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CASE STUDIES - ENVIRONMENT AND ENERGY. VOLUME I. HANDBOOK,(U)
APR 78 P J SWEENEY

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CASE STUDIES

ENVIRONMENT & ENERGY

VOLUME I

HANDBOOK

Edited by

Lt Col Patrick J. Sweeney, PhD

April 1978

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

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During the last few years it has become apparent that few good case studies concerning environmental or energy issues are available for the graduate student or the professional. In order to attempt to fill this void we have put together a short book of five cases--four that deal primarily with environmental issues and one that highlights a typical problem in the energy arena. Case number one concerns the problem of handling liquid industrial wastes generated at an Air Force owned but contractor operated

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20. facility. The second case concerns the environmental impact statement (EIS) process in the construction of an interstate highway city bypass. The third case is rather unique in format for it requires the student to present a briefing on all of the energy conservation directives and guidance provided by the Air Force to its installations. The briefing is to be prepared for the base commander and challenges the student to provide this decision-maker with all he needs to know about energy conservation and Air Force policy and do it in 15 minutes. The fourth case is about air pollution abatement. How should this base solve this pollution problem is the problem presented to the student. The last case concerns municipal solid waste alternatives available to a large metropolitan area. Data from consultants is provided to provide realism and from which the student must select the optimum course of action. These cases in industrial waste, EIS, conservation, air pollution and solid waste could serve as an adjunct reading and exercise to courses in environmental planning at both the graduate and undergraduate level. Volume II is a set of solutions that accompanies Volume I.

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CASE STUDIES

ENVIRONMENT & ENERGY

VOLUME I

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Lt Col Patrick J. Sweeney, PhD

April 1978

ACKNOWLEDGEMENTS

I would like to acknowledge the inspiration and challenge afforded to me by the students of the Air Force Institute of Technology. The authors of the enclosed cases are members of this talented and highly motivated student body. Specifically, I wish to thank Captains Donald J. Webb, Robert W. Bennett, James R. Berry, Ronald L. Schuldt, James R. Holt, Richard W. Laske, Hugh K. DeLong, and Robert M. Julsonnet, and Lieutenants James E. Judkins and David F. Manchester.

Finally, but by no means last, I must express my appreciation to Mrs. Renita M. Rapp and Mrs. Joan P. Paxton who proofed and typed both volumes of this book.

P. J. Sweeney

PREFACE

During the last few years it has become apparent that few good case studies concerning environmental or energy issues are available for the graduate student or the professional. In order to attempt to fill this void we have put together a short book of five cases--four that deal primarily with environmental issues and one that highlights a typical problem in the energy arena.

This book is divided into two volumes so that it may be utilized as a classroom aid. The first volume includes the scenario or background and provides the basis for the development of a case which the student is asked to solve. The second volume is the set of "school solutions." Each case is taken from an actual problem that existed and required solution.

Case number one concerns the problem of handling liquid industrial wastes generated at an Air Force owned but contractor operated facility. The second case concerns the environmental impact statement (EIS) process in the construction of an interstate highway city bypass.

The third case is rather unique in format for it requires the student to present a briefing on all of the energy conservation directives and guidance provided by the Air Force to its installations. The briefing is to be prepared for the base commander and challenges the student to provide this

decision-maker with all he needs to know about energy conservation and Air Force policy and do it in 15 minutes.

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These cases in industrial waste, EIS, conservation, air pollution and solid waste could serve as an adjunct reading and exercise to courses in environmental planning at both the graduate and undergraduate level.

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CASE #1

AIR FORCE PLANT NO. 44 WASTEWATER TREATMENT PROJECT

By

James E. Judkins, BSCE, EIT
1st Lt, USAF

Donald J. Webb, BSCE, EIT
Captain, USAF

BACKGROUND

Introduction

In the spring of 1973, Pete Brown, the Air Force Supervising Engineer for Air Force Plant Number 44 (AFP #44), found himself in an unenviable position. Plant 44, which is owned by the Air Force and operated by the Hughes Aircraft Company Tucson Division, was discharging industrial waste into the Arroyo Wash in concentrations which violated the regulations governing such discharges. Pete, who was responsible for managing the Air Force's engineering efforts to alleviate the above problem, had to come up with a solution which was not only feasible from an engineering point of view but also economical for both the Air Force (AF) and Hughes Aircraft (HAC).

