applications are funded. Such TA credit funds must be used for the ECM project only.

If an institution has not yet conducted the technical assistance analysis but wants to submit an energy conservation measures application on May 30, 1980, the institution would have to conduct the PEA, EA, and TA at its own expense. As explained above, the federal share of the TA would be provided to the grantee if the ECM ranks for funding and if there are enough federal technical assistance funds to provide for the expense. Again, such TA credit funds must be used for the ECM project only.

As required by the ECM grant application instructions, the TA Report Format, and the State Plan, the Technical Assistance Report Format must include (in Appendix A-3) the detailed energy savings calculations for each energy conservation measure giving consideration to the interaction between the measures. There will be no consideration of the ECM application unless detailed calculations for determining the number of energy units saved by type of energy for each ECM are provided. The ECM application must not include any measures which are not thoroughly analyzed in the technical assistance report.

Program Schedule

(1)	Energy Auditor Training (See enclosed brochure)	March 18 - April 2, 1980
(2)	Special Meeting for TENRAC to Review Applications with Applicants	April 28, 1980
(3)	Special Training for Technical Assistance Analysts	March 17, 1980 April 29, 1980
(4)	Deadline for Submission of TA and ECM Applications to TENRAC	May 30, 1980
(5)	TENRAC Submits Applications to DOE	July 1, 1980
(6)	DOE Sends Applicants Notice of Grant Award	September 1, 1980

Energy Auditor Training

Energy auditor training will be conducted throughout the state as identified in the enclosed brochure. The agenda for the training program has changed considerably from last year as the primary emphasis will be placed on specific activities which an energy auditor would perform to save energy. The training will be substantially supported by colored slides, video-tapes of energy auditing, and an energy auditor training manual. A review of PEA and EA forms, TA and ECM applications and the procedures of the grants program will also be included. Energy auditor certificates will be distributed to attendees during the training session. As stated above, a person must attend the energy auditor training program or demonstrate appropriate skills and experience (such as an engineer) in order to be eligible to complete the energy audit report. There are no registration fees required for attendance.

Application Review Meeting

TENRAC will conduct a meeting with institutional representatives on April 28, 1980 to review the TA and ECM application instructions and contents. Institutional representatives are encouraged to bring completed application forms including the preliminary energy audit report, the energy audit report, and the technical assistance report. We will review the instructions in detail. We will also provide individualized assistance to applicants to help them make any specific corrections that are needed. In order to gain the greatest benefit from this session, building representatives should bring completed applications and should already be familiar with the application instructions and contents. The meeting will be conducted in Austin at the Joe C. Thompson Center (just north of the L.B.J. Library on the U.T. campus) in room 3-102 from 9:00 am to 5:00 pm.

Meeting for Technical Assistance Analysts

TENRAC will conduct meetings for technical assistance analysts on March 17 in Dallas and April 29 in Austin. Although the meetings will be open to building representatives, the agenda will be designed for engineers and architects who are performing technical assistance analyses. The agenda will be primarily of a technical nature involving procedures for calculating energy savings. The common procedural problems experienced during the first grant program cycle will be reviewed as well as methodologies for calculating energy savings. Technical assistance analysts are encouraged to bring examples of calculations prepared for the application to be submitted to TENRAC on May 30. The Dallas meeting will be conducted on March 17 at the North Park Inn (9300 North Central Expressway) in the North Ball room from 9:00 am to 5:00 pm. The Austin meeting will be conducted on April 29 in the Joe C. Thompson Center in room 3-102 from 9:00 am to 5:00 pm.

Please notify all interested professional engineers and architects about the meetings since the discussion will be important in obtaining a complete understanding of the state requirements for the technical assistance report.

Notification of Intent to Apply

Because of the critical need to communicate with interested institutions about current grant program information, we have enclosed a self addressed post card that should be sent to TENRAC within the next few weeks. The post card indicates the estimated number of TA and/or ECM applications which you intend to send to TENRAC and your interest in obtaining copies of the Approved State Plan. After we receive the post card, we will send you the Technical Assistance Report Format and the approved State Plan. The information about the number of TA and/or ECM applications you intend to send TENRAC will assist us in program planning and will in no way limit the number of applications you may actually send by May 30, 1980.

Grant Application Review Process

As many first grant cycle applicants know, TENRAC has established procedures for conducting a very comprehensive review of grant applications, PEA report, EA report, and TA reports. Since we will only have about 30 days to review grant applications during the second grant cycle, it is critical that the contents of the application and attached materials be thoroughly checked by the applicant. Various problems could result in delays which might jeopardize the application. Some common problems experienced during the first grant cycle are identified below:

- Budget items did not sum to the total.
- Budget in Part I, Item 13 varied from budget in Part III.
- Application was submitted for several buildings rather than one application per building (Only an ECM application with common measures for a complex of buildings at the same location may include more than one building).

- Energy savings from M&O procedures in Part I, Item 45.1 did not relate to EA report (page 3) and/or the TA report.

- Responses were not provided in Part II for Items 2,4,8,10, and 11.

- Ineligible applicant match was sometimes claimed in Part III, Section B and Remarks. Such ineligible match included costs of PEA, EA, institutional administrative activities, TA and/or ECM application completion, ECM costs incurred prior to the grant application submission date to TENRAC, claim for reimbursement of technical assistance on a TA application for costs incurred prior to notice of grant award (TA costs may be reimbursed if claimed on the ECM application only). Such costs are not allowed.

- Instructions for Part III were not followed carefully (Pages 7 and 9 of Application).

- Part IV, Program Narrative was often vague. More explicit instructions are provided in the application for the second grant program cycle.

- Signatures were not provided where required . See Part I Item 23 b (page 2), Part IV F (page 15), Part V (page 22), EA report (page 1).

- Original signature was sometimes omitted.

- Signature date was sometimes omitted.

- Table A, Energy Savings Chart. Appropriate conversion factors were sometimes not used for Btu (cols. 11-14); the energy units saved by type were sometimes not multiplied by average annual energy cost rate to determine annual energy cost savings (cols. 4-9); sometimes columns did not total properly horizontally or vertically; although the energy cost rates on Table A are more recent than the PEA report, page 2, there should not be a significant variance, and the cost rates must match those identified in the TA report; descriptive information at top of form about building and building owner was sometimes omitted (Notice that some revisions have been made in Table A from last year).

- PEA, page 2, calculations were inaccurate occasionally. This chart should be double checked by applicant.

- The gross square feet figure for a given building in the PEA and EA was sometimes different in different spaces on the form.

- ECM recommendations of energy auditor in EA report, page 4, were not considered by TA analyst. TA analyst should identify reasons for rejecting EA auditor recommendations in an analysis in the TA report (See pages 13 and 17 of Technical Assistance Report Format).

- Item d. ECM Implementation Cost Estimate, in Part G (4.), Energy Conservation Measure Data, of the - Technical Assistance Report Format (page 17) includes a cost estimate for "Professional services for design and administration" of the ECM. "Administration" refers to project supervision costs and not institutional administrative costs.

- A technical assistance report was sometimes not provided for each building. The only exception is that one TA report may be provided incorporating all the buildings in the complex only if an application is for a complex of buildings with a common measure(s). In such a case a separate TA report will also be accepted for each building of the complex if the applicant wishes to submit them instead of the one TA report for the complex.

- Sometimes the federal funding requested for a TA application exceeded the allowable limits in the State Plan. (See attached Summary #9)

- Sometimes the energy savings calculations of the TA analyst were initially omitted from the ECM application.

Although the above stated problems should receive special consideration, the total application should be thoroughly double checked before being submitted to TENRAC.

Hospital Applicants

Hospitals which intend to submit an ECM application with total ECM costs in excess of $150,000 must acquire a Certificate of Need (CN) from the Health Facilities Commission. In order to avoid delays which could jeopardize the application, an application for Certificate of Need should be submitted to the Texas Health Facilities Commission as soon as the technical assistance analyst completes the Technical Assistance report. Hospitals may wish to give strong consideration to the amount of the total project cost since the timeline will be short between completing the TA report (at which time the CN application could be submitted) and July 31, 1980 when the Department of Energy would begin the paperwork on the Notice of Grant Award. Therefore, it should be understood that hospital ECM applications with total ECM costs in excess of $150,000 could be jeopardized if the Certificate of Need cannot be obtained by July 31, 1980. All affected hospitals should contact Tom Camp at the Health Facilities Commission (Telephone: (512) 475-6940).

Local Government and Public Care Applicants

Although the Energy Conservation Grants program has not provided funding for energy conservation measures for local governments and public care institutions, the Department of Energy has introduced legislation in Congress to provide such funding for retrofitting buildings. Also, the Economic Development Administration (EDA) of the U.S. Department of Commerce will be providing funding for energy conservation measures for local governments. If local governments desire additional information on the energy conservation measures funding included in the Public Investment Energy Conservation program of EDA, they may contact:

Mr. Joseph B. Swanner
U.S. Department of Commerce
Economic Development Administration
600 American Bank Tower
221 W. 6th Street
Austin, Texas 78701

Summary of the Grants Program

In order to provide potential applicants with some important information on the State Plan and the grants program, we have included a Summary of the program in the following pages. If you are interested in participating in the grants program, please review this information. More detailed program information will be sent to you when you send TENRAC the postcard identifying your intent to apply. At that time we will send you a copy of the approved State Plan and the Technical Assistance Report Format.

Application Submittal

The applications must be submittd to the following address by courier or by registered mail dated no later than May 30, 1980. Applications submitted later than May 30, 1980 will be rejected.

Mr. Duane Keeran
Energy Conservation Grants
Conservation Division
Texas Energy and Natural Resources
  Advisory Council
411 W. 13th Street, Room 903
Austin, Texas 78701

We sincerely hope that you will accept our invitation to apply to our grants program. Many institutions which participated in the first grant program cycle have identified considerable energy savings through maintenance and operating procedures and energy conservation measures.

The staff of the Energy Conservation Grants program will be available to answer your questions. If you have any questions or concerns, please feel free to contact Duane Keeran, Mel Roberts, or Julia Evans at (512) 475-5407.

/je

EXECUTIVE SUMMARY
OF THE
STATE PLAN

1. The basic sequence for participation in the program requires that the building owner (a) first conduct a preliminary energy audit (PEA) by completing the PEA form*, (b) complete the energy audit (EA) form*, (c) conduct an on-site energy audit of the building listing all maintenance and operating procedures identified to save energy, (d) initiate (implement) all the maintenance and operating procedures identified by the energy audit, (e) submit an application to the Texas Energy and Natural Resources Advisory Council (TENRAC) for federal funding to conduct technical assistance (detailed engineering analysis of the building), if desired**, (f) technical assistance (TA) analyst conducts the technical assistance analysis, (g) technical assistance analyst writes report (see Technical Assistance Report Format) identifying further maintenance and operating procedures and the energy conservation measures, (h) initiate (implement) the maintenance and operating procedures identified by the technical assistance analyst, (i) submit an application to TENRAC for federal funding for energy conservation measures (ECM) recommended in the technical assistance report, if desired**, (j) purchase and install the energy conservation measures, (k) monitor energy savings prior to and subsequent to the installation of energy conservation measures. (See Section 3.1)
2. Technical Assistance and Energy Conservation Measures applications must be submitted in duplicate with supporting materials. Therefore, institutions must submit one orignal and one copy of the Technical Assistance application each accompanied by the Preliminary Energy Audit report and the Energy Audit report. Likewise, institutions must submit one original and one copy of the Energy Conservation Measures application each accompanied by the Preliminary Energy Audit Report, the Energy Audit Report, and the Technical Assistance Report.
3. See Section 3.4 for application submission dates.

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*The preliminary energy audit (PEA) form and the energy audit (EA) form are included in the Energy Auditor Training Manual developed by the Texas Energy and Natural Resources Advisory Council (TENRAC). Also see Appendices A and B.

**See Section 8.3 for schedule for submission of applications to TENRAC.

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4. Funding will be awarded by the following categories: (a) schools and hospitals technical assistance (b) schools and hospitals energy conservation measures (c) schools and hospitals technical assistance severe hardship, (d) schools and hospitals energy conservation measures severe hardship, and (e) local government and public care technical assistance.
5. The technical assistance grant ranking criteria include (a) Btu/G.S.F./Annual Operating Hours/Yr.,* (b) $/G.S.F./Annual Operating Hours/Yr., (c) potential energy savings chart, (d) implementation of an institutional energy management plan, (e) cost of the TA per gross square foot, and (f) energy savings resulting from maintenance and operating procedures (See Section 6.1 for weighting factors).
6. The energy conservation measure grant ranking criteria weighting factors include (a) average simple payback, 0.24, (b) conversion to renewable and coal, 0.18, (c) quantities of types of energy saved including oil, natural gas, and electricity, 0.17, (d) climate within the state, 0.16, (e) technical review of technical assistance reports, 0.15, and (f) energy management plan implementation, 0.10. (See Section 6.2).
7. All TA and ECM grants will be awarded on a building-by-building basis unless an ECM grant application is for a common measure(s) for a complex of buildings. (See Section 7.0).
8. No building which is part of a complex that has received a grant will be awarded a grant on the basis of application as a single building except as provided below:
   (a) If a measure is for a central power plant building which serves a complex, applications may also be submitted for single buildings within the complex.
   (b) If a common measure or measures serving a complex of more than three buildings is not physically installed in any of the buildings in the complex (e.g. pipe system from existing solar energy system to serve more buildings, pipe insulation) and the total cost of the measure(s) is (are) less than $75,000,the applicant may also submit an application

*British thermal unit (Btu) per gross square foot (G.S.F.) per annual operating hours per year.

for any given building in the complex. However, such buildings are not eligible as part of a different combination of buildings (complex) within the institution (See Section 7.0).

9. The amount of the technical assistance grant shall be the least of (1) the application request, (2) $50,000, or (3) the following limits:

   (a)$0.10 per G.S.F. for primary and secondary buildings, (b) $0.15 per G.S.F. for post-secondary buildings, (c) $0.20 per G.S.F. for hospital buildings, (d) $0.15 per G.S.F. for buildings owned by units of local government, and (3) $0.10 per G.S.F. for public care buildings (See Section 7.1). It should also be noted that those applications with the lowest cost per gross square foot (G.S.F.) by program category will be given the most credit toward TA grant application rankings (See Section 6.1.5).

10. There are graduated limitations on the amount a single building owner may receive for TA and ECM prior to the funding of an established range of the highest ranked applications. Thus, the highest ranked 20 percent of applications will be awarded funding before any single building owner will receive more than 15 percent of the total funding for TA or ECM. The same provision applies to the second 20 percent of grant applications. The bottom 60 percent will be awarded funding in descending order of priority (See Section 7.1).

11. No building owner shall be permitted to apply for grants on a 50 percent federal (or less) and 50 percent institutional matching funds basis for some buildings and also apply for severe hardship funding for other buildings during the same grant program cycle (See Section 8.1).

12. The amount of funding for severe hardship grants will be based on a technical review of severe hardship statements which include financial status information (WF=0.80) and the ratio of the amount expended on energy to the total operating budget (WF=0.20)(See Sections 8.2, 8.2.1 and 8.2.2).

13. TENRAC has developed a required format for the technical assistance reports. This report format will be required for all technical assistance reports submitted to TENRAC with ECM applications after September 30, 1979, as well as all technical assistance funded by federal grants (See Section 15.1 and Appendix F).

14. Applicants should notice state requirements added to the content of the technical assistance report including a description of the interdependence of measures and a description of energy savings calculations and procedures (See Section 15.2).

SUMMARY OF THE FEDERAL REGULATIONS AND STATE PROGRAM FOR TECHNICAL ASSISTANCE (TA) AND ENERGY CONSERVATION MEASURES (ECM)

1. Technical assistance is a detailed engineering energy analysis of the building resulting in a final report with recommendations for maintenance and operating procedures and energy conservation measures. Energy conservation measures involve the installation of materials and equipment and the physical modification of the building to save energy and related costs.
2. For both TA and ECM, buildings must be owned by public or private non-profit schools, hospitals, units of local government, and public care institutions.
3. Eligibility for TA requires that an energy audit must have been conducted (the EA includes the PEA) and the recommended maintenance and operating procedures initiated (implemented), unless the building owner justifies the reasons for not implementing the maintenance and operating procedures, prior to submitting the grant application. The application would then be submitted in accordance with federal regulations and the State Plan.
4. In accordance with federal regulations and the State Plan, a qualified technical assistance analyst must be a registered professional engineer certified by the State or an architect-engineer team with chief members licensed by the State. The analyst must also have had appropriate training and experience in electrical and mechanical systems and energy using systems of buildings as well as experience in conducting most aspects of the detailed engineering analyses described in Section 15.2 of the Plan including energy savings, energy cost savings and payback period analyses.
5. The technical assistance analyst must have no financial interest in supplying materials and equipment for ECM. However, he/she may be involved in the design and supervision of the ECM provided the institution follows competitive procurement procedures for project design and supervision.
6. Eligibility for ECM requires that a technical assistance (detailed engineering analysis) must have been conducted according to 10 CFR 455.42 and the State Plan, and the recommended maintenance and operating procedures of the EA and TA report initiated (implemented) prior to the submission of the ECM application unless the building owner justifies the reasons for not implementing the maintenance and operating procedures. The application would then be submitted in accordance with federal regulations and the State Plan. Each ECM must have a simple payback period of not less than 1 year nor greater than 15 years, and the

Preceding page blank

estimated useful life of the measure must be greater than its simple payback period and the remaining useful life of the building.*

7. The TA report shall be evaluated as part of the grant ranking for each ECM application.
8. There are cost limits established on the amount of the TA grants as well as graduated limits on the amount any given building owner may receive.
9. The amount of federal funding for TA and ECM will be an amount up to 50% or up to 90% in cases of severe hardship. The institution must provide the balance of the project cost.
10. One copy of the TA report, TA application, and ECM application should be maintained by the building owner. One original and one copy of the TA application and the ECM application should be submitted to TENRAC with the PEA report and the EA report attached to each application. Each ECM application must also be accompanied by a TA report.
11. Technical assistance applications will be ranked on the basis of the potential for saving energy as well as various program incentives.
12. TA expense (not claimed as match for the TA grant) incurred on or after November 9, 1978 may count as in-kind match on the ECM application upon approval of the Secretary of Energy.
13. Only one TA grant and one ECM grant will be provided for any given building or complex (a complex is a group of two or more buildings at the same location for which one or more common measures are requested).
14. Buildings used primarily (more than 50%) for administration are not eligible for technical assistance and energy conservation measures. Local governments should interpret this provision to exclude buildings which are used more than 50 percent for internal administrative functions such as payroll processing, personnel record-keeping, pension system accounting and other services provided to the employees of the local governmental units. Local government and public care buildings must also be primarily occupied (more than 50%) by offices and/or agencies of the local government or public care institutions; thus municipal auditoriums, stadiums or other such buildings not primarily occupied by offices or agencies are not eligible for the program.

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*All references to simple payback periods may be modified as a result of the life cycle costing methodology adopted subsequent to the printing of the State Plan.

15. The institutions shall keep records and reports including (a) a report submitted each January and July on the progress and financial status of the project (b) a final report on TA and ECM projects submitted within 90 days of project completion - the TA final report shall include the TA analyst report and plan for implementing maintenance and operating procedures and acquiring and installing energy conservation measures; the ECM final report shall include a list of energy conservation measures acquired and installed with final projected payback periods and a statement that the ECMs conform with the TA report and ECM application and (c) annual reports for three years or for the life of the program, whichever is shorter. All the above records are to be maintained by the building owner for three years. TENRAC will provide a required format for all reports in order that such information may easily be analyzed and reported to DOE by TENRAC in a consistent manner.

16. The costs of conducting preliminary energy audits and energy audits shall not be used as applicant match for technical assistance or energy conservation measures.

17. Costs related to the institutional administration of the TA and ECM programs, including the costs of completing TA and ECM applications, shall not be claimed as applicant match credited toward the TA or ECM costs as identified in the application.