Plant Description

AFP #44 is located in southern Arizona approximately two and one half miles south of the city of Tucson (Figures 1 and 2). The climatic conditions of the area are those of a low latitude (Sonoran) desert. The mean yearly temperature is 67.4 degrees Fahrenheit (19.7 degrees Centigrade); the normal annual precipitation is 11.2 inches (28.4 centimeters); the mean relative humidity is 37.5

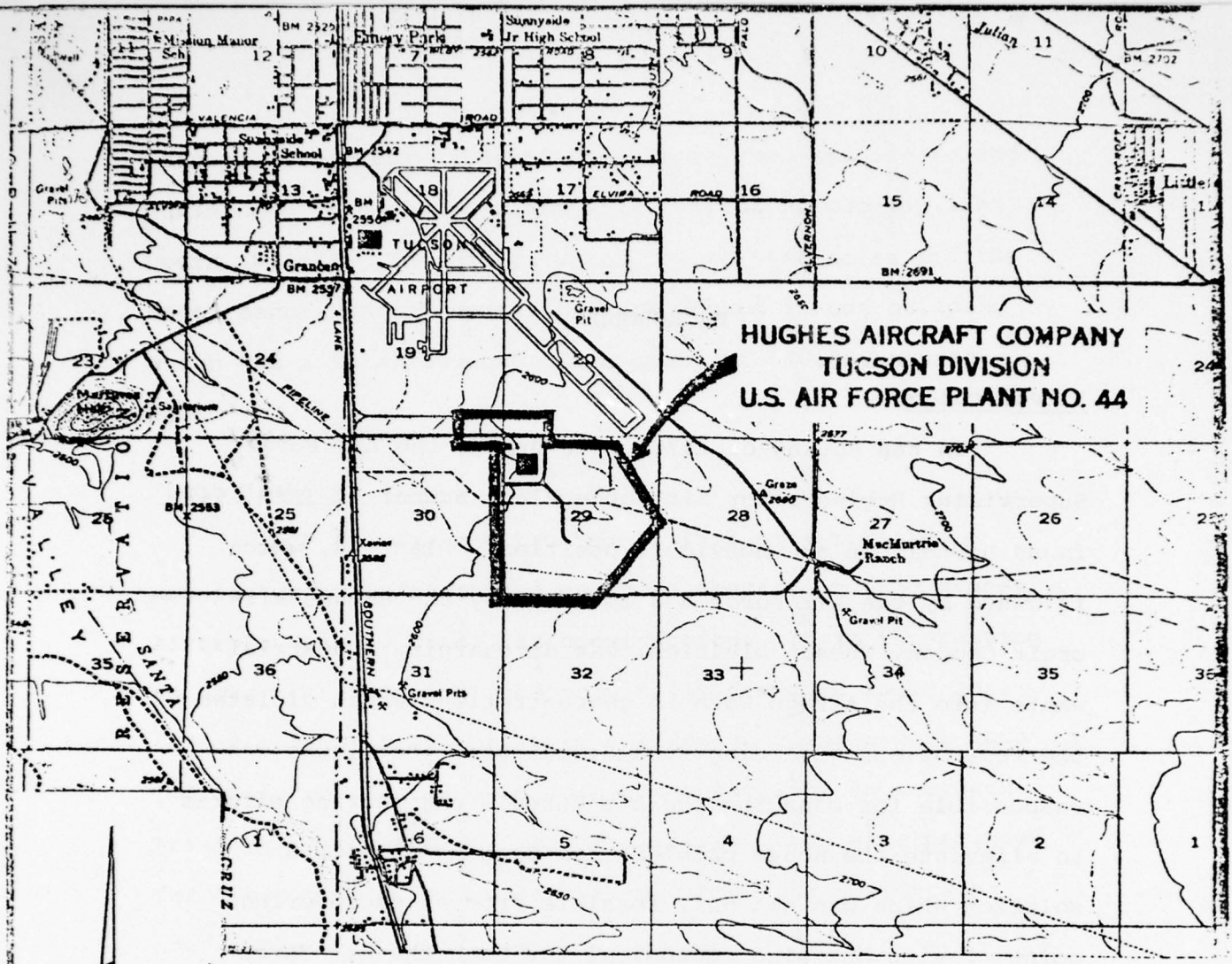


Figure 1

HUGHES AIRCRAFT COMPANY

AF-44

INDUSTRIAL WASTE WATER SYSTEM

LOCATION MAP

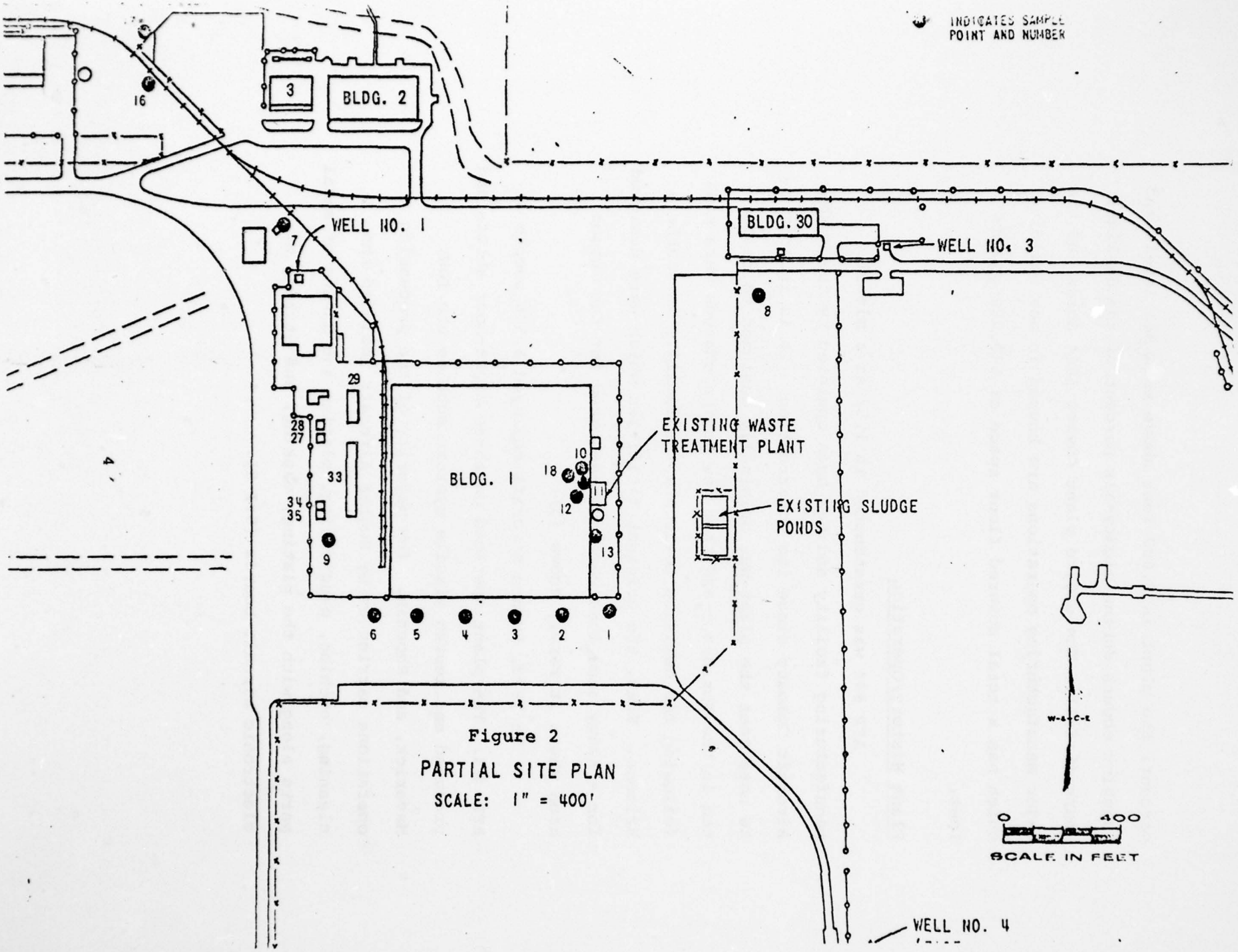


Figure 2

PARTIAL SITE PLAN

SCALE: 1" = 400'

percent; the plant is 2,600 feet above mean sea level; and sunshine occurs during eighty-six percent of the daylight hours (8:I-1). The entire plant covers 5644 acres and the major manufacturing operations are housed in one building which has a total covered floor space of 540,000 square feet.