18. Because of the need to implement some energy conservation measures during the summer months prior to the notice of grant award, an institution may implement measures identified on the ECM application and the TA report up to an amount which is equal to the non-federal match. Such ECMs must be completed with non-federal match only and initiated after the application deadline date established by TENRAC. Such ECMs must be identified fully in the TA report and the ECM application; and the ECMs must meet all eligibility requirements identified in the federal regulations and the State Plan. Such ECMs will also be included in the data used for grant ranking.

19. Institutions must use competitive procurement procedures in securing the services of the technical assistance analyst(s) and in all costs relating to energy conservation measures including project supervision, design, installation, and purchase of equipment and materials. The selection should be based upon the appropriateness of services and items for the project.

APPLICATION FOR TECHNICAL ASSISTANCE OR ENERGY CONSERVATION MEASURES

Texas Energy and Natural Resources Advisory Council

February 18, 1980

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Application Type - Technical Assistance or Energy Conservation Measures

Building Owner Name

Component Institution Name
(e.g., a specific campus within a university system)

Building Name

Institution Type - Primary and Secondary, Post-Secondary, Hospital, Local Government, or Public Care

Preceding page blank

PART I: GENERAL INFORMATION INSTRUCTIONS

Item 1. An "X" is already entered for "Application."

Item 2. You may use this for your own purposes, if desired.

Item 3. Leave this blank. TENRAC will assign a number.

Item 4. Fill out completely. Remember telephone number. Applicant name is name of building owner. Organization unit and address is office name and address of certifying representative who signs the application. Contact person address is provided in Part IV (A.), Program Narrative.

Item 5. Use federal employer identification number assigned for IRS purposes.

Item 6a. "81.052" is already entered.

Item 7. Title should be "Technical Assistance", "Energy Conservation Measures", "Severe Hardship-Technical Assistance," or "Severe Hardship-Energy Conservation Measures." Identify the building by name, I.D. number provided on PEA and EA, name of building owner and name of program category (i.e. primary and secondary, post-secondary, hospital, local government, public care). Briefly describe TA as a "detailed engineering analysis of the building to identify M&O and energy conservation measures."

Item 8. Identify applicant type by placing appropriate letter in box.

Item 9. An "A" is already entered in the box.

Item 10. Enter name of county where the building is located.

Item 11. Hospitals enter annual patient days, primary and secondary schools enter average daily attendance (ADA), post-secondary schools enter student head-count, local government and public care enter county population.

Item 12. An "A" is already entered in the box.

Item 13. Enter the funding to be provided by each source for the total project costs. Generally, you will enter amounts for only (a) Federal (b) Applicant and (c) Total. However, any third party funding match should be claimed under (e) and identified in Part III, Item 23 (Remarks). If the (f) Total divided by 2 results in a fraction of a dollar for (a) Federal and (b) Applicant, the amount entered for (a) Federal and (b) Applicant must be rounded to the nearest dollar. The applicant amount must be rounded upward to the next whole number so that the applicant would not provide less than 50 percent of the (f) Total. The amounts entered in Item 13 must be the same as identified in Part III.

Item 14. Enter the congressional district of the applicant and the project.

Item 15. "NA" is already entered.

Item 16. Enter anticipated date for the notice of grant award, September 1, 1980.

Item 17. Project duration should be "12" months.

Item 18. Enter the date which is 30 days after the application submission date to TENRAC.

Item 19. "NA" is already entered.

Item 20. "U.S. Department of Energy, Region VI, Dallas, Texas 75235" is already entered.

Item 21. An "X" is already entered for "Yes".

Item 22b. "Texas energy agency will comply with A-95 requirements of DOE" is already entered.

Item 23a. Type name and title of your authorized certifying representative.

Item 23b. Authorized certifying representative's signature. Provide original signature. The certifying representative should be the administrative officer who will be sent the grant award.

Item 23c. Date of signature in Item 23b.

Items 24 through 38 Leave Blank.

EIA-145

U.S. DEPARTMENT OF ENERGY
Energy Information Administration
Washington, D.C. 20461

FORM APPROVED
OMB NO. 038-R0402

GRANTS PROGRAMS FOR SCHOOLS AND HOSPITALS AND BUILDINGS OWNED BY UNITS OF LOCAL GOVERNMENT AND PUBLIC CARE INSTITUTIONS APPLICATION

PART I: GENERAL INFORMATION

FEDERAL ASSISTANCE

1. TYPE OF ACTION (Mark appropriate box)
   - ☐ PREAPPLICATION
   - ☒ APPLICATION
   - ☐ NOTIFICATION OF INTENT (Opt.)
   - ☐ REPORT OF FEDERAL ACTION

2. APPLICANT'S APPLICATION — a. NUMBER; b. DATE Year month day 19

Leave Blank

3. STATE APPLICATION IDENTIFIER — a. NUMBER; b. DATE ASSIGNED Year month day 19

SECTION I—APPLICANT/RECIPIENT DATA

4. LEGAL APPLICANT/RECIPIENT
   - a. Applicant Name :
   - b. Organization Unit :
   - c. Street/P.O. Box :
   - d. City : e. County :
   - f. State : g. ZIP Code:
   - h. Contact Person (Name & telephone No.) :

5. FEDERAL EMPLOYER IDENTIFICATION NO

6. PROGRAM (From Federal Catalog)
   - a. NUMBER 81.052
   - b. TITLE Grant Programs for Schools and Hospitals and Buildings owned by units of Local Government and Public Care Institutions.-

7. TITLE AND DESCRIPTION OF APPLICANT'S PROJECT

8. TYPE OF APPLICANT/RECIPIENT
   A— State; B— Interstate; C— Substate District; D— County; E— City; F— School District; G— Special Purpose District; H— Community Action Agency; I— Higher Educational Institution; J— Indian Tribe; K— Other (Specify)
   Enter appropriate letter: A

9. TYPE OF ASSISTANCE
   A— Basic Grant; B— Supplemental Grant; C— Loan; D— Insurance; E— Other
   Enter appropriate letter(s): A

10. AREA OF PROJECT IMPACT (Names of cities, counties, States, etc.)

11. ESTIMATED NUMBER OF PERSONS BENEFITING

12. TYPE OF APPLICATION
   A— New; B— Renewal; C— Revision; D— Continuation; E— Augmentation
   Enter appropriate letter

13. PROPOSED FUNDING

a. FEDERAL	$ .00
b. APPLICANT	.00
c. STATE	.00
d. LOCAL	.00
e. OTHER	.00
f. TOTAL	$ .00

14. CONGRESSIONAL DISTRICTS OF: a. APPLICANT; b. PROJECT

15. TYPE OF CHANGE (For 12 c or 12 e)
   A— Increase Dollars; B— Decrease Dollars; C— Increase Duration; D— Decrease Duration; E— Cancellation; F— Other (Specify) NA
   Enter appropriate letter(s)

16. PROJECT START DATE Year month day 19

17. PROJECT DURATION Months

18. ESTIMATED DATE TO BE SUBMITTED TO FEDERAL AGENCY ► Year month day 19

19. EXISTING FEDERAL IDENTIFICATION NUMBER NA

20. FEDERAL AGENCY TO RECEIVE REQUEST (Name, City, State, ZIP code)
U.S. Department of Energy, Region VI, Dallas, Texas 75235

21. REMARKS ADDED ☒ Yes ☐ No

SECTION II—CERTIFICATION

22. THE APPLICANT CERTIFIES THAT ►
   a. To the best of my knowledge and belief, data in this preapplication/application are true and correct, the document has been duly authorized by the governing body of the applicant and the applicant will comply with the attached assurances if the assistance is approved.
   b. If required by OMB Circular A-95 this application was submitted, pursuant to instructions therein, to appropriate clearinghouses and all responses are attached: No response NA; Response attached NA
   (1) Texas Energy Agency (TENRAC) will comply
   (2) with A-95 requirements of DOE
   (3)

23. CERTIFYING REPRESENTATIVE — a. TYPED NAME AND TITLE; b. SIGNATURE; c. DATE SIGNED Year month day 19

SECTION III—FEDERAL AGENCY ACTION

24. AGENCY NAME

25. APPLICATION RECEIVED Year month day 19

26. ORGANIZATIONAL UNIT

27. ADMINISTRATIVE OFFICE

28. FEDERAL APPLICATION IDENTIFICATION

29. ADDRESS

30. FEDERAL GRANT IDENTIFICATION

31. ACTION TAKEN
   - ☐ a. AWARDED
   - ☐ b. REJECTED
   - ☐ c. RETURNED FOR AMENDMENT
   - ☐ d. DEFERRED
   - ☐ e. WITHDRAWN

32. FUNDING

a. FEDERAL	$ .00
b. APPLICANT	.00
c. STATE	.00
d. LOCAL	.00
e. OTHER	.00
f. TOTAL	$ .00

33. ACTION DATE ► Year month day 19

34. STARTING DATE Year month day 19

35. CONTACT FOR ADDITIONAL INFORMATION (Name and telephone number)

36. ENDING DATE Year month day 19

37. REMARKS ADDED ☐ Yes ☐ No

38. FEDERAL AGENCY A-95 ACTION
   a. In taking above action, any comments received from clearinghouses were considered. If agency response is due under provisions of Part 1, OMB Circular A-95, it has been or is being made.
   b. FEDERAL AGENCY A-95 OFFICIAL (Name and telephone no.)

STANDARD FORM 424 PAGE 1 (Rev. 4-77)
Prescribed by OMB Circular A-102

PART I: GENERAL INFORMATION INSTRUCTIONS CONT'D

Since you must complete a TA or ECM application for each building, you will only complete one page 4. The only exception is if you are applying (ECM application only) for one or more measures which are common to all buildings in the complex. An example of a common measure is converting from incandescent to fluorescent lights in five buildings or installing a central control system. If such an ECM application is for a complex, you would complete one page 4 for each building in the complex.

The entry for item 45.1(b) should include the M&O energy savings identified by the completed energy audit report and/or the technical assistance report. For TA applications, multiply the percent of energy reduction from the M&Os identified on page 3 of the EA report times the amount in item 44.0 on page 4 of the application. For ECM applications, add the amount of M&O savings identified on the EA report and the M&O savings identified in the technical assistance report. Maintenance and operating savings accomplished outside the energy audit program and technical assistance program should not be identified.

PART I: GENERAL INFORMATION CONTINUED

SECTION IV—REMARKS

39.0 What is the name and address of the building? ______

40.0 What type of building is it?

(a) ☐ School Facility

(b) ☐ Hospital Facility

(c) ☐ Building owned and primarily occupied by Unit of Local Government

(d) ☐ Building owned and primarily occupied by Public Care Institution

41.0 What is the functional use of the building?

(a) ☐ School

☐ Elementary
☐ Secondary
☐ College/University
☐ Vocational
☐ Other, specify: ______

(b) ☐ Hospital

☐ General
☐ Tuberculosis
☐ Other, specify: ______

(c) ☐ Local Government Building

☐ Office
☐ Storage
☐ Service
☐ Library
☐ Other, specify: ______

(d) ☐ Public Care Building

☐ Nursing Home
☐ Long-Term Care
☐ Rehabilitation Facility
☐ Public Health Center
☐ Residential Child Care Ctr.
☐ Other, specify: ______

42.0 What is the size of the building?
(Same as PEA and EA) ______ gross sq. ft.

43.0 Is the building a public or non-profit institution?

(a) ☐ Public (b) ☐ Non-profit

(Same as PEA, page 2)
44.0 What is the current building energy consumption rate? ______ BTU/sq. ft./yr.

45.1 What is the estimated or actual energy savings resulting from implementation of operations and maintenance procedures? (See page 3 instructions)

(a) ☐ Estimated (b) ______ BTU/sq. ft./yr.
☐ Actual

45.2 Where are the operations and maintenance procedures identified?
(a) ☐ Energy Audit (b) ☐ Technical Assistance Project

PART II: PROJECT APPROVAL INFORMATION INSTRUCTIONS

Items 1,3, 5,6,7,9. Appropriate responses are already provided.

Item 2. An "X" is already entered for Yes. Name of Agency or Board is appropriate agency of the following: (a) Texas Education Agency, (b) Coordinating Board, Texas College and University System, (c) Texas Health Facilities Commission (for hospitals). Local government and public care should enter "NA."

Item 4. An "X" is already entered for Yes. Name of Approving Agency should be "Texas Energy and Natural Resources Advisory Council." For Date, enter the date of the first working day which follows the deadline for submission of applications to TENRAC by 30 days.

Item 8. Enter appropriate response for "Yes" or "No." If yes, include impact statement below.

Item 10. Enter appropriate response. Answer will most likely be "No."

Item 11. Enter appropriate response. If yes, provide insurance statement below.

ENVIRONMENTAL IMPACT STATEMENT (Provide only if Item 8 on page 6 of application is answered "Yes." The statement should provide an acknowledgement that the building is listed on the Environmental Protection Agency's (EPA) list of violation or is under consideration to be included on the list, if such is the case, see Part V, Assurance #10.

FLOOD INSURANCE STATEMENT (Provide only if Item 11 on page 6 of application is answered "Yes." The statement must acknowledge that appropriate flood insurance has been purchased in accordance with the Flood Disaster Protection Act of 1973 as described in Part V, Assurance #11.)

PART II: PROJECT APPROVAL INFORMATION

Item 1.
Does this assistance request require State, local, regional, or other priority rating?
X Yes ____ No

Name of Governing Body Texas Energy and Natural Resources Advisory Council
Priority Rating N/A

Item 2.
Does this assistance request require State, or local advisory, educational or health clearances?
X Yes ____ No

Name of Agency or Board ____
(Attach Documentation)

Item 3.
Does this assistance request require clearinghouse review in accordance with OMB Circular A-95?
X Yes ____ No

(Attach Comments)
TENRAC will comply with the limited A-95 requirements of D.O.E

Item 4.
Does this assistance request require State, local, regional or other planning approval?
X Yes ____ No

Name of Approving Agency Texas Energy and Natural Resources Advisory Council
Date ____

Item 5.
Is the proposed project covered by an approved comprehensive plan?
X Yes ____ No

Check one: State X
Local ____
Regional ____
Location of Plan TENRAC - Austin, Texas

Item 6.
Will the assistance requested serve a Federal installation?
____ Yes X No

Name of Federal Installation ____
Federal Population benefiting from Project ____

Item 7.
Will the assistance requested be on Federal land or installation?
____ Yes X No

Name of Federal Installation ____
Location of Federal Land ____
Percent of Project ____

Item 8.
Will the assistance requested have an impact or effect on the environment?
____ Yes ____ No

See instructions for additional information to be provided. See Part V, Assurance #10.

Item 9.
Will the assistance requested cause the displacement of individuals, families, businesses, or farms?
____ Yes X No

Number of:
Individuals ____
Families ____
Businesses ____
Farms ____

Item 10.
Is there other related assistance on this project previous, pending, or anticipated?
____ Yes ____ No

See instructions for additional information to be provided.

Item 11
Is the project in a designated flood hazard area?
____ Yes ____ No

See instructions for additional information to be provided.

See Part V, Assurance #11.

SECTION A - Budget Summary

Line 1.(a) Grant Program, Function, or Activity	Enter the appropriate designation, "Primary and Secondary," "Higher Education," "Hospital," "Local Government," "Public Care."
Line 1.(b) Federal Catalog No.	"81.052" is already entered.
Line 1.(c) and (d)	"NA" is already entered.
Line 1.(e)	Enter amount of project cost to be funded by federal grant. This cannot exceed 50% of the total cost (1.g.) except for severe hardship which may equal an amount up to 90% of the total cost (1.g).
Line 1.(f)	Enter amount of project costs to be funded by applicant with cash and/or in-kind match. This must be at least 50% of the total cost (1.g) except for severe hardship which may equal an amount less than 50% but not less than 10% of the total cost (1.g).
Line 1.(g)	Total of 1.(e) and 1.(f).
Line 5	Bring down amounts from 1.(e), 1.(f), and 1.(g).

SECTION B - Budget Categories

The total project costs funded by the federal government and the applicant are to be combined for the identified expense objects. The Total line, K, in Section B, must equal the Total, 1.(g), in Section A.

Technical Assistance Applications

1. The total amount will be indicated under Contractual (f) unless the institution is claiming in-kind match.

2. If the institution is claiming in-kind match, appropriate entries should be made in (a) through (h) excluding (g). The in-kind match must be identified in the Remarks Section F. No. 23. indicating the amount by expense object (a) through (h) excluding (g) and the source (institution, other-identify).

3. Because different indirect charge rates are used for different programs, delays could result in using indirect charge rates which have been assigned by the federal government if you use the rate improperly. Enter "0" in (j) and claim "Other" expenses (h) instead of indirect charges.

4. If you are claiming in-kind match, such as costs which are not claimed in (a) through (f), such costs may be entered in "Other" (h).

5. If you identify costs under "Other" (h), such costs should be listed with the appropriate amounts in the Remarks Section F. No. 23.

6. Remember, any claim for equipment (d) used for technical assistance is limited to $500.

7. Also, see 10 CFR 455.60 (d) and (e) and 10 CFR 455.81, 10 CFR 455.82 and 10 CFR 455.83 for further restrictions on the use of grant funds.

Energy Conservation Measure Applications

1. Most costs will be identified for equipment (d), supplies (e), and contractual (f). Since the ECM grants relate to the installation of materials (e.g. insulation, solar glaze material for windows) and equipment (e.g. thermostat controls, central control systems, solar collectors) as well as the physical modification of the building (e.g. adding a passive solar greenhouse to a school), the costs for materials must be entered under "Supplies" (e), equipment under "Equipment" (d), and any physical modification under "Other" (h). Identify the materials and costs in the Remarks Section F. No. 23.

2. Since DOE crossed out "Construction," enter any construction relating to physical modification under "Other" (h). Any costs claimed under "Other" (h) must be listed individually by an identifying name and amounts in the Remarks, Section F. No. 23.

3. The design work (e.g. blueprints, detailed specifications) and labor costs associated with the installation of the ECMs should be identified under "Contractual" (f). However, if you are claiming in-kind match based on your personnel installing the ECM and/or physically modifying the building, you should enter such costs in (a) through (f) and (h). Any in-kind match must be identified in the Remarks Section F. No. 23.

4. If you are requesting funding for more than one ECM, identify the amount of "Contractual" for each ECM in the Remarks section.

5. The discussion about claiming "Indirect Charges" (j) as stated above for technical assistance applications also applies for energy conservation measures applications.

6. See 10 CFR 455.60 (d) and (e) and 10 CFR 455.81, 10 CFR 455.82 and 10 CFR 455.83 for restrictions on the use of grant funds.

7. If the institution conducted the technical assistance at its own expense, the cost may be claimed in "h. Other" and identified in the Remarks section. However, the claimed TA cost cannot exceed twice the per gross square foot limits identified in the Executive Summary of the State Plan, #9.

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FORM APPROVED
OMB NO. 038-R0402

PART III – BUDGET INFORMATION

SECTION A – BUDGET SUMMARY

Grant Program, Function or Activity (a)	Federal Catalog No. (b)	Estimated Unobligated Funds: Federal (c)	Estimated Unobligated Funds: Non-Federal (d)	New or Revised Budget: Federal (e)	New or Revised Budget: Non-Federal (f)	New or Revised Budget: Total (g)
1.	81.052	$ NA	$ NA	$	$	$
2.						
3.						
4.						
5. TOTALS		$	$	$	$	$

SECTION B – BUDGET CATEGORIES

6. Object Class Categories	Grant Program, Function or Activity (1)	(2)	(3)	(4)	Total (5)
a. Personnel	$	$	$	$	$
b. Fringe Benefits					
c. Travel					
d. Equipment					
e. Supplies					
f. Contractual					
g. Construction					
h. Other					
i. Total Direct Charges					
j. Indirect Charges					
k. TOTALS	$	$	$	$	$
7. Program Income	$	$	$	$	$

PART III: BUDGET INFORMATION INSTRUCTIONS (Cont'd)

SECTION C - Non-Federal Resources

Line 8, Column (a)	Enter same response as you entered in Section A, 1.(a).
Line 8, Column (b)	Enter only applicant's match (cash plus in-kind).
Line 8, Columns (c) and (d)	Generally these columns will not be used, but enter amount if applicable and identify in Remarks Section F. No. 23.
Line 8, Column (e)	Enter total of (b), (c), and (d).
Line 12	Bring down the amounts identified in line 8.

SECTION D - Forecasted Cash Needs

Enter appropriate responses for federal and non-federal funds by first year (total project cost) and quarterly cash needs. Do not include applicant in-kind match costs or costs already paid, such as the cost of technical assistance claimed as match on the ECM application, as forecasted cash needs for line 14, "Non-Federal."

SECTION E - Budget Estimates of Federal Funds Needed for Balance of the Project

"NA" is already entered. Leave 16 through 20 blank.

SECTION F - Other Budget Information

Provide appropriate responses. Include separate Remarks page(s) to describe in-kind match and entries in Section B for "Other" (h), and Contractual (f) as described in instructions for Section B. Complete page 12 as part of the Remarks Section. Enter any other remarks you wish to make to clarify your application.

EIA-145

FORM APPROVED
OMB NO. 038-R0432

PART III: BUDGET INFORMATION Con't.

SECTION C – NON-FEDERAL RESOURCES

(a) Grant Program	(b) APPLICANT	(c) STATE	(d) OTHER SOURCES	(e) TOTALS
8.	$	$	$	$
9.				
10.				
11.				
12. TOTALS	$	$	$	$

SECTION D – FORECASTED CASH NEEDS

	Total for 1st Year	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
13. Federal	$	$	$	$	$
14. Non-Federal					
15. TOTAL	$	$	$	$	$

SECTION E – BUDGET ESTIMATES OF FEDERAL FUNDS NEEDED FOR BALANCE OF THE PROJECT

(a) Grant Program	FUTURE FUNDING PERIODS (YEARS)			
	(b) FIRST	(c) SECOND	(d) THIRD	(e) FOURTH
16. N.A.	$	$	$	$
17. N.A.				
18. N.A.				
19. N.A.				
20. TOTALS N.A.	$	$	$	$

SECTION F – OTHER BUDGET INFORMATION

(Attach Additional Sheets If Necessary)

21. Direct Charges

22. Indirect Charges

23. Remarks For ECM applications with TA credit only: The total cost of the technical assistance analysis already conducted at the applicant's expense was $______. (The total cost identified here cannot exceed an amount equal to twice the per square foot limits described on page [illegible], item [illegible] of the [illegible] TA/ECM Application Guidelines, Summary of the State Plan.) The cost of the technical assistance claimed as applicant match was $______. (Such TA match must equal ½ the total TA cost identified above or the appropriate severe hardship applicant match percentage of the total TA cost.)

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SAMPLE

SECTION F - Remarks (cont'd.)

APPLICANT MATCH CHART INSTRUCTIONS

Provide the information as illustrated in the sample. Identify the source of any cash match such as Capital Improvements Fund, Operating Fund, Short Term Loan, Bond Issue passed with date of bond issue. Describe any in-kind match from goods and services provided by your institution or a third party. Show the unit cost assumptions for calculating the amount of the in-kind match. The total of the applicant match for all buildings must equal the amount identified in "Part I, Item 13b. Applicant". Complete either Chart I or Chart II but not both.

CHART I: FOR TA OR ECM APPLICATIONS ONLY — SAMPLE FOR ECM

(1) Total TA or ECM Cost $ 70,000
(2) Federal Share (≤50% of Total or Federal Severe Hardship % of Total) $ 35,000
(3) Applicant Match (≥50% of Total or Non-Federal Severe Hardship % of Total) $ 35,000

Type of Applicant Match
(4) Cash Match $ 29,995 Source: Capital Improvements Fund
(5) In-Kind Match $ 5,005 Source: PTA Volunteers
Description: Install insulation by 5 people x $7/hour x 143 hours.

Note: (2)+(3)=(1); (1), (2), and (3) are the same as Part III, Section A, 1.(g), 1.(e), and L.(f) respectively.
(4)+(5)=(3)

CHART II: FOR ECM APPLICATION WITH TA CREDIT ONLY

TA credit is the amount of federal funding equal to Item (8) below which must be used to help fund the ECM project if granted to the applicant. TA credit can only be given to applicants who have already completed the technical assistance at their own expense without the use of federal funds. Applicants who have conducted the TA with federal assistance from prior TA grants or other federal programs cannot claim TA credit; instead such applicants must complete Chart I above to identify ECM costs only.

The applicant shall identify enough match for the ECM project in order to complete the ECM(s) in the event that technical assistance funds are no longer available because they have already been allocated for technical assistance projects and higher ranking ECM projects with TA credit. If there are sufficient funds to provide for TA credit, such credit funds in the amount of the Federal Share of the Total TA Cost (Item 8) shall be used to help fund the ECM project (the TA credit funds cannot be used for any other purpose by the institution); thus, the TA credit funds would be used to displace an equal amount of applicant ECM match identified in Item (4) during the actual project implementation.

(1) Total ECM and TA Cost (TA already completed)* $ 66,000
(2) Total ECM Cost $ 60,000
(3) Federal Share of Total ECM Cost (≤50% of Total or Federal Severe Hardship % of Total) $ 30,000
(4) Applicant Match Amount of Total ECM Cost (≥50% of Total or Non-Federal Severe Hardship % of Total) $ 30,000

Type of Applicant ECM Match
(5) Cash Match $ 24,400 Source: Short Term Loan
(6) In-Kind Match $ 5,600 Source: Operating Fund
Description: School personnel attach thermaseal to 50 windows. 4 personnel x $7/hour x 200 hours.

(7) Total TA Cost* $ 6,000
(8) Federal Share of Total TA Cost (≤50% of Total or Federal Severe Hardship % of Total) $ 3,000
(9) Applicant Match Amount of Total TA Cost (≥50% of Total or Non-Federal Severe Hardship % of Total) $ 3,000

Type of Applicant TA Match
(10) Cash Match $ 3,000 Source: Operating Fund
(11) In-Kind Match $ — Source:
Description:

*The TA costs identified here must equal the total actual TA cost not to exceed twice the per gross square foot limits described in the 1980 TA/ECM Application Guidelines, Summary of the State Plan, Item #9.

NOTE: (2)+(7)=(1); (3)+(4)=(2); (8)+(9)=(7); (5)+(6)=(4); (10)+(11)=(9). Item (1) is same as Part III, Section A, Line 1.(g). Sum of (3)+(8) is same as Part III, Section A, Line 1.(e). Sum of (4)+(9) is same as Part III, Section A, Line 1.(f).

SECTION F - Remarks (cont'd.)

APPLICANT MATCH CHART INSTRUCTIONS

Provide the information as illustrated in the sample. Identify the source of any cash match such as Capital Improvements Fund, Operating Fund, Short Term Loan, Bond Issue passed with date of bond issue. Describe any in-kind match from goods and services provided by your institution or a third party. Show the unit cost assumptions for calculating the amount of the in-kind match. The total of the applicant match for all buildings must equal the amount identified in "Part I, Item 13b. Applicant". Complete either Chart I or Chart II but not both.

CHART I: FOR TA OR ECM APPLICATIONS ONLY

(1) Total TA or ECM Cost $__________

(2) Federal Share (≤50% of Total or Federal Severe Hardship % of Total) $__________

(3) Applicant Match (≥50% of Total or Non-Federal Severe Hardship % of Total) $__________

Type of Applicant Match

(4) Cash Match $__________ Source:

(5) In-Kind Match $__________ Source:
Description:

Note: (2)+(3)=(1); (1), (2), and (3) are the same as Part III, Section A, 1.(g), 1.(e), and L.(f) respectively.
(4)+(5)=(3)

CHART II: FOR ECM APPLICATION WITH TA CREDIT ONLY

TA credit is the amount of federal funding equal to Item (8) below which must be used to help fund the ECM project if granted to the applicant. TA credit can only be given to applicants who have already completed the technical assistance at their own expense without the use of federal funds. Applicants who have conducted the TA with federal assistance from prior TA grants or other federal programs cannot claim TA credit; instead such applicants must complete Chart I above to identify ECM costs only.

The applicant shall identify enough match for the ECM project in order to complete the ECM(s) in the event that technical assistance funds are no longer available because they have already been allocated for technical assistance projects and higher ranking ECM projects with TA credit. If there are sufficient funds to provide for TA credit, such credit funds in the amount of the Federal Share of the Total TA Cost (Item 8) shall be used to help fund the ECM project (the TA credit funds cannot be used for any other purpose by the institution); thus, the TA credit funds would be used to displace an equal amount of applicant ECM match identified in Item (4) during the actual project implementation.

(1) Total ECM and TA Cost (TA already completed)* $__________

(2) Total ECM Cost $__________

(3) Federal Share of Total ECM Cost (≤50% of Total or Federal Severe Hardship % of Total) $__________

(4) Applicant Match Amount of Total ECM Cost (≥50% of Total or Non-Federal Severe Hardship % of Total) $__________

Type of Applicant ECM Match

(5) Cash Match $__________ Source:

(6) In-Kind Match $__________ Source:
Description:

(7) Total TA Cost* $__________

(8) Federal Share of Total TA Cost (≤50% of Total or Federal Severe Hardship % of Total) $__________

(9) Applicant Match Amount of Total TA Cost (≥50% of Total or Non-Federal Severe Hardship % of Total) $__________

Type of Applicant TA Match

(10) Cash Match $__________ Source:

(11) In-Kind Match $__________ Source:
Description:

*The TA costs identified here must equal the total actual TA cost not to exceed twice the per gross square foot limits described in the 1980 TA/ECM Application Guidelines, Summary of the State Plan, Item #9.

NOTE: (2)+(7)=(1); (3)+(4)=(2); (8)+(9)=(7); (5)+(6)=(4); (10)+(11)=(9). Item (1) is same as Part III, Section A, Line 1.(g). Sum of (3)+(8) is same as Part III, Section A, Line 1.(e). Sum of (4)+(9) is same as Part III, Section A, Line 1.(f).

PART IV: PROGRAM NARRATIVE

A. CONTACT PERSON

Name of Contact Person: ____________________

Address of Contact Person (Institution) ____________________

(Street/P.O. Box) ____________________

(City/State/Zip) ____________________

Telephone of Contact Person: ( ) ____________________

B. PROJECT DESCRIPTION (narrative)

1. Objectives and Need for this Assistance (The objectives may include institutional goals for saving energy both in the short-term and long-term, the number of buildings you plan on phasing into a program for saving energy, and plans for community and/or institutional personnel involvement. A brief history of your energy consumption and related costs would illustrate the critical need to save energy and costs.)

2. <u>Results or Benefits Expected</u> (If the application is for energy conservation measures, identify the building(s) included in the application and the amount of energy and energy cost savings estimated to result from the energy conservation measures identified in the technical assistance report. If the application is for technical assistance, you might identify some maintenance and operating procedures and energy conservation measures identified in the energy audit as examples of what needs to be done to the building. Indicate how expected savings will benefit the institution, its programs, and clientele.)

3. <u>Approach</u> (For a technical assistance application, you may refer to the contents of the technical assistance report; narrative may be taken from Section 15.2 of the State Plan or 10 CFR 455.42 of the federal regulations. For an energy conservation measures application, identify the measures to be implemented and any unusual characteristics about the building(s) and/or measures. Identify your competitive procurement procedures for selecting the technical assistance analyst or project supervision, design, materials, equipment and labor related to the measures. Show that you have or will advertise your need for technical assistance and/or project supervision, design, materials, equipment and labor or considered various alternatives.)

C. SCHEDULE OF MILESTONES

(Provide dates for technical assistance or energy conservation measures but not both. Additional activities may be added if desired.)

Technical Assistance	Date
• Notice of Grant Award	September 1, ______
• Procurement Procedures Initiated	
• Contract Awarded	
• Current Energy Consumption Analysis	
• M&O Procedures Identified	
• On-Site Analysis Completed	
• Applicable ECM's Identified	
• TA Report Completed	
• M&O Procedures Implemented	
• ECM Application Completed	

Energy Conservation Measures	Date
• Notice of Grant Award	September 1, ______
• Procurement procedures Initiated for Supervision, Design Work, and Labor	
• Contract for Project Supervision (if any)	
• Contract for Design Work (if any)	
• Contract for Labor (if any)	
• Procurement of Materials and Equipment	
• Installation of Materials and Equipment (further detail may be provided)	
• Final Payment to Contractor	

D. JUSTIFICATION STATEMENT

(Provide statement required by Assurance No. 15, if applicable)

E. ANNUAL OPERATING HOURS

(For Technical Assistance Applications only, provide the number of annual operating hours the building was open to the clientele being served by the building during the prior 12 month period. Exclude any days the building was closed to serving its clientele such as weekends, holidays, and acts of nature).

F. INSTITUTIONAL ENERGY MANAGEMENT PLAN CERTIFICATION

I hereby certify that our institution has implemented a comprehensive energy management plan or will develop and implement such a plan within 180 days from the date of this application.

____

First or Second Administrative Officer (Signature)

G. SEVERE HARDSHIP STATEMENT (Provide this information only if you are applying for severe hardship. You must apply for all buildings on a 50% matching funds basis or a severe hardship basis, but not both.)

1. Ratio of Energy Expenditures to Operating Expenditures (provide the information as indicated.)

a. Amount expended for energy during the last fiscal year in all buildings owned by the building owner.*__________

b. Total operating expenditures during the last fiscal year.**__________

c. Ratio of energy expenditures to operating expenditures.__________

2. Severe Hardship Statement (Although all the information identified below will not be required (with the exception of (a) and (b) which are required) by the building owner, the building owners* which provide justification of severe hardship based on these or similar data will receive the most credit for severe hardship. The following or similar severe hardship information will assist TENRAC in evaluating the applicant's financial need:)

a. Identification of the fifty (50) percent match amount, the additional amount of funding required beyond the fifty (50) percent match up to ninety (90) percent of the total cost of the technical assistance or energy conservation measure, and the total percentage of the measure to be supported by federal funding.

b. Describe how the amount being requested beyond the fifty (50) percent matching requirement is the minimum additional amount needed for the building owner to participate in the program.

c. Total cash disbursements from the operating and capital improvement budgets for each of the past three fiscal years as well as the total estimated cash disbursements from the current fiscal year operating and capital improvements budgets of the building owner. These cash disbursements and budgets should also be calculated on a per occupant basis with identification of the percent change between years.

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*This information must relate to the financial status of the building owner and not just the building relating to a single application. For example, the information would be for a school district or university system rather than just for a high school budget or university campus within a system.

**Exclude federally funded expenditures and debt service on bonds.

d. Year-ending unencumbered balances** from operating and capital improvements budgets for each of the past three fiscal years as well as the total estimated cash disbursements from the current fiscal year operating and capital improvements budgets of the building owner. These cash disbursements and budgets should also be calculated on a per occupant basis with identification of the percent change between years.

e. The current fiscal year operating budget personnel reductions from the previous fiscal year identifying the numbers of personnel cut from the budget. Indicate the percent reductions in the numbers of personnel cut. Indicate reductions, if any, in non-compensation items.

f. The current fiscal year operating budget personnel increases over the previous fiscal year identifying the number of personnel added to the payroll. Indicate the percent increase in the number of personnel added. Indicate increases, if any, in non-compensation items.

g. The percent change in compensation (salary plus fringe benefits) of all personnel employed by the building owner between each of the past three fiscal years and the percent change from the last fiscal year to the current fiscal year.

h. Other information may be provided by the building owners to justify severe hardship funding.

**Unencumbered balances is defined as total revenues of the building owner which have neither been disbursed nor committed to a vendor or other party not employed by the building owner.

PART V: ASSURANCES

SPECIFIC INSTRUCTIONS

This part contains the certifications required of applicants for Federal grants. The applicant shall certify in its application for, and acceptance and use of Federal funds, that it will comply with the laws and regulations governing these grant programs.

The Assurances section applies to the original application and to any subsequent modification or amendments.

The Applicant hereby assures and certifies that he will comply with the regulations, policies, guidelines, and requirements, including OMB Circular No. A–102 and FMC 74–4, as they relate to the application, acceptance and use of Federal funds for this federally assisted project.† Also the Applicant assures and certifies with respect to the grant that:

1. It possesses legal authority to apply for the grant; that a resolution, motion or similar action has been duly adopted or passed as an official act of the applicant's governing body, authorizing the filing of the application, including all understandings and assurances contained therein, and directing and authorizing the person identified as the official representative of the applicant to act in connection with the application and to provide such additional information as may be required.
2. It will comply with Title VI of the Civil Rights Act of 1964 (P.L. 88-352) and in accordance with Title VI of that Act, no person in the United States shall, on the ground of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be otherwise subjected to discrimination under any program or activity for which the applicant receives Federal financial assistance and will immediately take any measures necessary to effectuate this agreement.
3. It will comply with Title VI of the Civil Rights Act of 1964 (42 USC 2000d) prohibiting employment discrimination where (1) the primary purpose of a grant is to provide employment or (2) discriminatory employment practices will result in unequal treatment of persons who are or should be benefiting from the grant aided activity.
4. It will comply with requirements of the provisions of the Uniform Relocation Assistance and Real Property Acquisitions Act of 1970 (P.L. 91-646) which provides for fair and equitable treatment of persons displaced as a result of Federal and federally assisted programs.
5. It will comply with the provisions of the Hatch Act which limit the political activity of employees.
6. It will comply with the minimum wage and maximum hours provisions of the Federal Fair Labor Standards Act, as they apply to hospital and educational institution employees of State and local governments.
7. It will establish safeguards to prohibit employees from using their positions for a purpose that is or gives the appearance of being motivated by a desire for private gain for themselves or others, particularly those with whom they have family, business, or other ties.
8. It will give the sponsoring agency or the Comptroller General through any authorized representative the access to and the right to examine all records, books, papers, or documents related to the grant.
9. It will comply with all requirements imposed by the Federal sponsoring agency concerning special requirements of law, program requirements, and other administrative requirements.
10. It will insure that the facilities under its ownership, lease or supervision which shall be utilized in the accomplishment of the project are not listed on the Environmental Protection Agency's (EPA) list of Violation Facilities and that it will notify the Federal grantor agency of the receipt of any communication from the Director of the EPA Office of Federal Activities indicating that a facility to be used in the project is under consideration for listing by the EPA.

† The regulation which we wish to bring to your attention is 10CFR 455.

11. It will comply with the flood insurance purchase requirements of Section 102(a) of the Flood Disaster Protection Act of 1973, Public Law 93-234, 87 Stat. 975, approved December 31, 1976. Section 102(a) requires, on and after March 2, 1975, the purchase of flood insurance in communities where such insurance is available as a condition for the receipt of any Federal financial assistance for construction or acquisition purposes for use in any area that has been identified by the Secretary of the Department of Housing and Urban Development as an area having special flood hazards. The phrase "Federal financial assistance" includes any form of loan, grant, guaranty, insurance payment, rebate, subsidy, disaster assistance loan or grant, or any other form of direct or indirect Federal assistance.

12. It will assist the Federal grantor agency in its compliance with Section 106 of the National Historic Preservation Act of 1966 as amended (16 U.S.C. 470), Executive Order 11593, the Archeological and Historic Preservation Act of 1966 (16 U.S.C. 469a-1 et seq.) by (a) consulting with the State Historic Preservation Officer on the conduct of investigations, as necessary, to identify properties listed in or eligible for inclusion in the National Register of Historic Places that are subject to adverse effects (see 36 CFR Part 800.8) by the activity, and notifying the Federal grantor agency of the existence of any such properties, and by (b) complying with all requirements established by the Federal Grantor agency to avoid or mitigate adverse effects upon such properties.

13. It meets the eligibility requirements contained in 10 CFR 455.41 (for applications for technical assistance), or 10 CFR 455.51 (for applications for energy conservation measures).

14. It has or will satisfy the requirements set forth in 10 CFR 455.60.

15. It has implemented all energy conservation maintenance and operating procedures identified in an energy audit or its equivalent (for applications for technical assistance), or identified in an energy audit and technical assistance program or their equivalents (for applications for energy conservation measures), unless an exception is requested as provided in 10 CFR 455.41 (d) and 10 CFR 455.51 (a)(4) which permit the applicant to "provide a satisfactory written justification for not implementing any specific maintenance and operating procedures." (In such a case, the applicant has attached a list of the specific maintenance and operating procedures not implemented as well as a justification for not implementing each procedure. Reference to State or Federal schedules will not be accepted as justification for not implementing each procedure).