Plant History/Operation

AFP #44 was constructed in 1952 as a missile manufacturing facility and has been operated by the Hughes Aircraft Company since its construction. It is interesting to note that the plant was originally designed to be located in the Northeast and that few design changes were made following the decision to locate the facility in southern Arizona. Thus, the original facilities which were designed for a heavy snow load were over-designed for the Tucson area where it rarely snows (5).

In 1973, Hughes Aircraft employed 3,500 people at AFP #44. The plant operated on three eight-hour shifts and produced and tested missile systems such as the TOW, Maverick, and Phoenix. The majority of the processing operations carried on by Hughes Aircraft included the cleaning, etching, passivating, plating and dyeing of metal parts along with the plating, masking, and etching of electronic circuit boards (8:I-8).

Wastewater Treatment History

The original design and construction (1952) of AFP #44 did comply with the then existing industrial wastewater treatment and disposal regulations and practices. However, the regulations and practices began becoming more stringent and in 1962 a primary industrial wastewater treatment (IWT) facility was constructed on the east side of the main production facility (Building 801). This IWT facility was designed to reduce toxic hexavalent chromium to its nontoxic trivalent form and to oxidize cyanide wastes. The facility also included a neutralization and clarification system. The discharge from this primary treatment system flowed into the Arroyo Wash, where it usually evaporated or percolated into the ground before reaching any large bodies of water (8:I-8).

Between 1962 and 1972, the water pollution laws and regulations continued to become more stringent and the primary treatment facility was updated in 1972 to bring the plant's discharges into compliance with the more stringent requirements. The update included the following:

1. A better segregated waste collection and discharge system;
2. An updated control system;
3. An improved chemical feed system;
4. A carbonate reduction system;
5. Changes in the cyanide oxidization system;

6. Changes in the neutralization system;

7. Changes in the sludge disposal system (9:1-1 - 3-8).

The update cost approximately $127,000 and, unfortunately, never functioned as well as had been expected (5).

Applicable Laws and Regulations

Federal Laws. The Federal Water Pollution Control Act, which was enacted in October, 1972, directed:

> Each department, agency, or instrumentality of the executive, legislative, and judicial branches of the Federal Government (1) having jurisdiction over any property or facility, or (2) engaging in any activity resulting, or which may result, in the discharge or runoff of pollutants shall comply with Federal, State, interstate, and local requirements respecting control and abatement of pollution to the same extent that any person is subject to such requirements including the payment of reasonable service charges [3:71-5121].

Presidential Order. President Nixon stated in Executive Order 11752 that:

> It is the purpose of this order to assure that the Federal Government, in the design, construction, management, operation, and maintenance of its facilities, shall provide leadership in the nationwide effort to protect and enhance the quality of our air, water and land resources . . . [4].

Air Force Policy. The following Air Force environmental policies which were in existence in late 1972 and early 1973 have been excerpted from Paragraph 2 of Air Force Regulation 19-1, *Protection and Enhancement of Environmental Policy*:

2. Air Force Policy

a. Eliminate or control environmental pollutants generated by or resulting from . . . contractor operations, on real property owned, leased or controlled by the Air Force consistent with the overall mission of the Air Force.

b. Lead in preventing, controlling and abating environmental pollution by accelerating corrective measures at Air Force installations, and by initiating and supporting local area programs of local communities in developing area-pollution abatement programs.

d. Provide preventive pollution control by:

(1) Reducing or eliminating waste at the point of generation.

(2) Considering potential environmental pollution control problems when selecting chemical compounds and materials to be used in Air Force operations.

(3) Including pollution abatement as an element in specifications.

e. Comply not only with Air Force directives relating to pollution criteria and standards, but also with criteria and standards published by the Environmental Protection Agency (EPA) and by state and local pollution abatement agencies in the area.

g. Dispose of a dishcarge pollutant in a manner that will not directly or indirectly expose people to concentrations of any substance hazardous to health; result in substantial harm to domestic animals, fish, shellfish, or wildlife; cause economic loss through damage to plants or crops; or cause groundwater contamination.

j. Store and handle gasoline, jet fuels, and other volatile petroleum distillates or organic liquids in accordance with Federal, state and local standards.

k. Avoid or minimize the creation of wastes throughout the complete cycle of operations at each facility.

l. Preferentially use municipal or regional waste collection or disposal systems to dispose of wastes from Air Force facilities. When use of such a system is not feasible or appropriate, do whatever is necessary to satisfactorily dispose of such wastes, including the following:

(1) When appropriate, install and operate waste treatment and disposal facilities.