16. It will expend funds granted under 10 CFR 455 for the purposes stated in this application and in compliance with the requirements of 10 CFR 455 and the approved Texas State Plan.

17. It will obtain from the technical assistance analyst, prior to the analyst performing work in connection with a technical assistance program or energy conservation measure, a signed statement certifying that the technical assistance analyst has no conflicting financial interest and is otherwise qualified to perform the functions of a technial assistance analyst in accordance with the requirements set forth in the Texas State Plan.

18. It will comply with all reporting requirements contained in 10 CFR 455.63.

19. It will not enter into any contract relating to an energy conservation measure which requires or may require expenditure of more than $5,000 (excluding technical assistance program costs), that does not conform to the provisions of the Davis-Bacon Act (40 U.S.C. Sections 276 a-5).

20. It will provide the required matching non-Federal funds, including in-kind contributions (limited to the goods and services described in OMB Circular A-102), and that such funds or contributions are directly related to the project.

21. It will comply with the civil rights requirements pursuant to 10 CFR 455.3(a)(8).

22. It has implemented or will develop and implement a comprehensive energy management plan within 180 days from the date of this application if credit has been claimed toward the grant ranking value for technical assistance or energy conservation measures.

23. It will not reallocate any funds, which were previously allocated for energy conservation projects by the institution, for any purposes unrelated to energy conservation because of the receipt of federal funding. Thus, the federal funding will supplement and not supplant institutional funds already allocated for energy conservation projects.

Authorized Certifying Representative (Signature)

FORMS

ENERGY SAVINGS CHART (TABLE A)

PRELIMINARY ENERGY AUDIT

ENERGY AUDIT

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Complete for ECM Application Only

SAMPLE

TABLE A
ENERGY SAVINGS CHART

REVISED 2/11/80

Date	Category of Building	Building Use Category
5/30/80	HOSPITAL	GENERAL

Building Name & I.D. Number: MEDICAL SCHOOL HOSPITAL 012

Name and Address of Building Owner: GREATER TEXAS UNIVERSITY 61 ADAMS, STILLS, TX 77336

Component Institution Name & I.D. No.: PANHANDLE CAMPUS 703

Contact Person Name, Address, & Telephone No.: JOHN DOE GTU SYSTEM, 61 ADAMS, STILLS, TX (315) 472-1980

Bldg Size: 453,770 Gross Square Feet

Name of Energy[1] Conservation Measure (1)	I or D	TA P	Total[1] Cost of Measure ($) (2)	Average[2] Simple Payback (Years) (3)	Annual Energy Cost Savings[3] ($): Renewable (4)	Coal (5)	Oil (6)	Natural Gas (7)	Electricity (8)	Other (9)	Total (10)
HIGH EFFICIENCY BOILER CONTROLS	I	15	87,227	7.0	—	—	—	12,572	-111 **	—	12,461
ROOFTOP SOLAR COLLECTORS	I	18	280,000	13.27	21,100	—	—	(20,000)	(1,100)	—	21,100
TIME SCHEDULING CONTROL FOR HVAC SYSTEM	I	25	3,500	3.47	—	—	—	477	533	—	1,010
TOTAL			370,727	Av. S.P.P.[5] 10.72	21,100			13049	422		34,571

Number of Energy Units Saved (Gal., MCF, KWH, Etc.)
Annual Btu Saved
Annual Btu/GSF Saved By Energy Type[4]

Name of Energy Conservation Measure	Oil Gal/Btu/Btu/GSF (11)	Natural Gas MCF/Btu/Btu/GSF (12)	Electricity KWH/Btu/Btu/GSF (13)	Other[7] ___/Btu/Btu/GSF (14)	Total Btu/Btu/GSF (15)
HIGH EFFICIENCY BOILER CONTROLS		4854	-3966 **		
		5000×10^6	-46×10^6		4954×10^6
		11019	-101		10918
ROOFTOP SOLAR COLLECTORS		7722	39138		
		7954×10^6	454×10^6		8408×10^6
		17529	1001		18530
TIME SCHEDULING CONTROL FOR HVAC SYSTEM		184	15966		
		190×10^6	220×10^6		410×10^6
		418	485		903
TOTAL		12760	54138		
		13144×10^6	628×10^6		13772×10^6
		28966	1385		30351

[1] Name of measure and cost of measure must be the same as identified in the TA report. After name of ECM, enter "D" if the ECM energy savings calculations or feasibility are dependent (D) upon the installation of one or more of the other ECMs, enter "I" if the ECM energy savings calculations or feasibility are independent of the other ECMs. After "I" or "D", enter page number(s) of TA report where the ECM analysis is located.

[2] The average simple payback is the total cost of the measure, as determined pursuant to 10 CFR 455.42(b)(5)(ii) divided by the estimated annual cost savings accruing from the measure, as determined pursuant to 10 CFR 455.42(b)(5)(vi). The annual cost savings must be calculated on the basis of 10 CFR 455.42(b)(5)(vi) as described in footnote #3.

[3] Annual energy cost savings must be calculated by multiplying the number of energy units saved (Gal., MCF, KWH, etc.) by the appropriate energy cost rate. Identify cost savings for converting to renewable or coal under headings for renewable or coal (cols. 4, 5); also, identify cost savings for renewable or coal in parentheses ( ) under the headings of the type(s) of energy being saved (cols. 6, 7, 8, 9). Do not duplicate the renewable or coal response(s) (cols. 4, 5) and the response(s) by energy type (cols. 6, 7, 8, 9) for the same ECM in the total column (col. 10). See sample Table A.

[4] The annual energy savings calculations must be based on the federal conversion factors in 10 CFR 450.42(a)(11) and the State PEA and EA forms. Identify the annual number of energy units saved, the annual Btu saved, and the annual Btu saved per gross square foot (GSF). Any increased energy loads caused by the operation of the ECM must be considered in calculating the net annual energy savings. See sample Table A, footnote (**).

[5] The average simple payback period (S.P.P.) for all measures is the total cost of all measures, as determined pursuant to 10 CFR 455.42(b)(5)(ii), divided by the estimated annual cost savings accruing from all the measures, as determined pursuant to 10 CFR 455.42(b)(5)(vi). The annual cost savings must be calculated on the basis of 10 CFR 455.42(b)(5)(vi) as described in footnote #3. The total average simple payback period equals the total of column (2) divided by the total of column (10).

[6] Identify the current energy rates used in the above calculations. The energy cost rates are determined by dividing the total energy units saved by fuel type by the total cost of the fuel type during the prior 12 month period. The average annual rate must be the same as identified in the TA report. Identify "other" if used.

[7] Identify in the column headings for "other" the type of energy being saved.

Current Energy Cost Rates
For Energy Types Saved[6]

Natural Gas	$2.59	MCF
Electricity	$0.0211	KWH
Fuel Oil #2	$	Gal.
Fuel #6	$	Gal.
Steam	$	Lb.
Pur. Steam/Hot Water	$	MMBTU
Chilled Water	$	Ton Hrs.
Propane	$	Gal.
Butane	$	Gal.
Coal	$	S. Ton
Other	$	
Other	$	

** ELECTRIC MOTORS CONNECTED TO THE CONTROLS CAUSE A LOAD ON THE ELECTRIC SYSTEM.

Complete for ECM Application Only

SEE SAMPLE TABLE A

REVISED 2/11/80

TABLE A
ENERGY SAVINGS CHART

Date ____ Category of Building ____ Building Use Category ____

Building Name & I.D. Number ____

Name and Address of Building Owner ____

Component Institution Name & I.D. No. ____

Contact Person Name, Address, & Telephone No. ____

Name of Energy[1] Conservation Measure (1)	I or D	TA P	Total[1] Cost of Measure ($) (2)	Average[2] Simple Payback (Years) (3)	Annual Energy Cost Savings[3] ($) Renew-able (4)	Coal (5)	Oil (6)	Natural Gas (7)	Electricity (8)	Other ____ (9)	Total (10)	Number of Energy Units Saved (Gal., MCF, KWH, Etc.) Annual Btu Saved Annual Btu/GSF Saved By Energy Type[4] — Oil Gal/Btu/Btu/GSF (11)	Natural Gas MCF/Btu/Btu/GSF (12)	Electricity KWH/Btu/Btu/GSF (13)	Other[7] ____ /Btu/Btu/GSF (14)	Bldg. Size ____ Gross Square Feet — Total Btu/Btu/GSF (15)
TOTAL				Av. S.P.P.[5]												

[1] *Name of measure and cost of measure* must be the same as identified in the TA report. After name of ECM, enter "D" if the ECM energy savings calculations or feasibility are dependent (D) upon the installation of one or more of the other ECMs; enter "I" if the ECM energy savings calculations or feasibility are independent of the other ECMs. After "I" or "D", enter page number(s) of TA report where the ECM analysis is located.

[2] *The average simple payback* is the total cost of the measure, as determined pursuant to 10 CFR 455.42(b)(5)(ii) divided by the estimated annual cost savings accruing from the measure, as determined pursuant to 10 CFR 455.42(b)(5)(vi). The annual cost savings must be calculated on the basis of 10 CFR 455.42(b)(5)(vii) as described in footnote #3.

[3] *Annual energy cost savings* must be calculated by multiplying the number of energy units saved (Gal., MCF, KWH, etc.) by the appropriate energy cost rate. Identify cost savings for converting to renewable or coal under headings for renewable or coal (cols. 4, 5); also, identify cost savings for renewable or coal in parentheses, (), under the headings of the type(s) of energy being saved (cols. 6, 7, 8, 9). Do not duplicate the renewable or coal response(s) (cols. 4, 5) and the response(s) by energy type (cols. 6, 7, 8, 9) for the same ECM in the total column (col. 10). See sample Table A.

[4] *The annual energy savings calculations* must be based on the federal conversion factors in 10 CFR 450.42(a)(11) and the State PEA and EA forms. Identify the annual number of energy units saved, the annual Btu saved, and the annual Btu saved per gross square foot (GSF). Any increased energy loads caused by the operation of the ECM must be considered in calculating the *net* annual energy savings. See sample Table A, footnote (**).

[5] *The average simple payback period (S.P.P.)* for all measures is the total cost of all measures, as determined pursuant to 10 CFR 455.42(b)(5)(ii), divided by the estimated annual cost savings accruing from all the measures, as determined pursuant to 10 CFR 455.42(b)(5)(vi). The annual cost savings must be calculated on the basis of 10 CFR 455.42(b)(5)(vii) as described in footnote #3. The total average simple payback period equals the total of column (2) divided by the total of column (10).

[6] Identify the current energy rates used in the above calculations. The energy cost rates are determined by dividing the total energy units saved by fuel type by the total cost of the fuel type during the prior 12 month period. The average annual rate must be the same as identified in the TA report. Identify "other" if used.

[7] Identify, in the column headings for "other", the type of energy being saved.

Current Energy Cost Rates For Energy Types Saved[6]

Natural Gas	$ ____ /MCF
Electricity	$ ____ /KWH
Fuel Oil #2	$ ____ /Gal.
Fuel #6	$ ____ /Gal.
Steam	$ ____ /Lb.
Pur. Steam/Hot Water	$ ____ /MMBTU
Chilled Water	$ ____ /Ton Hrs.
Propane	$ ____ /Gal.
Butane	$ ____ /Gal.
Coal	$ ____ /S. Ton
Other	$ ____ / ____
Other	$ ____ / ____

PRELIMINARY ENERGY AUDIT

AUDIT DATE: (a1) ____________

FORM PEA-1

(a) COMPONENT INSTITUTION NAME & I.D. NO. ____ (b) BUILDING ____ (c) BUILDING ADDRESS ____

(d) CATEGORY OF BLDG. ____ (e) BUILDING USE CATEGORY ____ (f) BUILDING OPERATOR NAME, ADDRESS & TELEPHONE ____

(g) NAME AND ADDRESS OF OWNER ____ PUBLIC ( ) PRIVATE NON-PROFIT ( ) INDIAN TRIBE ( )

(jj) PEA AUDITOR NAME, ADDRESS & TELEPHONE: ____________

I BASIC BUILDING DATA

BUILDING SIZE (h)	OPERATING SCHEDULE							BASIC HVAC CONTROL DATA
	DAYS	TIME PERIOD: HRS/OCCUPANTS/% GSF			(m) PARTIAL USAGE (n)			
		(j) DAYLIGHT	(k) EVE	(l) NITE	QTR	WEEKS	% GSF	
	M-F	/ /	/ /	/ /	1st			CENTRAL BLDG. PANEL (q) YES ____ NO ____
DATE (i) CONSTRUCTED	SAT	/ /	/ /	/ /	2nd			"FCMS" CONNX (s) YES ____ NO ____
	SUN	/ /	/ /	/ /	3rd			
					4th			

II MAJOR ENERGY USING SYSTEMS

PRIMARY HEAT SOURCE (u)	PRIMARY COOLING SOURCE (v)	SPACE TERMINAL HEAT (w)	SPACE TERMINAL COOLING (x)	DOMESTIC HOT WATER SOURCE (y)	INTERIOR LIGHTING SYSTEM (z)	SPECIAL BUILDING SYSTEMS & FACILITIES (aa)
					INCAN. ____ % FLUOR. ____ % H.I.D. ____ %	

III UNIQUE BUILDING CHARACTERISTICS

1. YEAR ROUND, 24 HR. PER DAY OPERATION YES ____ NO ____ (bb)
2. 9 MONTH PER YEAR OPERATION YES ____ NO ____ (cc)
3. SUMMER PROGRAM USE YES ____ NO ____ (dd)
4. EVENING CLASS SCHEDULE YES ____ NO ____ (ee)
5. BUILDING HAS EXTERIOR FLOODLIGHTING YES ____ NO ____ (ff)
6. LIST YEAR & TYPE OF MAJOR BUILDING MODIFICATIONS AND ADDITIONS (gg) ____________ TOTAL # OF MAJOR MOD. & ADD. ____
7. OTHER: (hh) ____________

4-79 Revised 4/23/79

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P R E L I M I N A R Y   E N E R G Y   A U D I T

(b) BUILDING NAME & I.D. NUMBER ______________________ (h) BUILDING SIZE (GROSS SQ.FT.) ______________________

(b1) COMPONENT INSTITUTION NAME & I.D. NUMBER ______________________

FORM PEA-2

IV   E N E R G Y   U S E   &   C O S T   D A T A   (ii) FOR YEAR ENDING AUG. 31   METERED ____ BEST ESTIMATE ____

MONTH	E L E C T R I C I T Y			N A T U R A L G A S			O I L - #2 or # ____			P U R C H A S E D T H E R M A L				TOTAL ENERGY COSTS $ (xx)
										STEAM-HOT WATER		CHILLED WATER		
	KWH (jj)	COST $ (kk)	$/KWH (ll)	MCF (mm)	COST $ (nn)	$/MCF (oo)	GAL (pp)	COST $ (rr)	$/GAL (ss)	MMBTU OR LBS. (tt)	COST $ (uu)	TON HRS (vv)	COST $ (ww)	
SEPTEMBER														
OCTOBER														
NOVEMBER														
DECEMBER														
JANUARY														
FEBRUARY														
MARCH														
APRIL														
MAY														
JUNE														
JULY														
AUGUST														
ANNUAL TOTALS	①		AVG.	②		AVG.	③		AVG.	④		⑤		

ANNUAL ENERGY CONSUMPTION IN BTU'S: (10^6 identifies the number in millions)

(1) (yy) Electricity ______________ KWH X 0.0116 = ______ x 10^6 BTU
(2) (zz) Nat. Gas ______________ MCF X 1.03 = ______ x 10^6 BTU
(3) (aaa) Fuel Oil #2 ______________ GAL X 0.138690 = ______ x 10^6 BTU
(4) (bbb) Fuel Oil #6 ______________ GAL X 0.149690 = ______ x 10^6 BTU
(5) (ccc1) Steam/Hot Water ______________ MMBTU X 1.0 = ______ x 10^6 BTU
or
(6) (ccc2) Steam ______________ LBS X 0.001390 = ______ x 10^6 BTU
(7) (ddd) Chilled Water ______________ TON HRS X 0.012 = ______ x 10^6 BTU
(8) (eee) Propane or Butane ______________ GAL X 0.095475 = ______ x 10^6 BTU

______________ X (fff) ______ = ______ x 10^6 BTU
Other Fuel

(ggg) TOTAL ANNUAL BTU'S = ______ x 10^6 BTU

ENERGY UTILIZATION INDEX (EUI)

EUI = $\frac{\text{TOTAL ANNUAL BTU'S}}{\text{BUILDING GROSS SQ. FT.}}$ = BTU's/FT^2/YR

EUI = $\frac{\text{(ggg) \_\_\_\_\_\_,000,000}}{\text{(h)}}$

EUI = (hhh) ______________ BTU's/FT^2/YR

ENERGY COST INDEX (ECI)

ECI = $\frac{\text{TOTAL ANNUAL ENERGY COSTS}}{\text{BUILDING GROSS SQ. FT.}}$ = $/FT^2/YR

ECI = $\frac{\text{(xx) TOTAL}}{\text{(h)}}$

ECI = (iii) ______________ $/FT^2/YR

Revised 5/1/79 2/11/80

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PRELIMINARY ENERGY AUDIT

FORM PEA-3

(b) BUILDING NAME & I.D. NUMBER ______________________

(b1) COMPONENT INSTITUTION NAME & I.D. NUMBER ______________________

V ENERGY CONSERVATION ACTIVITIES

1. NAME OF ENERGY MANAGER FOR BUILDING: (jjj) ______________________
2. HAS WORK WHICH PARTIALLY OR FULLY SATISFIES THE REQUIREMENTS OF AN ENERGY AUDIT ON THIS BUILDING BEEN ACCOMPLISHED PRIOR TO THIS "PEA" DATE? _____ YES, _____ NO. (kkk)
3. HAVE ANY DETAILED ENGINEERING STUDIES BEEN CONDUCTED ON THIS BUILDING OR ITS SYSTEMS PRIOR TO THIS "PEA" DATE? _____ YES _____ NO. (lll) IF "YES" NAME SYSTEMS STUDIED. (mmm) ______________________
4. HAVE ANY ENERGY CONSERVATION MEASURES BEEN CONSIDERED OR IMPLEMENTED ON THIS BUILDING PRIOR TO THIS "PEA" DATE? _____ YES _____ NO. (nnn) IF "YES" LIST THESE MEASURES BELOW WITH ESTIMATES OF THEIR COSTS & ENERGY SAVINGS, IF AVAILABLE:

(ooo) ______________________

5. GENERAL AUDIT COMMENTS: (ppp) ______________________
6. DO YOU INTEND TO CONDUCT AN "ENERGY AUDIT" OF THIS BUILDING? (rrr) YES _____ NO _____

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PRELIMINARY ENERGY AUDIT

(b) BUILDING NAME & I.D. NUMBER ______

(b1) COMPONENT INSTITUTION NAME & I.D. NUMBER ______

FORM PEA-4 4-79

VI RENEWABLE ENERGY RESOURCE POTENTIAL

1. BUILDING LOCATION: _____URBAN, _____SUBURBAN, _____RURAL AREA.

2. BUILDING HEIGHT: _____STORIES.

3. IS OPEN LAND SUCH AS FIELDS, YARDS, PARKING AREAS, WHICH IS NOT HEAVILY SHADED BY TALL BUILDINGS, TREES, OR OTHER OBSTRUCTIONS AVAILABLE IN THE IMMEDIATE VICINITY OF THE BUILDING? _____YES _____NO.

4. IS APPROXIMATELY ONE-HALF OR MORE OF THE BUILDING'S ROOF AREA OR SOUTHERN ORIENTED WALL SURFACES HEAVILY SHADED BY TREES, SHRUBS, BUILDINGS OR OTHER OBSTRUCTIONS? _____YES _____NO.