(2) Provide trained manpower, laboratories, and other supporting facilities, as appropriate to meet the requirements of issued standards.

(3) Require operators of Air Force pollution control facilities to meet levels of proficiency consistent with the operator certification requirements of the State in which the facility is located. If the State has no requirements use the guidelines on operator qualifications and performance issued by HQ USAF.

m. Insure that all materials (including solid fuels, ashes, petroleum products, and other chemical and biological agents) are used, stored, and handled to avoid or minimize the possibilities of water and air pollution.

n. Provide the engineering safeguards (such as dikes, catchment areas, relief vessels) that are necessary to prevent pollution of water by accidental discharge of stored fuels, oils, and other chemicals.

o. Assure that discharges of radioactivity conform with the applicable rules, regulations, and requirements of the Atomic Energy Commission and with the policies and guidance of the Environmental Protection Agency as specified in AFR 160-132 and the 11ON Technical Order Series.

t. Fully coordinate environmental protection matters with all agencies concerned to avoid duplication and insure timely solutions to mutual problems [8].

State Regulations. In 1962, the State of Arizona published its *Water Quality Standards for Surface Waters of Arizona.* The regulation placed limitations on such water quality criteria as the following:

1. pH
2. Turbidity
3. Biocides
4. Radioactivity
5. Dissolved oxygen
6. Oils and greases
7. Sludge forming materials
8. Temperature

The Arizona regulation also referenced the *U.S. Public Health Service Drinking Water Standards of 1962* (Figure 3).

Tucson Sanitary Regulations. Since AFP #44 was discharging a portion of its industrial waste to the Tucson sanitary system, it came under the requirements of the Tucson sanitary regulations. These regulations stated that,

> Wastes which are discharged into the City of Tucson sanitary sewer must meet the following requirements:
>
> 1. Shall have a maximum temperature of 150°F.
> 2. Shall contain a maximum of 100 parts per million, by weight, of fat, oil, or grease.
> 3. Shall not contain any gasoline, benzine naphtha, fuel oil, or other flammable or explosive liquid, solid or gas.
> 4. Shall not contain any garbage that has not been properly shredded.
> 5. Shall not contain any ashes, cinders, sand, mud, straw, shavings, metal, glass, or any other solid or viscous substance capable of causing any obstruction to the flow in sewers or any other interference with the proper operation of the treatment plant.
> 6. Shall not contain any waste having a pH lower than 5.5 or higher than 9.0, or any other corrosive property capable of causing damage or hazards to the structures, equipment, or personnel of the treatment plant.
> 7. Shall not contain any wastes containing a toxic or poisonous substance in sufficient quantity to injure or interfere with any sewage treatment process, constitute any hazard to humans or create any hazard in the receiving waters of the sewage treatment plant.
> 8. Shall not contain suspended solids of such character and quantity that unusual attention or expense is required to handle such material at the sewage treatment plant.
> 9. Shall not contain any noxious or malodorous gas or substance capable of creating a public nuisance.
> 10. Shall not contain any substance whose physical, chemical, or electrical properties might be such as to interfere with any phase of the operation of the sewage treatment plant.
> 11. Chemical Oxygen demand shall not exceed 450 parts per million by weight [8].

Substance	Max Concentration (mg/l)
Alkyl benzine sulfonate (ABS)	0.5
Arsenic* (As)	0.01
Chloride (Cl)	250
Copper (Cu)	1.0
Carbon Chloroform Extract (CCE)	0.2
Cyanide* (CN)	0.2
Fluoride* (F)	3.4**
Iron (Fe)	0.3
Manganese (Mn)	0.05
Nitrate (NO_3)	45
Phenols	0.001
Sulfate (SO_4)	250
Total Dissolved Solids (TDS)	500
Zinc (Zn)	5.0
Barium* (Ba)	1.0
Cadmium* (Cd)	0.01
Chromium* (Cr)	0.05
Lead* (Pb)	0.05
Selenium* (Se)	0.01
Silver* (Ag)	0.05
Magnesium (Mg)	50
Radium 226	3 micro micro curies/liter
Strontium 90	10 micro micro curies/liter
Gross Betta Activity	1,000 micro micro curies/liter

* Manditory limits for rejection of water.
** Based on 5-year average annual max. daily air temperature range of 50°F to 53.7°F.