5. GENERAL DESCRIPTION OF BUILDING SHAPE: _____SQUARE, _____RECTANGULAR, _____H-SHAPED, _____E-SHAPED. _____T-SHAPED, _____L-SHAPED, _____X-SHAPED, _____Y-SHAPED, _____O-SHAPED.

6. ROOF DATA: _____FLAT, _____PITCHED. IF PITCHED, IS PITCH ORIENTED TO SOUTH? _____YES _____NO.

7. EXISTING ROOF OBSTRUCTIONS: _____NONE, _____CHIMNEYS, _____SPACE CONDITIONING UNITS, _____WATER TOWERS, _____EQUIPMENT PENTHOUSES, _____STAIRWELLS, _____OTHER PERMANENT ROOF MOUNTED STRUCTURES.

8. SOUTH FACING WALL MATERIALS: _____MASONRY, _____WOOD, _____ALUMINUM, _____GLASS, _____STEEL, _____COMBINATION.

9. SOUTH FACING WALL GLASS AREA: _____LESS THAN 25%, _____25-75%, _____MORE THAN 75%.

10. PRIMARY SPACE HEATING SYSTEM: _____OUTSIDE BUILDING, _____INSIDE BUILDING; IF INSIDE BUILDING, IS IT LOCATED _____IN BASEMENT, _____ON GROUND FLOOR, _____ON ROOF? IS INSIDE BUILDING HEATING SYSTEM OF _____CENTRAL TYPE, _____MULTIPLE UNITS, OR _____COMBINATION OF BOTH?

11. PRIMARY DOMESTIC HOT WATER SYSTEM: _____OUTSIDE BUILDING, _____INSIDE BUILDING: IF INSIDE BUILDING IS IT LOCATED _____IN BASEMENT, _____ON GROUND FLOOR, _____ON ROOF? IS INSIDE BUILDING DOMESTIC HOT WATER SYSTEM OF _____CENTRAL TYPE, _____MULTIPLE UNITS, OR _____COMBINATION OF BOTH?

12. ARE ANY OF FOLLOWING ENERGY SOURCES AVAILABLE TO THIS IMMEDIATE BUILDING LOCATION? (a) YEAR AROUND STEADY, CONSTANT WIND VELOCITIES, 10 MPH MINIMUM _____YES _____NO. (b) NATURAL WATER STREAM OF MINIMUM 10 FOOT HEAD, CONSTANT YEAR AROUND FLOW _____YES _____NO. (c) NATURAL HOT GROUND WATER WELLS (GEOTHERMAL WELLS) _____YES _____NO. (d) SEACOAST TIDES OF 8 FOOT OR GREATER _____YES _____NO. (e) SOURCE OF LOW COST FOREST TIMBER BY-PRODUCTS _____YES _____NO. (f) ANY OTHER RENEWABLE ENERGY SOURCE _____YES _____NO; IF YES, DESCRIBE ______

______

______

PRELIMINARY ENERGY AUDIT

FORM PEA-5

(b) BUILDING NAME & I.D. NUMBER

(b1) COMPONENT INSTITUTION NAME & I.D. NUMBER

VII BUILDING ENERGY SAVING POTENTIAL

(ttt) CHART OF POTENTIAL ENERGY SAVINGS

1.0 ANNUAL ENERGY USE: (SEE EUI PAGE PEA-2)

BTU/SQ.FT./YR.	WF
400,000 AND ABOVE	9
300,000 TO 400,000	8
200,000 TO 300,000	7
100,000 TO 200,000	6
LESS THAN 100,000	5

2.0 RATIO OF OCCUPANCY/SPACE UTILIZATION HOURS TO HVAC EQUIPMENT OPERATING HOURS:

$\frac{\text{OCCUPANCY/UTILIZATION HRS.}}{\text{HVAC OPERATING HOURS}}$ = RATIO

RATIO	
UNDER 0.20	14.4
0.2 TO 0.4	12.8
0.4 TO 0.6	11.2
0.6 TO 0.8	9.6
0.8 TO 1.0	8.0

3.0 RATED CAPACITY OF HEATING & COOLING EQUIPMENT:

COMBINED HVAC CAPACITY IN BTUH X 10^6	
40 AND ABOVE	9
25 TO 40	8
15 TO 25	7
5 TO 15	6
BELOW 5	5

BUILDING MODIFICATION POTENTIAL:

4.1

BUILDING AGE & REMAINING LIFE (R.L.)	WF
NEW (1-5 YRS) OVER 40 YR. R.L.	3.6
NEW (1-5 YRS) UNDER 40 YR. R.L.	3.2
RECENT (5-15 YRS) OVER 40 YR. R.L.	2.8
RECENT (5-15 YRS) UNDER 40 YR. R.L.	2.4
OLD (OVER 15 YRS)	2.0
OLD (OVER 15 YRS) LESS THAN 5 YR. R.L.	0.0

4.2 TOTAL WALL AREA PERCENT GLASS & INFILTRATION:

% GLASS RANGE	
OVER 40% GLASS	4.5
LARGE INFILTRATION	4.0
UNDER 40% GLASS	3.5
LOW INFILTRATION	3.0
UNDER 15% GLASS	2.5

4.3 LIGHTING LEVELS POTENTIAL REDUCTION:

RANGE	
REDUCED TO 3.0 W/SQ.FT.	6.3
REDUCED TO 2.0 - 3.0 W/SQ.FT.	5.6
REDUCED TO 1.0 - 2.0 W/SQ.FT.	4.9
CAN REDUCE BY SWITCHING CHANGES	4.2
LIGHTING LEVELS CANNOT BE REDUCED	3.5

4.4 PREDOMINANT HVAC SYSTEM:

TYPE	WF
DUAL DUCT OR REHEAT	12.6
MULTIZONE OR INDUCTION UNITS	11.2
ROOFTOP, PACKAGED WALL UNITS, OR UNIT VENTILATION	9.8
FAN-COIL, VAV, OR HEAT/VENT ONLY UNIT	8.4
RADIATION, UNIT HEATERS (NO FAN SYS.)	7.0

4.5 NORMAL OUTSIDE AIR SUPPLY PERCENTAGE:

RANGE	WF
75 TO 100%	8.1
50 TO 75%	7.2
25 TO 50%	6.3
10 TO 25%	5.4
INFILTRATION ONLY WITH TOILET EXHAUST	4.5

4.6 FAN ENERGY:

FAN STATIC PRESS.	GROSS BLDG. SQ.FT./FAN HP	WF
10" OR ABOVE	≅200 SQ.FT./HP	5.4
8" SP TO 10" SP	≅600 SQ.FT./HP	4.8
6" SP TO 8" SP	≅1000 SQ.FT./HP	4.2
4" SP TO 6" SP	≅1500 SQ.FT./HP	3.6
UNDER 4" SP	≅2000 SQ.FT./HP	3.0

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PRELIMINARY ENERGY AUDIT

FORM PEA-6

(b) BUILDING NAME & I.D. NUMBER

(b1) COMPONENT INSTITUTION NAME & I.D. NUMBER

VII BUILDING ENERGY SAVING POTENTIAL (CONT'D)

CHART OF POTENTIAL ENERGY SAVINGS (Continued)

4.7 HVAC CONTROL SYSTEM:

CONDITION	WF
OUTSIDE AIR & RELIEF DAMPERS HANG OPEN	5.4
INOPERATIVE CONTROLS	4.8
NO WRITTEN PREVENTIVE MAINT. PROGRAM	4.2
CONTROLS ARE SERVICED REGULARLY	3.6
CONTROLS UNDER MAINTENANCE CONTRACT	3.0

4.8 BUILDING PROCESS ENERGY BASE LOAD:

% OF TOTAL LOAD	WF
20% BASE LOAD - COULD REDUCE	2.7
15% BASE LOAD - COULD REDUCE	2.4
10% BASE LOAD - COULD REDUCE	2.1
5% BASE LOAD - COULD REDUCE	1.8
NO REDUCTION OF BASE LOADS POSSIBLE	1.5

4.9 HVAC HEAT RECOVERY:

RANGE	WF
100% O.A., RECOVERY FEASIBLE	4.5
75% O.A., RECOVERY FEASIBLE	4.0
50% O.A., RECOVERY FEASIBLE	3.5
100% O.A., RECOVERY DIFFICULT	3.0
HEAT RECOVERY NOT FEASIBLE	2.5

4.10 USER RETROFIT TOLERANCE:

RANGE	WF
USER CAN TOLERATE MAJOR RETROFIT	4.5
USER CAN TOLERATE MINOR RETORFIT	3.5
USER CANNOT TOLERATE ANY DISRUPTIONS	2.5

ENERGY SAVING POTENTIAL TABULATION (uuu)

ITEM	WF
1.0 ANNUAL ENERGY USE	
2.0 RATIO UTILIZ. HRS. TO OPER. HRS.	
3.0 RATED CAP. OF HVAC EQUIP.	
4.1 BUILDING AGE & LIFE EXPECT.	
4.2 PERCENT GLASS & INFILTRATION	
4.3 LIGHTING LEVELS	
4.4 HVAC SYSTEM TYPE	
4.5 OUTSIDE AIR RATIO	
4.6 FAN ENERGY	
4.7 HVAC CONTROL SYSTEM	
4.8 BUILDING BASE LOAD	
4.9 HVAC HEAT RECOVERY	
4.10 USER RETROFIT TOLERANCE	
TOTAL	

4-79 Revised 5/1/79

E N E R G Y   A U D I T

Energy Auditor Certification: I hereby certify that I, ____________ (name of auditor), have participated fully in the Energy Auditor Training Program developed by the Governor's Office of Energy Resources conducted at ____________ (address of training site) by ____________ (Sponsoring Agency-Instructor) on ____________ (date), or in lieu of attending the training session, have completed _____ (# of classroom hrs) hours of educational courses and/or on-the-job experience in analyzing and/or operating the mechanical and electrical and other energy using systems of the type of building or complex being audited. I have attached a copy of official educational transcripts and/or resumes of previous applicable work experience including the address and telephone numbers of such employers if I have claimed past education and/or work experience in lieu of attending the official training program. I further certify that I am not responsible for the day-to-day operations of the building and that a full disclosure of any financial interest which I might have relating to this energy audit or any energy conservation measure is attached hereto. I also certify that the energy audit was conducted in accordance with the requirements set forth under 10 CFR Part 450, paragraph 450.43 of the regulation which was published in the Federal Register dated April 2, 1979.

Signature of Energy Auditor ____________ Energy Auditor Certificate Number ____________ Organization of Auditor ____________ (a) Date ____________

(b) ____________ BUILDING

(c) ____________ BUILDING SIZE (GROSS SQ.FT.)

FOLLOWING PEA FORMS COMPLETED ATTACHED HERETO:

(d) ______ PEA-1, (d1) ______ PEA-2, (e) ______ PEA-3, (e1) ______ PEA-4, (f) ______ PEA-5, (f1) ______ PEA-6

(b1) ____________ COMPONENT INSTITUTION NAME & I.D. NUMBER

____________ NAME AND ADDRESS OF OWNER

FORM EA-1

THE CONTENT OF THIS AUDIT FORM IS DESIGNED TO MEET THE REQUIREMENTS OF FEDERAL REGISTER, APRIL 2, 1979. VOL. 44, No. 64, PARA. 450.43

I   D E S C R I P T I V E   B U I L D I N G   D A T A

1.0 LIST MAJOR CHANGES IN "FUNCTIONAL USE" OR "MODE OF OPERATION" PLANNED FOR NEXT 15 YEARS:

(g) ____________

2.0 FOR BUILDINGS OVER 200,000 GROSS SQUARE FEET AREA, PROVIDE THE FOLLOWING FROM AVAILABLE DATA (AD) OR BY REASONABLE ESTIMATE (BE) IDENTIFY SOURCE IN ALL BLANKS.

2.1 PEAK ELECTRICAL DEMAND IN KW: (h) ____________

MONTHS (h1) ______, ______, ______, DAY (j) ______, ______, ______,

HOUR OF DAY (k) ______, ______, ______.

2.2 PROVIDE BELOW THE ANNUAL ENERGY USE OF THE MAJOR BUILDING SYSTEM BY FUEL TYPE:

3.0 GENERAL BUILDING & SYSTEMS CONDITION:

(y) ____________

MAJOR SYSTEM (l)	ELECTRICITY		NATURAL GAS		#2 OIL		CENTRAL PLANT THERMAL			10^6 TOTAL BTU
	KWH (m)	10^6 BTU (n)	MCF (o)	10^6 BTU (p)	GAL (r)	10^6 BTU (s)	STEAM-HOT WATER (t) 10^6 BTU	CHILLED WATER TON HRS. (u)	CHILLED WATER 10^6 BTU (v)	(w)

BTU CONVERSION FACTORS (x) (10^6 identifies the number in millions)

ELEC. ______	KWH x 0.011,600 =	______ 10^6 BTU	STEAM/HW ______	MMBTU x 1.0	=	______ 10^6 BTU
NAT.GAS. ______	MCF x 1.03 =	______ 10^6 BTU	STEAM ______	LBS x 0.001,390	=	______ 10^6 BTU
OIL #2 ______	GAL x 0.138,690 =	______ 10^6 BTU	CH.WATER ______	TON HR x 0.012,000	=	______ 10^6 BTU
OIL #6 ______	GAL x 0.149,690 =	______ 10^6 BTU	OTHER ______	x ______	=	______ 10^6 BTU
			OTHER ______	x ______	=	______ 10^6 BTU

4/79 Revised 4/23/79 Revised 5/1/79 Revised 2/6/80

E N E R G Y   A U D I T

(b) ______________________ BUILDING NAME

(c) ______________________ BUILDING SIZE (GROSS SQ. FT.)

(b1) ______________________ COMPONENT INSTITUTION NAME & I.D. NUMBER

FORM EA-2   4-79 REVISED 4-23-79   5/1/80

I DESCRIPTIVE BUILDING DATA (CONTINUED)

4.0 CLIMATIC FACTORS:

4.1 AVERAGE ANNUAL HEATING DEGREE DAYS ______________   4.2 AVERAGE ANNUAL COOLING DEGREE DAYS ______________

4.3 AVERAGE MONTHLY SOLAR INSOLATION, HORIZONTAL SURFACES IN BTU/SQ.FOOT AND WIND VELOCITY IN MPH

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
SOLAR (A)												
WIND VEL.(B)												

5.0 ROOF CHARACTERISTICS:

5.1 PRIMARY STRUCTURAL COMPONENT: ____STEEL, ____WOOD, ____REINF. CONC., ____OTHER, SPECIFY ______________

5.2 ROOF SURFACE: ____BUILT UP, ____SLATE, ____TILE, ____WOOD SHINGLES, ____COMP. SHINGLES, ____OTHER ______________

II ENERGY CONSERVATION MAINTENANCE & OPERATION PROCEDURES

1.0 COMPLETE FOLLOWING TABLE USING ANNUAL TOTALS FOR FISCAL YEARS ENTERED, CONVERSION FACTORS LISTED ON FORM EA-1, & TOTALS OF BTU CONSUMPTION PER YEAR. PROVIDE INFORMATION FOR INDIVIDUALLY METERED BUILDINGS ONLY. USE ACTUAL DATA. (10^6 identifies the number in millions)

FISCAL YEAR (z)	ELECTRICITY (aa)		NATURAL GAS (bb)		#2 OIL (cc)		CENTRAL PLANT THERMAL (dd)			(ee)	TOTAL BTU/GROSS SQ. FT.*
	KWH	BTU X 10^6	MCF	BTU X 10^6	GAL	BTU X 10^6	STEAM-HOT WATER MMBTU	CHILLED WATER TON HRS.	CHILLED WATER BTU X 10^6	(ff)	TOTAL BTU X 10^6
BASE YEAR		X X X		X X X		X X X	X X X X X		X X X	(ee)	Btu/GSF
	X X X		X X X		X X X			X X X		(ff)	x 10^6 Btu
COMPARISON YR.		X X X		X X X		X X X	X X X X X		X X X	(ee)	Btu/GSF
	X X X		X X X		X X X			X X X		(ff)	x 10^6 Btu
LAST FULL YR		X X X		X X X		X X X	X X X X X		X X X	(ee)	Btu/GSF
	X X X		X X X		X X X			X X X		(ff)	x 10^6 Btu

2.0 LIST OF MAINTENANCE PROCEDURES AND OPERATING PROCEDURES WHICH HAVE BEEN IMPLEMENTED OVER ABOVE TIME SPAN OF YEARS TO REDUCE ENERGY CONSUMPTION.

(gg) ______________________ ______________________

(BASE YEAR: BTU/SQ. FT.) (hh) ____________ — (LESSER COMPARISON YEAR: BTU/SQ.FT.) (jj) ____________ = (kk) ____________ BTU/SQ. FT. REDUCTION

(kk) ____________ BTU/SQ. FT. REDUCTION ÷ (hh) ____________ BASE YEAR: BTU/SQ.FT. = (ll) ____________ % REDUCTION FROM BASE YEAR

*Move Btu decimal point six places to the right before dividing by GSF since Btu is expressed in millions.

E N E R G Y   A U D I T

(b) ______________________________ BUILDING OR COMPLEX NAME & ID NUMBER

(c) ______________________________ BUILDING SIZE (GROSS SQ. FT.)

(b1) ______________________________ COMPONENT INSTITUTION NAME & I.D. NUMBER

III RECOMMENDED ENERGY CONSERVATION MAINTENANCE & OPERATION PROCEDURES

PROVIDE FOLLOWING RECOMMENDATIONS BASED ON AN ON-SITE INSPECTION OF BUILDING:

1. SCHEDULED PREVENTIVE MAINTENANCE PLAN. RECOMMEND (mm) ________ YES ________ NO; IN EXISTENCE (nn) ________ YES ________ NO

2. PROVIDE A GENERAL ESTIMATE, EXPRESSED AS A RANGE, OF ANNUAL ENERGY SAVINGS & ANNUAL ENERGY COST SAVINGS WHICH COULD RESULT FROM IMPLEMENTING THE FOLLOWING MAINTENANCE & OPERATING PROCEDURES.

SYSTEM CHANGES	VALUES	% ENERGY	% COST
VENTILATION SYSTEM OPERATION	% SUB-TOTAL	(oo)	(pp)
REDUCED VENTILATION	2.0		
VARIABLE VENTILATION	1.0		
UNOCCUPIED AREA VENTILATION SHUT DOWN	0.5		
REPAIR OF CAULKING & WEATHER STRIPPING	0.5		
MAINTENANCE & REPAIR OF OPERATING CONTROLS	1.0		
HEATING & COOLING SYSTEM OPERATION	SUB-TOTAL	(rr)	(ss)
CHANGE IN THERMOSTAT CONTROL SET POINTS	2.0		
PROVIDE LOCKING THERMOSTAT COVERS	1.0		
RESET OF AIR & WATER TEMPERATURES	2.0		
UNOCCUPIED RESET OR SHUT DOWN OF SYSTEM	2.0		
SHUT DOWN NON-CRITICAL EXHAUST SYSTEMS	1.0		
LIGHTING SYSTEMS OPERATING	SUB-TOTAL	(tt)	(uu)
REDUCE ILLUMINATION LEVELS	3.0		
MAXIMIZE USE OF DAYLIGHT	1.0		
INSTALL HIGH EFFICIENCY LAMPS	1.0		
REDUCE OR DELETE EVENING CLEANING HOURS	2.0		

SYSTEM CHANGES		% ENERGY	% COST
WATER SYSTEMS OPERATIONS	% SUB-TOTAL	(vv)	(ww)
REPAIR ALL LEAKS	0.5		
REDUCTION OF WATER CONSUMPTION (FLOW RESTRICTION)	0.5		
REDUCE HOT WATER TEMPERATURE	1.0		
INCREASE CHILLED WATER TEMPERATURE	1.0		
UTILITY PLANT & DISTRIBUTION SYSTEM OPERATION	SUB-TOTAL	(xx)	(yy)
EQUIPMENT CLEANING	0.5		
ADJUSTMENT OF AIR/FUEL RATIO	0.5		
COMBUSTION MONITORING & CONTROL	[illegible]		
ADJUSTMENT OF DRIVES, FANS, MOTORS, ETC.	1.0		
STEAM TRAP MAINTENANCE	1.5		
PIPE INSULATION REPAIR	1.0		
OTHER MAINTENANCE & OPERATION PROCEDURES	SUB-TOTAL	(zz)	(aaa)
______________________			
______________________			
______________________			
______________________			
______________________			
TOTALS			

FORM EA-3 4-79 REVISED 4-23-79

E N E R G Y   A U D I T

(b) ______________________ BUILDING OR COMPLEX NAME & ID NUMBER

(c) ______________________ BUILDING SIZE (GROSS SQ. FT.)

(b1) ______________________ COMPONENT INSTITUTION NAME & I.D. NUMBER

FORM EA-4 4-79 REVISED 4-23-79

IV ENERGY CONSERVATION RETROFIT RECOMMENDATIONS

1.0 BASIC BUILDING DATA: 1.1 ANNUAL ENERGY USE (bbb) ______________________ BTU/GROSS SQ. FT. PER YEAR

1.2 ANNUAL ENERGY COST (ccc) ______________________ $/GROSS SQ. FT. PER YEAR

1.3 DESCRIBE PHYSICAL CONDITION OF BUILDING ENVELOPE: (ddd) ______________________

____

1.4 DESCRIBE PHYSICAL CONDITION OF BUILDING ENERGY USING SYSTEMS: (eee) ______________________

____

2.0 BASED ON 1.1, 1.2, 1.3, AND/OR 1.4 ABOVE INDICATE THE NEED & POTENTIAL FOR ENERGY CONSERVATION RETROFIT IMPLEMENTATION. BRIEFLY OUTLINE RECOMMENDED RETROFIT OPTIONS:

(fff) ______________________

____

3.0 BASED ON DATA NOTED IN SECTION VI, FORM PEA-4 & ITEMS 4.0 & 5.0, FORM EA-2 THE AUDITOR SHALL INDICATE WHETHER OR NOT THE BUILDING CONDITIONS AND/OR SITE CHARACTERISTICS PRESENT AN OPPORTUNITY TO APPLY SOLAR HEATING AND/OR COOLING SYSTEMS, OR SOLAR DOMESTIC HOT WATER HEATING SYSTEMS. ____YES, ____NO

V ENERGY CONSERVATION RETROFIT ASSESSMENT

1.0 DESCRIBE PROPOSED ENERGY CONSERVATION PROCEDURE (ECP): (ggg) ______________________

____

____

2.0 ESTIMATE OF INSTALLED COST OF ABOVE ECP: (hhh) $ ______________________

3.0 ESTIMATE OF ANNUAL ENERGY COST SAVINGS FOR ABOVE ECP: (iii) $ ______________________

4.0 PROJECTED SIMPLE PAYBACK PERIOD FOR ABOVE ECP IN YEARS:

ITEM 2.0 $ ______________ (hhh) ÷ ITEM 3.0 $ ______________ (iii) = ______________ (jjj) YEARS

THE IMPLEMENTATION OF ENERGY CONSERVATION MAINTENANCE AND OPERATING PROCEDURES ARE A PREREQUISITE CONDITION FOR ELIGIBILITY FOR RECEIVING FEDERAL ASSISTANCE UNDER THE TECHNICAL ASSISTANCE PROGRAM AS DESCRIBED IN 10 CFR PART 455, D.O.E. RULES & REGULATIONS.

GLOSSARY OF COMMON ENERGY TERMS

Absorption Chiller: A refrigeration machine using heat as the power input to generate chilled water.

Air Changes: Replacement of air in a room over a period of time. Often in cubic feet per minute (CFM).

Alternate Energy Source: A non-depletable energy source such as solar, geothermal, wind, etc.

Ambient Air: Existing air.

Ancillary: Miscellaneous energy consuming equipment.

Average Occupancy: The number of people in a building over a 24-hour period.

Ballast: A device used in starting circuit for fluorescent and high intensity discharge lamps.

Base: A selected time unit with consumption level or dollar amounts to which all future usage or costs are compared.

Blow Down: The discharge of water from a boiler or cooling tower sump that contains a high proportion of total dissolved solids.

British Thermal Unit (BTU): A heat unit equal to the amount of heat required to raise one pound of water one degree Fahrenheit.

Building Envelope: All external surfaces which are subject to climatic impact; for example, walls, windows, roof, floor, etc.

Centigrade: The temperature scale on which the freezing point of water is 0 degrees and the boiling point is 100 degrees at sea level.

Centrifugal Chiller: A device for propelling air by centrifugal action. Forward curved fans have blades which are sloped forward relative to direction of rotation. Backward-curved fans have blades which are sloped backward relative to direction of rotation. Backward-curved fans are generally more efficient at high pressure than forward-curved fans.

CFM: Cubic feet per minute -- usually refer to air change.

Chillers (Centrifugal): A refrigeration machine using mechanical energy input to drive a centrifugal compressor to generate chilled water.

Chimney Effect: The tendency of the cold, denser outside air to replace the heated air through penetrations such as doors, cracks, fireplaces, etc.

Coefficient of Performance: The ratio of the rate of heat removal to the rate of energy input, in consistent units, for a complete refrigerating plant, under designated operating conditions.

Coefficient of Utilization: Ratio of lumens on the work plane to total lumens emitted by the lamps.

Cold Deck: A cold air chamber forming part of a ventilating unit.

Condensate: Water obtained by changing the state of water vapor (i.e., steam or moisture in the air) from a gas to a liquid usually by cooling.

Condenser: A heat exchanger which removes heat from a vapor changing it to its liquid state. (In refrigeration systems, the component which reject heat.)

Conduction: Method of heat transfer where heat moves through a solid.

Control: Any device for regulation of a system or component, manual or automatic.

Convection: Method of heat transfer where heat moves by motion of a fluid or gas, usually air.

Cooling Tower: A device that cools water directly by evaporation.

Damper: A device used to vary the volume of air passing through an air outlet, inlet or duct.

Degree Days: This is the average of the daily maximum or minimum temperatures of any given day. The degree day value for any given day is the differences between 65 degress and the mean daily temperature. Example: Mean daily temperature of 50 degrees -- the degree days are 65 minus 50 degree days. They measure the severity of the entire season.

Demand Load: The requirement of electric energy measured in 15 minute cycles for commercial operations. The price of electric usage is directly related to the level of this demand. The higher the demand, the higher the cost per electrical unit.

Direct Expansion: Generic term used to describe the refrigeration systems where the cooling effect is obtained directly from the refrigerant (e.g., refrigerant is evaporated directly in a cooling coil in the air stream.)

D.O.E.: The Department of Energy.

Double-Bundle Condenser: Condenser (usually in refrigeration machine) that contains two separate tube bundles allowing the option of either rejecting heat to the cooling tower or to another building system requiring heat input.

Dry Bulb Temperature: The measure of the sensible temperature of air.

Economizer Cycle: A method of operating a ventilation system to reduce refirgeration load. Whenever the outdoor air conditions are more favorable (lower heat content) than return air conditions, outdoor air quantity is increased.

Efficacy of Fixtures: Ratio of usable light to energy input for a lighting fixture or system (lumens/watt).

Energy Conservation Project (ECP): An installation or modification to an existing building primarily intended to reduce energy consumption or allow for the use of alternate energy sources. (See The Federal Register for a more detailed definition.)

CONTINUED

4 OF 5

Energy Conservation Project (ECP): A group of related Energy Conservation Measures within a building.

Energy Utilization Index (EUI): A reference which expresses the total energy (fossil fuel and electricity) used by a building in a given period (month, year) in terms of BTU's/gross conditioned square feet.

Enthalpy: For the purpose of air conditioning enthalpy is the total heat content of air and is expressed in units of BTU/lb. It is the sum of sensible and latent heat and ignores internal energy changes due to pressure change.

Evaporator: A heat exchanger which adds heat to a liquid changing it to a gaseous state. (In a refrigeration system, it is the component which absorbs heat.)

Foot-candle: Illumination at a distance of one foot from a standard candle.

Gross Square Feet (GSF): The total number of square feet contained in a building envelope using the floors as area to be measured.

Heat Gain: As applied to HVAC calculations, it is that amount of heat gained by a space from all sources, including people, lights, machines, sunshine, etc. The total heat gain represents the amount of heat that must be removed from a space to maintain indoor comfort conditions.

Heat, Latent: The quantity of heat required to effect a change in state.

Heat Loss: The sum cooling effect of the building structure when the outdoor temperature is lower than the desired indoor temperature. It represents the amount of heat that must be provided to a space to maintain indoor comfort conditions.

Heat, Sensible: Heat that results in a temperature change but no change in state.

Heat, Specific: Ratio of the amount of heat required to raise a unit of mass of material one degree to that required to raise a unit mass of water one degree.

Heat Pump: A refrigeration machine possessing the capability of reversing the flow so that its output can be either heating or cooling. When used for heating, it extracts heat from a low temperature source to the point where it can be used.

Horsepower: British unit of power, 1 H.P. = 746 watts or 42.408 BTU s per minute.

Hot Deck: A hot air chamber forming part of a ventilation unit.

Humidity, Relative: A measurement indicating moisture content of air.

Infiltration: The process by which outdoor air leaks into a building by natural forces through cracks around doors and windows, etc.

Life Cycle Cost: The cost of the equipment over its entire life including operating and maintenance costs.

Load Profile: Time distribution of building heating, cooling and electrical load.

Lumen: Unit of luminous flux.

Luminaire: Light fixture designed to produce a specific effect.

Make-up: Water supplied to a system to replace that lost by blow down, leakage, evaporation, etc.

Modular: System arrangement whereby the demand for energy (heating, cooling) is met by a series of units sized to meet a portion of the load.

NECPA: The National Energy Conservation Policy Act.

Orifice Plate: Device inserted in a pipe or duct which causes a pressure drop across it. Depending on orifice size, it can be used to restrict flow or form part of a measuring device.

Orsat Apparatus: A device for measuring the combustion components of boiler or furnace flue gases.

Outside Air: Air taken from outdoors and therefore not previously circulated through the system.

PEA: Preliminary Energy Audit.

Piggyback Operation: Arrangement of chilled water generation equipment whereby exhaust steam from a steam turbine driven centrifugal chiller is used as the heat source for an absorption chiller.

Plenum: A large duct used as a distributor of air from a furnace.

Power Factor: Relationship between KVA and KW. When the power factor is one, KVA equals KW.

Radiation: The transfer of heat from one body to another by heat waves without heating the air between the bodies.

R-Value: The resistance to heat flow.

Seasonal Efficiency: Ration of useful output to energy input for a piece of equipment over an entire heating and cooling season. It can be derived by integrating part load efficiencies against time.

Software: Term used in relation to computers normally describing computer programs and other intangibles.

Therm: A unit of gas fuel containing 100,000 BTU s.

Ton of Refrigeration: A means of expressing cooling capacity: 1 ton = 12,000 BTU/hour cooling (removal of heat).

'U' Value: A coefficient expressing the thermal conductance of a composite structure in BTU's per (square foot) (hour) (degree F temperature difference).

Veiling Reflection: Reflection of light from a task or work surface into the viewer's eyes.

Vapor Barrier: A moisture impervious layer designed to prevent moisture migration.

Wet Bulb Temperature: The lowest temperature attainable by evaporating water in the air without the addition or subtraction of energy.

Zone: An area composed of a building, a portion of a building, or a group of buildings affected by a single device or piece of equipment.

Sources: Total Energy Management, op. cit., pp. 75-76 and "University of Texas Energy Management Plan," Board of Regents, University of Texas, 1979.

ENERGY TERMS AND SOURCE CONVERSION FACTORS

Energy Use Terminology:*

KWH	=	Kilowatt Hours = 1,000 Watt-Hours
BTU	=	Unit of Energy
MBTU	=	1×10^3 BTU = 1,000 BTU's
MMBTU	=	1×10^6 BTU = 1,000,000 BTU's
CF	=	Cubic Feet (natural gas or water)
CCF	=	Hundreds of Cubic Feet
MCF	=	Thousand of Cubic Feet
1 Ton	=	Air Conditioning Capacity (12,000 BTU per hour)
1 Ton-Hour	=	12,000 BTU
HVAC	=	Heating, Ventilating and Air Conditioning
HVAC System	=	Means all heating and air conditioning equipment including fans, pumps, compressors, etc.

Source Energy Conversion Factors:

1 KWH	=	11,600 BTU's
1 MCF	=	1,030,000 BTU's
1 Gallon Distillate Fuel Oil	=	138,690 BTU's
1 Gallon Residual Fuel Oil	=	149,690 BTU's
1 Short Ton Coal	=	24.5 million BTU's
1 Gallon LPG Gas	=	95,475 BTU's
1 Pound Steam	=	1,390 BTU's

*Source: "University of Texas Energy Management Plan," op. cit.

Energy Data Form

	A		B		C		D		E		F		G	
Month	Reading Date		KWH Used		Measured Demand KW		$ Cost		(F.C.A) Fuel Cost Adjustment ($)		Total Cost (D + E = F)		$/KWH (F ÷ B = G)	
	FROM	TO	CURRENT	BASE	CURRENT	BASE	CURRENT	BASE	CURRENT	BASE	CURRENT	BASE	CURRENT	BASE
Jan														
Feb														
Mar														
Apr														
May														
Jun														
Jul														
Aug														
Sep														
Oct														
Nov														
Dec														
Column B Totals														

On-Site BTU Conversion Factor	x 3,413	x 3,413
Total BTU's		
Column B Totals		
Point of Generation BTU Conversion Factor	x 11,600	x 11,600
Total BTU's		

ELECTRICITY ______________________ KWH/YR.

Electricity Rate No. __________

Building ______________________

NOTES: This form is intended to be a working document. If it is kept monthly, you will see how effective your Energy Conservation Programs are.

CURRENT means current month.

BASE means the corresponding month of your base year.

Energy Data Form

Month	A Reading Date		B Gas Used CCF		C Gas Cost		D Gas Cost Adjustment		E Total Cost (C + D = E)		F $/CCF (E ÷ B = F)		G Heating Degree Days	
	FROM	TO	CURRENT	BASE	CURRENT	BASE	CURRENT	BASE	CURRENT	BASE	CURRENT	BASE	CURRENT	BASE
Jan														
Feb														
Mar														
Apr														
May														
Jun														
Jul														
Aug														
Sep														
Oct														
Nov														
Dec														

TOTAL		
BTU Conversion Factor	x 103,000	x 103,000
Total BTU's		

NATURAL GAS ________________ CCF/YR.

Natural Gas Rate No. ________

Building ________________________

NOTES: This form is intended to be a working document. If it is kept monthly, you will see how effective your Energy Conservation Programs are.

CURRENT means current month.

BASE means the corresponding month of your base year.

NOTE: Billing units may vary according to your utility's billing procedure. For example, natural gas may be billed in cubic feet (CF), in hundreds of cubic feet (CCF), in thousands of cubic feet(MCF), or in therms. Since the PEA form uses MCF, CCF billings, which are common to small buildings; should be converted to MCF on the PEA form by moving the decimal point one place to the left. The example above uses CCF because of its common use in many locations(e.g., 7703 CCF= 770.3 MCF).

Energy Data Form

	A		B		C		D		E		F	
Month	Reading Date		Steam Used (1,000's of Lbs.)		$ Cost		$'s Per 1,000 Lbs. (C ÷ B = D)		Heating Degree Days		Steam Used Per Degree Day (B ÷ E = F)	
	FROM	TO	CURRENT	BASE	CURRENT	BASE	CURRENT	BASE	CURRENT	BASE	CURRENT	BASE
Jan												
Feb												
Mar												
Apr												
May												
Jun												
Jul												
Aug												
Sep												
Oct												
Nov												
Dec												
Column B Totals												

On-Site BTU Conversion Factor	x 1,000	x 1,000
Total BTU's		
Column B Totals		
Point of Generation BTU Conversion Factor	x 1,390	x 1,390
Total BTU's		

STEAM ________________ LBS./YR.

PERCENTAGE TOTAL CONSUMPTION ________________ %

CURRENT YEAR ________________

BASE YEAR ________________

NOTES: This form is intended to be a working document. If it is kept monthly, you will see how effective your Energy Conservation Programs are.

CURRENT means current month.

BASE means the corresponding month of your base year.

Energy Data Form

	A		B		C		D		E		F	
Month	Reading Date		Fuel Used (Gallons)		$ Cost		$/Gallon (C ÷ B = D)		Heating Degree Days		Fuel Used Per Degree Day (B ÷ E = F)	
	FROM	TO	CURRENT	BASE	CURRENT	BASE	CURRENT	BASE	CURRENT	BASE	CURRENT	BASE
Jan												
Feb												
Mar												
Apr												
May												
Jun												
Jul												
Aug												
Sep												
Oct												
Nov												
Dec												
TOTAL												

Conversion Factor:		
#2 Oil	x 138,690	x 138,690
#6 Oil	x 149,690	x 149,690
Propane	x 95,475	x 95,475
Other	x	x
Total BTU's		

OIL ☐ #2 Oil ☐ #6 Oil ____________ Gal./Yr.

PROPANE ____________ Gal./Yr. Other ____________ Gal./Yr.

PERCENTAGE TOTAL CONSUMPTION ____________ %

CURRENT YEAR ____________ BASE YEAR ____________

NOTES: This form is intended to be a working document. If it is kept monthly, you will see how effective your Energy Conservation Programs are.

CURRENT means current month.

BASE means the corresponding month of your base year.

(a) BUILDING NAME AND I. D. NUMBER ______ (c) FISCAL YEAR ______

(v) METER TYPE: K. W. ______ KVAR ______ DEMAND PERIOD:

KWH ______ OTHER ______ 15 Min. ____ Other ____ Min.

ELECTRICITY:

MONTH	10^3 GROSS SQ. FT. BUILDING SIZE (d)	DAYS IN BILLING PERIOD (e)	DEMAND KVA (f)	DEMAND P.F. (g)	DEMAND KW (j)	DEMAND CHARGE $ (k)	10^3 KWH (l)	LOAD FACTOR (m)	FUEL COST ADJUST. $ (n)	TOTAL CHARGES $ (o)	COST PER KWH ¢ (p)	10^6 B T U TOTAL (Nearest whole number) SITE (r)	10^6 B T U TOTAL (Nearest whole number) SOURCE (s)	10^3 B T U PER SQ. FT. SITE (t)	10^3 B T U PER SQ. FT. SOURCE (u)
SEPTEMBER															
OCTOBER															
NOVEMBER															
DECEMBER															
JANUARY															
FEBRUARY															
MARCH															
APRIL															
MAY															
JUNE															
JULY															
AUGUST															
	**	*	AVG.	AVG.	AVG.	*$	*	AVG.	*$	*	¢ AVG.	*	*	*	*

*ANNUAL TOTALS — IN KWH
**Same as August Entry

(m) = (l) ÷ [(j) x (e) x 24 hrs.]
(r) = (l) x 3.413
(s) = (l) x 11.60

(t) = (r) ÷ (d)
(u) = (s) ÷ (d)
(p) = (o) ÷ [(l) x 1000]

ANNUAL PEAK DEMAND: ______

NAME OF ELECTRIC UTILITY: ______
ADDRESS: ______
TELEPHONE: ______
CONTACT: ______
ELECTRIC RATE DESIGNATION: ______

ANNUAL ELECTRIC COST PER SQ. FT. = ANNUAL TOTAL (o) ÷ (d) x 1000 ______
ANNUAL ELECTRIC COST/MMBTU (1,000,000 BTU) = ANNUAL TOTAL (o) ÷ ANNUAL TOTAL (r) = ______ (COST AT SITE)

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(a) BUILDING NAME AND I. D. NUMBER

FISCAL YEAR
(c)

FORM ECC-2 2/79 REV. 3/79

NATURAL GAS:

(b) HEAT CONTENT (at site) ________________ BTU PER CU. FT.