Figure 3

United States Public Health Service
Drinking Water Standards
1962
[8]

EPA Guidelines. As of the spring of 1973, the United States Environmental Protection Agency had not published its wastewater discharge limitations. It had, however, published some tentative guidelines which are contained in Figure 4.

The Problem

As of March, 1973, the industrial wastewater discharges from AFP #44 violated at least one of the preceding regulations in the following areas:

1. Aluminum
2. Arsenic
3. Cadmium
4. Chromium
5. Copper
6. Iron
7. Lead
8. Manganese
9. Molybdenum
10. Nickel
11. Selenium
12. Silver
13. Tin
14. Titanium
15. Zinc
16. Fluoride

Parameter	Limit
Aluminum	1.0 mg/l
Arsenic	50 ug/l
Barium	2.0 mg/l
Cadmium	100 ug/l
Chromium (Total)	100 ug/l
Copper	1.0 mg/l
Iron (Total)	2.0 mg/l
Iron (Soluble)	1.0 mg/l
Lead	100 ug/l
Manganese	0.1 mg/l
Mercury	No Discharge
Nickel	1.0 mg/l
Selenium	10 ug/l
Silver	50 ug/l
Zinc	1.0 mg/l
Cyanide	0.025 mg/l
Fluoride	1.5 mg/l
Phosphorous	2.0 mg/l
Oil and Grease	10.0 mg/l
Phenols	1.0 mg/l
Surfactants	To Be Established
Settleable Solids	0.2 mg/l
Suspended Solids	30 mg/l
Total Heavy Metals	1.0 mg/l
BOD, 5-day	30-75 mg/l
Turbidity	50 JTU
pH	6-9 (7 ± 0.5 preferred)

Figure 4

EPA Tentative Guidelines for Uniform
Maximum Effluent Controls
[8:I-6]

17. Nitrate
18. Phosphorous
19. Sulfate
20. Sulfide
21. pH
22. Dissolved Solids
23. Suspended Solids
24. Oil and Grease
25. Mercury
26. Nitrates
27. Cyanide

The industrial wastewaters were draining from several areas within the main production building. Not all of the waste was processed through the primary industrial wastewater plant and the plant was not performing satisfactorily. What would you do to solve this problem?

RELEVANT DATA

Funding Arrangement

Under the terms of the facilities contract between Hughes Aircraft and the Air Force, the Air Force would pay the initial capital investment involved with the construction of a wastewater collection and treatment facility and Hughes Aircraft would operate and maintain the facility as an overhead cost item which would be charged against future production.

Water Pollution Control Study. A water pollution control study had been performed by an engineering firm for Hughes Aircraft. The study contained both qualitative and quantitative data on the characteristics of the industrial wastewater being discharged from AFP #44. The study also recommended that AFP #44 reroute all of its industrial wastes through a sophisticated pretreatment facility and into the Tucson sanitary system.

Environmental Assessment

An environmental assessment which had been written on the proposal to reroute the wastewaters to the Tucson sanitary system found no truly detrimental environmental

impacts to the proposal. There was a grove of trees, much like an oasis, which had grown around the surface waste-water discharges. The assessment found that the grove would die after their water supply had been stopped. However, the trees were of no environmental value to the area so their loss was not considered detrimental.

Available Funding

The Air Force did have funding available for the design of a pretreatment system.