MONTH	10^3 GROSS SQ. FT. BUILDING SIZE (d)	DAYS IN BILLING PERIOD (e)	BILLED MCF (f)	FUEL COST ADJUST. $ (g)	TOTAL CHARGES $ (h)	COST PER MCF $ (j)	10^6 BTU TOTAL SITE (k)	10^6 BTU TOTAL SOURCE (l)	10^3 BTU PER SQ. FT. SITE (m)	10^3 BTU PER SQ. FT. SOURCE (n)	FUEL COST ¢ PER SQ. FT. (o)	FUEL COST PER MMBTU $ SITE (p)	
SEPTEMBER													
OCTOBER													
NOVEMBER													
DECEMBER													
JANUARY													
FEBRUARY													
MARCH													
APRIL													
MAY													
JUNE													
JULY													
AUGUST													
	**	*	*	* $	* $	AVG. $	*	*	*	*	* ¢	$ AVG.	

(j) = (h) ÷ (f)
(k) = (f) x (b) ÷ 1000
(l) = (f) x (b) ÷ 1000 (?)
(m) = (k) ÷ (d)
(n) = (l) ÷ (d)
(o) = (h) ÷ (d) x 1000
(p) = (h) ÷ (k)

Σ N.D.A.

* ANNUAL TOTAL
** SAME AS AUGUST

NAME OF GAS UTILITY : ________________

ADDRESS: ________________

TELEPHONE: ________________

CONTACT: ________________

GAS RATE: ________________

(a) BUILDING NAME AND I.D. NUMBER

METER TYPE:

(c) FISCAL YEAR

CHILLED WATER and STEAM/HOT WATER (STRIKE ONE)

CHILLED WATER

STEAM

CONDENSATE

METER MFGR.

METER MFGR.

METER MFGR.

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MONTH	10^3 GROSS SQ.FT. BUILDING SIZE (f)	DAYS IN BILLING PERIOD (g)	NET BILLED TON-HRS. CHILLED WATER (h)	NET BILLED MMBTU STEAM/HW (j)	FUEL COST ADJUST. $ (k)	TOTAL CHARGES $ (l)	10^6 B T U TOTAL SITE (m)	10^6 B T U TOTAL SOURCE (n)	10^3 B T U PER. SQ. FT. SITE (o)	10^3 B T U PER. SQ. FT. SOURCE (p)	ENERGY COST PER SQ. FT. $ (r)	ENERGY COST $ PER MMBTU (TOTAL) SITE (s)	
SEPTEMBER													
OCTOBER													
NOVEMBER													
DECEMBER													
JANUARY													
FEBRUARY													
MARCH													
APRIL													
MAY													
JUNE													
JULY													
AUGUST													
	**	*	*	*	*$	*$	*	*	*	*	*$	$ AVG.	

* ANNUAL TOTAL

** SAME AS AUGUST

(m) = (h) x 0.012 + (j)

(n) = (m) x (1.0+) Factor (?) N.D.A.

(o) = (m) ÷ (f)

(p) = $\boxed{(m) \div (f)}$ x (1.0+) Factor (?) N.D.A.

(r) = (l) ÷ $\boxed{(f) \times 1000}$

(s) = (l) ÷ (m)

NAME OF UTILITY:

ADDRESS:

TELEPHONE:

CONTACT:

RATES:

(a) BUILDING NAME AND I. D. NUMBER ____________________ (c) FISCAL YEAR ________

(d) FUEL OIL: ____ #2 @ 138,690 BTU/GAL., ____ #6 @ 149,690 BTU/GAL SOURCE BTU/GAL. ________

(e) PROPANE: ____ AT 95,476 BTU/GAL., ____ OTHER ________ BTU/GAL. SOURCE BTU/GAL. ________

MONTH	10^3 GROSS SQ. FT. BUILDING. SIZE (f)	DAYS IN BILLING PERIOD (g)	AMT. BILLED 10^3 GALLONS (h)	FUEL COST ADJUST. $ (j)	TOTAL CHARGES $ (k)	COST Per GAL. $ (l)	10^6 B T U TOTAL SITE (m)	10^6 B T U TOTAL SOURCE (n)	10^3 B T U PER SQ. FT. SITE (o)	10^3 B T U PER SQ. FT. SOURCE (p)	FUEL COST PER SQ. FT. $ (r)	FUEL COST PER MMBTU SITE $ (s)	
September													
October													
November													
December													
January													
February													
March													
April													
May													
June													
July													
August													
	**	*	*	*$	*$	AVG. $	*	*	*	*	*$	$ AVG.	

* ANNUAL TOTAL - ** SAME AS AUGUST

(l) = (k) ÷ (h) x 1000
(m) = (h) x [(d) or (e) ÷ 1000]
(n) = (m) x (1.0+) factor N.C.A.
(o) = (m) ÷ (f)

(p) = (n) ÷ (f)
(r) = (k) ÷ [(f) x 1000]
(s) = (k) ÷ (m)

NAME OF OIL-PROPANE SOURCE: ________

ADDRESS: ________

TELEPHONE: ________

CONTACT: ________

FUEL RATE: ________

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(a) BUILDING NAME AND I. D. NUMBER ______________________

(c) FISCAL YEAR ______________

CITY WATER:

(g) METER TYPE: TURBINE ________ POS. DISPL. ________ OTHER ________

METER MFGR. ______________

MONTH	HEATING DEGREE DAYS (h)	COOLING DEGREE DAYS (i)	DAYS IN BILLING PERIOD (k)	BILLED CCF DOMESTIC (l)	IRRIGATION (m)	PROCESS (n)	TOTAL (o)	TOTAL CHARGES $ (p)	COST PER CCF $ (r)	CCF PER 1000 SQ.FT. (s)	10^3 GROSS SQ. FT. BUILDING SIZE (t)	
SEPTEMBER												
OCTOBER												
NOVEMBER												
DECEMBER												
JANUARY												
FEBRUARY												
MARCH												
APRIL												
MAY												
JUNE												
JULY												
AUGUST												
	*	*	*	*	*	*	*	* $	* $	*	*	

* ANNUAL TOTAL

CCF = 100 CU. FT. = 748 GAL. = 6235.5 lbs.
1000 Gal - 1.34 C.C.F.

FOR (l), (m), and (n) USE BEST ESTIMATE IF NOT METERED SEPARATELY

(o) = CCF FROM BILLING
(r) = (P) ÷ (o)
(s) = (o) ÷ $\boxed{(c) \times 1000}$ = CCF/SQ.FT.
(s) = (o) ÷ (t) = CCF/1000 SQ.FT.

NAME OF CITY WATER UTILITY: ______________

ADDRESS: ______________

TELEPHONE: ______________

CONTACT: ______________

RATES: ______________

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(a) BUILDING NAME AND I.D. NUMBER ______

(c) FISCAL YEAR ______

OTHER FUEL TYPE:

(d) FUEL NAME: ______

METERING METHOD & MFGR. ______ (r)

BTU CONTENT PER UNIT MEASURE ______ (t)

MONTH	10^3 GROSS SQ. FT. BUILDING SITE (f)	DAYS IN BILLING PERIOD (g)	QUANTITY BILLED (h)	FUEL COST ADJUST. $ (j)	TOTAL CHARGES $ (k)	COST PER FUEL UNIT $ (l)	10^6 B T U TOTAL		10^3 B T U PER SQ. FT.		FUEL COST PER SQ.FT. $ (r)	FUEL COST PER MMBTU SITE $ (s)	
							SITE (m)	SOURCE (n)	SITE (o)	SOURCE (p)			
SEPTEMBER													
OCTOBER													
NOVEMBER													
DECEMBER													
JANUARY													
FEBRUARY													
MARCH													
APRIL													
MAY													
JUNE													
JULY													
AUGUST													
	**	*	*	*$	*$	$ AVG.	*	*	*	*	*$	$ AVG.	

*ANNUAL TOTAL ** SAME AS AUGUST

(h) - from billing
(l) = (k) ÷ (h)
(m) = (h) x (t) ÷ 10^6
(n) = (m) x (1.0+) Factor (7) N.A.
(o) = (m) ÷ (f)
(p) = (n) ÷ (f)
(r) = (k) ÷ (f)
(s) = (k) ÷ (m)

NAME OF UTILITY CO.: ______

ADDRESS: ______

TELEPHONE: ______

CONTACT: ______

RATE: ______

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FORM ECC-5 2/79 REV. 3/79

PRELIMINARY ENERGY AUDIT

AUDIT DATE: (a1) ______________

FORM PEA-1

(a) COMPONENT INSTITUTION NAME & I.D. NO: ______ (b) BUILDING ______ (c) BUILDING ADDRESS ______

(d) CATEGORY OF BLDG. ______ (e) BUILDING USE CATEGORY ______ (f) BUILDING OPERATOR NAME, ADDRESS & TELEPHONE ______

PUBLIC ( ) PRIVATE NON-PROFIT ( ) INDIAN TRIBE ( )

(g) NAME AND ADDRESS OF OWNER ______

(jj) PEA AUDITOR NAME, ADDRESS & TELEPHONE: ______

I BASIC BUILDING DATA

BUILDING SIZE (h)	OPERATING SCHEDULE						
	DAYS	TIME PERIOD: HRS/OCCUPANTS/% GSF			(m) PARTIAL USAGE (n)		
		(j) DAYLIGHT	(k) EVE	(l) NITE	QTR	WEEKS	% GSF
	M-F	/ /	/ /	/ /	1st		
DATE (i) CONSTRUCTED	SAT	/ /	/ /	/ /	2nd		
					3rd		
	SUN	/ /	/ /	/ /	4th		

BASIC HVAC CONTROL DATA

CENTRAL BLDG. PANEL (q) YES ______ NO ______

"FCMS" CONNX (s) YES ______ NO ______

II MAJOR ENERGY USING SYSTEMS

PRIMARY HEAT SOURCE (u)	PRIMARY COOLING SOURCE (v)	SPACE TERMINAL HEAT (w)	SPACE TERMINAL COOLING (x)	DOMESTIC HOT WATER SOURCE (y)	INTERIOR LIGHTING SYSTEM (z)	SPECIAL BUILDING SYSTEMS & FACILITIES (aa)
					INCAN. ______ % FLUOR. ______ % H.I.D. ______ %	

III UNIQUE BUILDING CHARACTERISTICS

1. YEAR ROUND, 24 HR. PER DAY OPERATION YES ____ NO ____ (bb)
2. 9 MONTH PER YEAR OPERATION YES ____ NO ____ (cc)
3. SUMMER PROGRAM USE YES ____ NO ____ (dd)
4. EVENING CLASS SCHEDULE YES ____ NO ____ (ee)
5. BUILDING HAS EXTERIOR FLOODLIGHTING YES ____ NO ____ (ff)
6. LIST YEAR & TYPE OF MAJOR BUILDING MODIFICATIONS AND ADDITIONS (gg) ______

TOTAL # OF MAJOR MOD. & ADD. ______

7. OTHER: (hh) ______

4-79 Revised 4/23/79

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P R E L I M I N A R Y   E N E R G Y   A U D I T

FORM PEA-2

(b) BUILDING NAME & I.D. NUMBER ______________________ (h) BUILDING SIZE (GROSS SQ.FT.) ______________________

(b1) COMPONENT INSTITUTION NAME & I.D. NUMBER ______________________

IV   E N E R G Y   U S E   &   C O S T   D A T A   (ii) FOR YEAR ENDING AUG. 31   METERED ____ / BEST ESTIMATE ____

MONTH	ELECTRICITY			NATURAL GAS			OIL - #2 or # ____			PURCHASED THERMAL				TOTAL ENERGY COSTS $ (xx)
										STEAM-HOT WATER		CHILLED WATER		
	KWH (jj)	COST $ (kk)	$/KWH (ll)	MCF (mm)	COST $ (nn)	$/MCF (oo)	GAL (pp)	COST $ (rr)	$/GAL (ss)	MMBTU OR LBS (tt)	COST $ (uu)	TON HRS (vv)	COST $ (ww)	
SEPTEMBER														
OCTOBER														
NOVEMBER														
DECEMBER														
JANUARY														
FEBRUARY														
MARCH														
APRIL														
MAY														
JUNE														
JULY														
AUGUST														
ANNUAL TOTALS	1		AVG.	2		AVG.	3		AVG.	4		5		

ANNUAL ENERGY CONSUMPTION IN BTU'S: (10^6 identifies the number in millions)

(1) (yy) Electricity ______ KWH X 0.0116 = ______ x 10^6 BTU
(2) (zz) Nat. Gas ______ MCF X 1.03 = ______ x 10^6 BTU
(3) (aaa) Fuel Oil #2 ______ GAL X 0.138690 = ______ x 10^6 BTU
(4) (bbb) Fuel Oil #6 ______ GAL X 0.149690 = ______ x 10^6 BTU
(5) (ccc1) Steam/Hot Water ______ MMBTU X 1.0 = ______ x 10^6 BTU
or
(6) (ccc2) Steam ______ LBS X 0.001390 = ______ x 10^6 BTU
(7) (ddd) Chilled Water ______ TON HRS X 0.012 = ______ x 10^6 BTU
(8) (eee) Propane or Butane ______ GAL X 0.095475 = ______ x 10^6 BTU

______ Other Fuel X (fff) ______ = ______ x 10^6 BTU

(ggg) TOTAL ANNUAL BTU'S = ______ x 10^6 BTU

ENERGY UTILIZATION INDEX (EUI)

EUI = $\frac{\text{TOTAL ANNUAL BTU'S}}{\text{BUILDING GROSS SQ. FT.}}$ = BTU's/FT^2/YR

EUI = $\frac{\text{(ggg) \_\_\_\_\_\_,000,000}}{\text{(h)}}$

EUI = (hhh) ______ BTU's/FT^2/YR

ENERGY COST INDEX (ECI)

ECI = $\frac{\text{TOTAL ANNUAL ENERGY COSTS}}{\text{BUILDING GROSS SQ. FT.}}$ = $/FT^2/YR

ECI = $\frac{\text{(xx) TOTAL}}{\text{(h)}}$

ECI = (iii) ______ $/FT^2/YR

4-79 Revised 5/1/79 2/11/80

PRELIMINARY ENERGY AUDIT

(b) BUILDING NAME & I.D. NUMBER ______

(b1) COMPONENT INSTITUTION NAME & I.D. NUMBER ______

V ENERGY CONSERVATION ACTIVITIES

1. NAME OF ENERGY MANAGER FOR BUILDING:(jjj) ______
2. HAS WORK WHICH PARTIALLY OR FULLY SATISFIES THE REQUIREMENTS OF AN ENERGY AUDIT ON THIS BUILDING BEEN ACCOMPLISHED PRIOR TO THIS "PEA" DATE? ______ YES, ______ NO. (kkk)
3. HAVE ANY DETAILED ENGINEERING STUDIES BEEN CONDUCTED ON THIS BUILDING OR ITS SYSTEMS PRIOR TO THIS "PEA" DATE? ______ YES ______ NO. (lll) IF "YES" NAME SYSTEMS STUDIED. (mmm) ______
4. HAVE ANY ENERGY CONSERVATION MEASURES BEEN CONSIDERED OR IMPLEMENTED ON THIS BUILDING PRIOR TO THIS "PEA" DATE? ______ YES ______ NO. (nnn) IF "YES" LIST THESE MEASURES BELOW WITH ESTIMATES OF THEIR COSTS & ENERGY SAVINGS, IF AVAILABLE:

(ooo) ______

5. GENERAL AUDIT COMMENTS: (ppp) ______
6. DO YOU INTEND TO CONDUCT AN "ENERGY AUDIT" OF THIS BUILDING? (rrr) YES ______ NO ______

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PRELIMINARY ENERGY AUDIT

(b) BUILDING NAME & I.D. NUMBER ____________ (b1) COMPONENT INSTITUTION NAME & I.D. NUMBER ____________

FORM PEA-4 4-79

VI RENEWABLE ENERGY RESOURCE POTENTIAL

1. BUILDING LOCATION: _____URBAN, _____SUBURBAN, _____RURAL AREA.
2. BUILDING HEIGHT: _____STORIES.
3. IS OPEN LAND SUCH AS FIELDS, YARDS, PARKING AREAS, WHICH IS NOT HEAVILY SHADED BY TALL BUILDINGS, TREES, OR OTHER OBSTRUCTIONS AVAILABLE IN THE IMMEDIATE VICINITY OF THE BUILDING? _____YES _____NO.
4. IS APPROXIMATELY ONE-HALF OR MORE OF THE BUILDING'S ROOF AREA OR SOUTHERN ORIENTED WALL SURFACES HEAVILY SHADED BY TREES, SHRUBS, BUILDINGS OR OTHER OBSTRUCTIONS? _____YES _____NO.
5. GENERAL DESCRIPTION OF BUILDING SHAPE: _____SQUARE, _____RECTANGULAR, _____H-SHAPED, _____E-SHAPED. _____T-SHAPED, _____L-SHAPED, _____X-SHAPED, _____Y-SHAPED, _____O-SHAPED.
6. ROOF DATA: _____FLAT, _____PITCHED. IF PITCHED, IS PITCH ORIENTED TO SOUTH? _____YES _____NO.
7. EXISTING ROOF OBSTRUCTIONS: _____NONE, _____CHIMNEYS, _____SPACE CONDITIONING UNITS, _____WATER TOWERS, _____EQUIPMENT PENTHOUSES, _____STAIRWELLS, _____OTHER PERMANENT ROOF MOUNTED STRUCTURES.
8. SOUTH FACING WALL MATERIALS: _____MASONRY, _____WOOD, _____ALUMINUM, _____GLASS, _____STEEL, _____COMBINATION.
9. SOUTH FACING WALL GLASS AREA: _____LESS THAN 25%, _____25-75%, _____MORE THAN 75%.
10. PRIMARY SPACE HEATING SYSTEM: _____OUTSIDE BUILDING, _____INSIDE BUILDING; IF INSIDE BUILDING, IS IT LOCATED _____IN BASEMENT, _____ON GROUND FLOOR, _____ON ROOF? IS INSIDE BUILDING HEATING SYSTEM OF _____CENTRAL TYPE, _____MULTIPLE UNITS, OR _____COMBINATION OF BOTH?
11. PRIMARY DOMESTIC HOT WATER SYSTEM: _____OUTSIDE BUILDING, _____INSIDE BUILDING: IF INSIDE BUILDING IS IT LOCATED _____IN BASEMENT, _____ON GROUND FLOOR, _____ON ROOF? IS INSIDE BUILDING DOMESTIC HOT WATER SYSTEM OF _____CENTRAL TYPE, _____MULTIPLE UNITS, OR _____COMBINATION OF BOTH?
12. ARE ANY OF FOLLOWING ENERGY SOURCES AVAILABLE TO THIS IMMEDIATE BUILDING LOCATION? (a) YEAR AROUND STEADY, CONSTANT WIND VELOCITIES, 10 MPH MINIMUM _____YES _____NO. (b) NATURAL WATER STREAM OF MINIMUM 10 FOOT HEAD, CONSTANT YEAR AROUND FLOW _____YES _____NO. (c) NATURAL HOT GROUND WATER WELLS (GEOTHERMAL WELLS) _____YES _____NO.. (d) SEACOAST TIDES OF 8 FOOT OR GREATER _____YES _____NO. (e) SOURCE OF LOW COST FOREST TIMBER BY-PRODUCTS _____YES _____NO. (f) ANY OTHER RENEWABLE ENERGY SOURCE _____YES _____NO; IF YES, DESCRIBE ____________

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PRELIMINARY ENERGY AUDIT

FORM PEA-5

(b) BUILDING NAME & I.D. NUMBER

(b1) COMPONENT INSTITUTION NAME & I.D. NUMBER

VII BUILDING ENERGY SAVING POTENTIAL

(ttt) CHART OF POTENTIAL ENERGY SAVINGS

1.0 ANNUAL ENERGY USE: (SEE EUI PAGE PEA-2)

BTU/SQ.FT./YR.	WF
400,000 AND ABOVE	9
300,000 TO 400,000	8
200,000 TO 300,000	7
100,000 TO 200,000	6
LESS THAN 100,000	5

2.0 RATIO OF OCCUPANCY/SPACE UTILIZATION HOURS TO HVAC EQUIPMENT OPERATING HOURS:

$\frac{\text{OCCUPANCY/UTILIZATION HRS.}}{\text{HVAC OPERATING HOURS}}$ = RATIO

RATIO	WF
UNDER 0.20	14.4
0.2 TO 0.4	12.8
0.4 TO 0.6	11.2
0.6 TO 0.8	9.6
0.8 TO 1.0	8.0

3.0 RATED CAPACITY OF HEATING & COOLING EQUIPMENT:

COMBINED HVAC CAPACITY IN BTUH X 10^6	WF
40 AND ABOVE	9
25 TO 40	8
15 TO 25	7
5 TO 15	6
BELOW 5	5

BUILDING MODIFICATION POTENTIAL:

4.1

BUILDING AGE & REMAINING LIFE (R.L.)	WF
NEW (1-5 YRS) OVER 40 YR. R.L.	3.6
NEW (1-5 YRS) UNDER 40 YR. R.L.	3.2
RECENT (5-15 YRS) OVER 40 YR. R.L.	2.8
RECENT (5-15 YRS) UNDER 40 YR. R.L.	2.4
OLD (OVER 15 YRS)	2.0
OLD (OVER 15 YRS) LESS THAN 5 YR. R.L.	0.0

4.2 TOTAL WALL AREA PERCENT GLASS & INFILTRATION:

% GLASS RANGE	WF
OVER 40% GLASS	4.5
LARGE INFILTRATION	4.0
UNDER 40% GLASS	3.5
LOW INFILTRATION	3.0
UNDER 15% GLASS	2.5

4.3 LIGHTING LEVELS POTENTIAL REDUCTION:

RANGE	WF
REDUCED TO 3.0 W/SQ.FT.	6.3
REDUCED TO 2.0 - 3.0 W/SQ.FT.	5.6
REDUCED TO 1.0 - 2.0 W/SQ.FT.	4.9
CAN REDUCE BY SWITCHING CHANGES	4.2
LIGHTING LEVELS CANNOT BE REDUCED	3.5

4.4 PREDOMINANT HVAC SYSTEM:

TYPE	WF
DUAL DUCT OR REHEAT	12.6
MULTIZONE OR INDUCTION UNITS	11.2
ROOFTOP, PACKAGED WALL UNITS, OR UNIT VENTILATION	9.8
FAN-COIL, VAV, OR HEAT/VENT ONLY UNIT	8.4
RADIATION, UNIT HEATERS (NO FAN SYS.)	7.0

4.5 NORMAL OUTSIDE AIR SUPPLY PERCENTAGE:

RANGE	WF
75 TO 100%	8.1
50 TO 75%	7.2
25 TO 50%	6.3
10 TO 25%	5.4
INFILTRATION ONLY WITH TOILET EXHAUST	4.5

4.6 FAN ENERGY:

FAN STATIC PRESS.	GROSS BLDG. SQ.FT./FAN HP	WF
10" OR ABOVE	≅ 200 SQ.FT./HP	5.4
8" SP TO 10" SP	≅ 600 SQ.FT./HP	4.8
6" SP TO 8" SP	≅ 1000 SQ.FT./HP	4.2
4" SP TO 6" SP	≅ 1500 SQ.FT./HP	3.6
UNDER 4" SP	≅ 2000 SQ.FT./HP	3.0

4-79 Revised 5/1/79

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PRELIMINARY ENERGY AUDIT

(b) BUILDING NAME & I.D. NUMBER

(b1) COMPONENT INSTITUTION NAME & I.D. NUMBER

FORM PEA-6

4-79 Revised 5/1/79

VII BUILDING ENERGY SAVING POTENTIAL (CONT'D)

CHART OF POTENTIAL ENERGY SAVINGS (Continued)

4.7 HVAC CONTROL SYSTEM:

CONDITION	WF
OUTSIDE AIR & RELIEF DAMPERS HANG OPEN	5.4
INOPERATIVE CONTROLS	4.8
NO WRITTEN PREVENTIVE MAINT. PROGRAM	4.2
CONTROLS ARE SERVICED REGULARLY	3.6
CONTROLS UNDER MAINTENANCE CONTRACT	3.0

4.8 BUILDING PROCESS ENERGY BASE LOAD:

% OF TOTAL LOAD	WF
20% BASE LOAD - COULD REDUCE	2.7
15% BASE LOAD - COULD REDUCE	2.4
10% BASE LOAD - COULD REDUCE	2.1
5% BASE LOAD - COULD REDUCE	1.8
NO REDUCTION OF BASE LOADS POSSIBLE	1.5

4.9 HVAC HEAT RECOVERY:

RANGE	WF
100% O.A., RECOVERY FEASIBLE	4.5
75% O.A., RECOVERY FEASIBLE	4.0
50% O.A., RECOVERY FEASIBLE	3.5
100% O.A., RECOVERY DIFFICULT	3.0
HEAT RECOVERY NOT FEASIBLE	2.5

4.10 USER RETROFIT TOLERANCE:

RANGE	WF
USER CAN TOLERATE MAJOR RETROFIT	4.5
USER CAN TOLERATE MINOR RETORFIT	3.5
USER CANNOT TOLERATE ANY DISRUPTIONS	2.5

ENERGY SAVING POTENTIAL TABULATION (uuu)

ITEM	WF
1.0 ANNUAL ENERGY USE	
2.0 RATIO UTILIZ. HRS. TO OPER. HRS.	
3.0 RATED CAP. OF HVAC EQUIP.	
4.1 BUILDING AGE & LIFE EXPECT.	
4.2 PERCENT GLASS & INFILTRATION	
4.3 LIGHTING LEVELS	
4.4 HVAC SYSTEM TYPE	
4.5 OUTSIDE AIR RATIO	
4.6 FAN ENERGY	
4.7 HVAC CONTROL SYSTEM	
4.8 BUILDING BASE LOAD	
4.9 HVAC HEAT RECOVERY	
4.10 USER RETROFIT TOLERANCE	
TOTAL	

E N E R G Y   A U D I T

Energy Auditor Certification: I hereby certify that I, ____________________(name of auditor), have participated fully in the Energy Auditor Training Program developed by the Governor's Office of Energy Resources conducted at ______________(address of training site) by ____________________(Sponsoring Agency-Instructor) on ____________(date), or in lieu of attending the training session, have completed ______(# of classroom hrs) hours of educational courses and/or on-the-job experience in analyzing and/or operating the mechanical and electrical and other energy using systems of the type of building or complex being audited. I have attached a copy of official educational transcripts and/or resumes of previous applicable work experience including the address and telephone numbers of such employers if I have claimed past education and/or work experience in lieu of attending the official training program. I further certify that I am not responsible for the day-to-day operations of the building and that a full disclosure of any financial interest which I might have relating to this energy audit or any energy conservation measure is attached hereto. I also certify that the energy audit was conducted in accordance with the requirements set forth under 10 CFR Part 450, paragraph 450.43 of the regulation which was published in the Federal Register dated April 2, 1979.

Signature of Energy Auditor ____________ Energy Auditor Certificate Number ____________ Organization of Auditor ____________ (a) Date ____________

(b) ______________________ BUILDING

(c) ______________________ BUILDING SIZE (GROSS SQ.FT.)

FOLLOWING PEA FORMS COMPLETED ATTACHED HERETO:

(d)______ PEA-1, (d1)______ PEA-2, (e)______ PEA-3, (e1)______ PEA-4, (f)______ PEA-5, (f1)______ PEA-6

(b1) ______________________ COMPONENT INSTITUTION NAME & I.D. NUMBER

______________________ NAME AND ADDRESS OF OWNER

THE CONTENT OF THIS AUDIT FORM IS DESIGNED TO MEET THE REQUIREMENTS OF FEDERAL REGISTER, APRIL 2, 1979. VOL. 44, No. 64, PARA. 450.43

I   D E S C R I P T I V E   B U I L D I N G   D A T A

1.0 LIST MAJOR CHANGES IN "FUNCTIONAL USE" OR "MODE OF OPERATION" PLANNED FOR NEXT 15 YEARS:

(g) ______________________

2.0 FOR BUILDINGS OVER 200,000 GROSS SQUARE FEET AREA, PROVIDE THE FOLLOWING FROM AVAILABLE DATA (AD) OR BY REASONABLE ESTIMATE (BE) IDENTIFY SOURCE IN ALL BLANKS.

2.1 PEAK ELECTRICAL DEMAND IN KW: (h) ____________

MONTHS (h1) ______, ______, ______, DAY (j) ______, ______, ______,

HOUR OF DAY (k) ______, ______, ______.

2.2 PROVIDE BELOW THE ANNUAL ENERGY USE OF THE MAJOR BUILDING SYSTEM BY FUEL TYPE:

3.0 GENERAL BUILDING & SYSTEMS CONDITION:

(y) ______________________

MAJOR SYSTEM (l)	ELECTRICITY		NATURAL GAS		#2 OIL		CENTRAL PLANT THERMAL			10^6 TOTAL BTU
	KWH (m)	10^6 BTU (n)	MCF (o)	10^6 BTU (p)	GAL (r)	10^6 BTU (s)	STEAM-HOT WATER (t) 10^6 BTU	CHILLED WATER TON HRS.	CHILLED WATER 10^6 BTU	
								(u)	(v)	(w)

BTU CONVERSION FACTORS (x) (10^6 identifies the number in millions)

ELEC. ______	KWH	X 0.011,600 =	______ 10^6 BTU	STEAM/HW ______	MMBTU x 1.0	=	______ 10^6 BTU
NAT.GAS. ______	MCF	X 1.03 =	______ 10^6 BTU	STEAM ______	LBS x 0.001,390	=	______ 10^6 BTU
OIL #2 ______	GAL	X 0.138,690 =	______ 10^6 BTU	CH.WATER ______	TON HR x 0.012,000	=	______ 10^6 BTU
OIL #6 ______	GAL	X 0.149,690 =	______ 10^6 BTU	OTHER ______	x ______	=	______ 10^6 BTU
				OTHER ______	x ______	=	______ 10^6 BTU

FORM EA-1

4/79 Revised 4/23/79 Revised 5/1/79 Revised 2/6/80

E N E R G Y   A U D I T

FORM EA-2 4-79 REVISED 4-23-79 5/11/80

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(b) ______________________ BUILDING NAME

(c) ______________________ BUILDING SIZE (GROSS SQ. FT.)

(b1) ______________________ COMPONENT INSTITUTION NAME & I.D. NUMBER

I D E S C R I P T I V E   B U I L D I N G   D A T A (CONTINUED)

4.0 CLIMATIC FACTORS:

4.1 AVERAGE ANNUAL HEATING DEGREE DAYS ______________ 4.2 AVERAGE ANNUAL COOLING DEGREE DAYS ______________

4.3 AVERAGE MONTHLY SOLAR INSOLATION, HORIZONTAL SURFACES IN BTU/SQ.FOOT AND WIND VELOCITY IN MPH

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
SOLAR (A)												
WIND VEL.(B)												

5.0 ROOF CHARACTERISTICS:

5.1 PRIMARY STRUCTURAL COMPONENT: _____STEEL, _____WOOD, _____REINF. CONC., _____OTHER, SPECIFY ______________

5.2 ROOF SURFACE: _____BUILT UP, _____SLATE, _____TILE, _____WOOD SHINGLES, _____COMP. SHINGLES, _____OTHER ______________

II E N E R G Y   C O N S E R V A T I O N   M A I N T E N A N C E   &   O P E R A T I O N   P R O C E D U R E S

1.0 COMPLETE FOLLOWING TABLE USING ANNUAL TOTALS FOR FISCAL YEARS ENTERED, CONVERSION FACTORS LISTED ON FORM EA-1, & TOTALS OF BTU CONSUMPTION PER YEAR. PROVIDE INFORMATION FOR INDIVIDUALLY METERED BUILDINGS ONLY. USE ACTUAL DATA. (10^6 identifies the number in millions)

FISCAL YEAR (z)	ELECTRICITY (aa)		NATURAL GAS (bb)		#2 OIL (cc)		CENTRAL PLANT THERMAL (dd)			(ee)	TOTAL BTU/GROSS SQ. FT.*
	KWH	BTU X 10^6	MCF	BTU X 10^6	GAL	BTU X 10^6	STEAM-HOT WATER MMBTU	CHILLED WATER TON HRS.	CHILLED WATER BTU X 10^6	(ff)	TOTAL BTU X 10^6
BASE YEAR		X X X		X X X		X X X	X X X X X		X X X	(ee)	Btu/GSF
	X X X		X X X		X X X			X X X		(ff)	x 10^6 Btu
COMPARISON YR.		X X X		X X X		X X X	X X X X X		X X X	(ee)	Btu/GSF
	X X X		X X X		X X X			X X X		(ff)	x 10^6 Btu
LAST FULL YR		X X X		X X X		X X X	X X X X X		X X X	(ee)	Btu/GSF
	X X X		X X X		X X X			X X X		(ff)	x 10^6 Btu

2.0 LIST OF MAINTENANCE PROCEDURES AND OPERATING PROCEDURES WHICH HAVE BEEN IMPLEMENTED OVER ABOVE TIME SPAN OF YEARS TO REDUCE ENERGY CONSUMPTION.

(gg) ______________________ ______________________

______________________ ______________________

______________________ ______________________

(BASE YEAR: BTU/SQ. FT.) (hh) ______________ − (LESSER COMPARISON YEAR: BTU/SQ.FT.) (jj) ______________ = (kk) ______________ BTU/SQ. FT. REDUCTION

(kk) ______________ BTU/SQ. FT. REDUCTION ÷ (hh) ______________ BASE YEAR: BTU/SQ.FT. = (ll) ______________ % REDUCTION FROM BASE YEAR

*Move Btu decimal point six places to the right before dividing by GSF since Btu is expressed in millions.

E N E R G Y   A U D I T

(b) ______________________ BUILDING OR COMPLEX NAME & ID NUMBER

(c) ______________________ BUILDING SIZE (GROSS SQ. FT.)

(b1) ______________________ COMPONENT INSTITUTION NAME & I.D. NUMBER

III RECOMMENDED ENERGY CONSERVATION MAINTENANCE & OPERATION PROCEDURES

PROVIDE FOLLOWING RECOMMENDATIONS BASED ON AN ON-SITE INSPECTION OF BUILDING:

1. SCHEDULED PREVENTIVE MAINTENANCE PLAN. RECOMMEND (mm) ________ YES ________ NO; IN EXISTENCE (nn) ________ YES ________ NO

2. PROVIDE A GENERAL ESTIMATE, EXPRESSED AS A RANGE, OF ANNUAL ENERGY SAVINGS & ANNUAL ENERGY COST SAVINGS WHICH COULD RESULT FROM IMPLEMENTING THE FOLLOWING MAINTENANCE & OPERATING PROCEDURES.

SYSTEM CHANGES	VALUES	% ENERGY	% COST
VENTILATION SYSTEM OPERATION	% SUB-TOTAL	(oo)	(pp)
REDUCED VENTILATION	2.0		
VARIABLE VENTILATION	1.0		
UNOCCUPIED AREA VENTILATION SHUT DOWN	0.5		
REPAIR OF CAULKING & WEATHER STRIPPING	0.5		
MAINTENANCE & REPAIR OF OPERATING CONTROLS	1.0		
HEATING & COOLING SYSTEM OPERATION	SUB-TOTAL	(rr)	(ss)
CHANGE IN THERMOSTAT CONTROL SET POINTS	2.0		
PROVIDE LOCKING THERMOSTAT COVERS	1.0		
RESET OF AIR & WATER TEMPERATURES	2.0		
UNOCCUPIED RESET OR SHUT DOWN OF SYSTEM	2.0		
SHUT DOWN NON-CRITICAL EXHAUST SYSTEMS	1.0		
LIGHTING SYSTEMS OPERATING	SUB-TOTAL	(tt)	(uu)
REDUCE ILLUMINATION LEVELS	3.0		
MAXIMIZE USE OF DAYLIGHT	1.0		
INSTALL HIGH EFFICIENCY LAMPS	1.0		
REDUCE OR DELETE EVENING CLEANING HOURS	2.0		

SYSTEM CHANGES	VALUES	% ENERGY	% COST
WATER SYSTEMS OPERATIONS	% SUB-TOTAL	(vv)	(ww)
REPAIR ALL LEAKS	0.5		
REDUCTION OF WATER CONSUMPTION (FLOW RESTRICTION)	0.5		
REDUCE HOT WATER TEMPERATURE	1.0		
INCREASE CHILLED WATER TEMPERATURE	1.0		
UTILITY PLANT & DISTRIBUTION SYSTEM OPERATION	SUB-TOTAL	(xx)	(yy)
EQUIPMENT CLEANING	0.5		
ADJUSTMENT OF AIR/FUEL RATIO	0.5		
COMBUSTION MONITORING & CONTROL	0.5		
ADJUSTMENT OF DRIVES, FANS, MOTORS, ETC.	1.0		
STEAM TRAP MAINTENANCE	1.5		
PIPE INSULATION REPAIR	1.0		
OTHER MAINTENANCE & OPERATION PROCEDURES	SUB-TOTAL	(zz)	(aaa)
______________________			
______________________			
______________________			
______________________			
______________________			
TOTALS			

FORM EA-3

4-79 REVISED 4-23-79

12-25

ENERGY AUDIT

(b) ______________________________
BUILDING OR COMPLEX NAME & ID NUMBER

(c) ______________________________
BUILDING SIZE (GROSS SQ. FT.)

(b1) ______________________________
COMPONENT INSTITUTION NAME & I.D. NUMBER

IV ENERGY CONSERVATION RETROFIT RECOMMENDATIONS

1.0 BASIC BUILDING DATA: 1.1 ANNUAL ENERGY USE (bbb) ______________________ BTU/GROSS SQ. FT. PER YEAR

1.2 ANNUAL ENERGY COST (ccc) ______________________ $/GROSS SQ. FT. PER YEAR

1.3 DESCRIBE PHYSICAL CONDITION OF BUILDING ENVELOPE: (ddd) ______________________

____

1.4 DESCRIBE PHYSICAL CONDITION OF BUILDING ENERGY USING SYSTEMS: (eee) ______________________

____

2.0 BASED ON 1.1, 1.2, 1.3, AND/OR 1.4 ABOVE INDICATE THE NEED & POTENTIAL FOR ENERGY CONSERVATION RETROFIT IMPLEMENTATION. BRIEFLY OUTLINE RECOMMENDED RETROFIT OPTIONS:

(fff) ____

____

3.0 BASED ON DATA NOTED IN SECTION VI, FORM PEA-4 & ITEMS 4.0 & 5.0, FORM EA-2 THE AUDITOR SHALL INDICATE WHETHER OR NOT THE BUILDING CONDITIONS AND/OR SITE CHARACTERISTICS PRESENT AN OPPORTUNITY TO APPLY SOLAR HEATING AND/OR COOLING SYSTEMS, OR SOLAR DOMESTIC HOT WATER HEATING SYSTEMS. ____YES, ____NO

V ENERGY CONSERVATION RETROFIT ASSESSMENT

1.0 DESCRIBE PROPOSED ENERGY CONSERVATION PROCEDURE (ECP): (ggg) ______________________

____

____

2.0 ESTIMATE OF INSTALLED COST OF ABOVE ECP: (hhh) $ ______________________

3.0 ESTIMATE OF ANNUAL ENERGY COST SAVINGS FOR ABOVE ECP: (iii) $ ______________________

4.0 PROJECTED SIMPLE PAYBACK PERIOD FOR ABOVE ECP IN YEARS:

ITEM 2.0 $ ______________ (hhh) ÷ ITEM 3.0 $ ______________ (iii) = ______________ (jjj) YEARS

THE IMPLEMENTATION OF ENERGY CONSERVATION MAINTENANCE AND OPERATING PROCEDURES ARE A PREREQUISITE CONDITION FOR ELIGIBILITY FOR RECEIVING FEDERAL ASSISTANCE UNDER THE TECHNICAL ASSISTANCE PROGRAM AS DESCRIBED IN 10 CRF PART 455, D.O.E. RULES & REGULATIONS.

FORM EA-4 4-79 REVISED 4-23-79

12-26

END