Deadlines

The deadlines set by the Federal Water Pollution Control Act for industrial polluters were as follows:

1. July 1, 1977 - best practicable water pollution control technology must be used.

2. July 1, 1983 - best available water pollution control technology must be used.

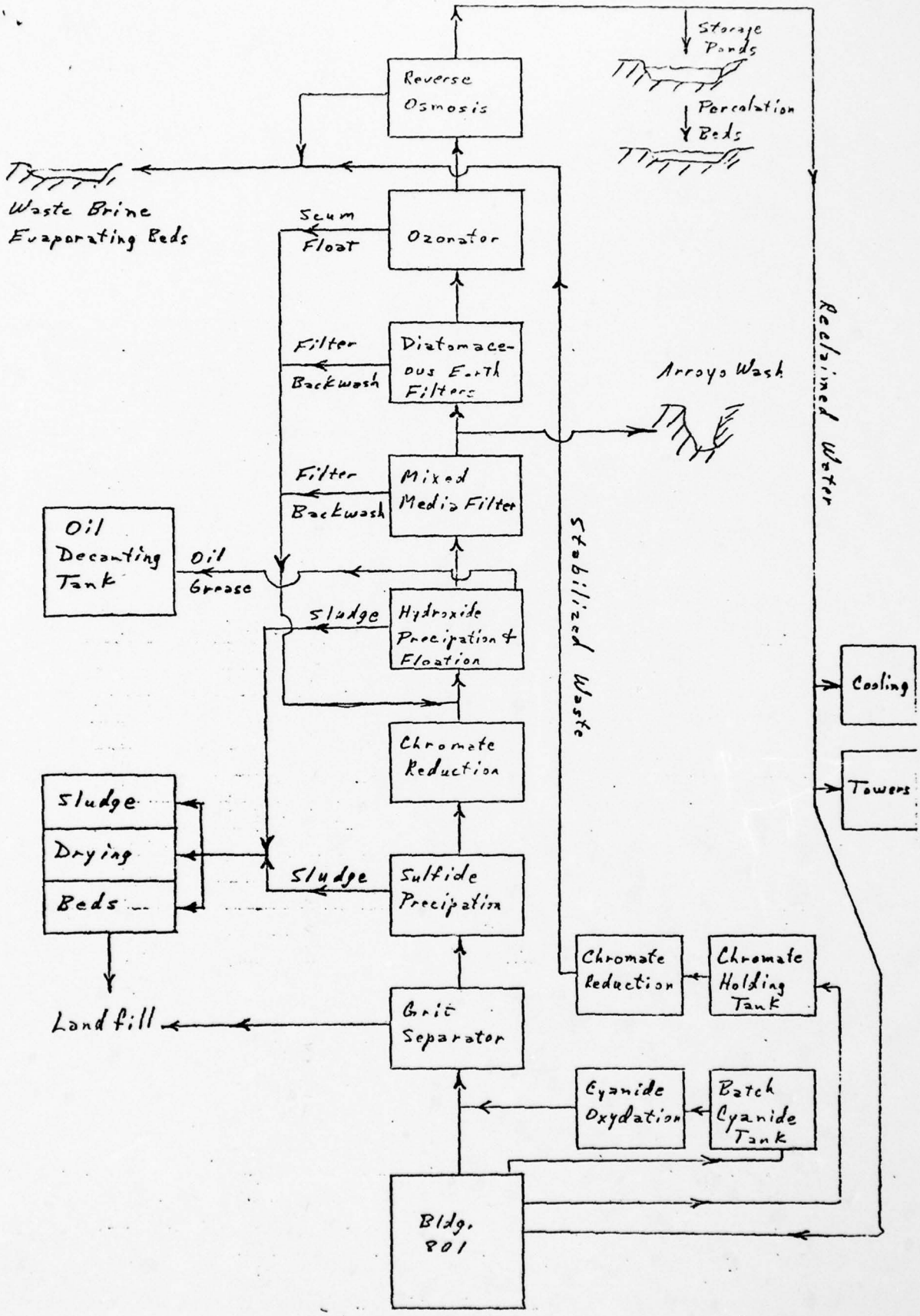
3. 1985 - zero discharge of pollutants must be attained.

Question

Again, what would you do if you were in Pete Brown's shoes? You now know just about as much (except for the nitty gritty technical data) as Pete Brown knew in 1973.

APPENDIX A

Schematic Diagram of the Waste-water Treatment Plant (AFP #44)


Storage Ponds
Percolation Beds
Reverse Osmosis
Waste Brine Evaporating Beds
Scum Float
Ozonator
Filter Backwash
Diatomaceous Earth Filters
Arroyo Wash
Reclaimed Water
Filter Backwash
Mixed Media Filter
Oil Decanting Tank
Oil Grease
Sludge
Hydroxide Precipitation & Floation
Stabilized Waste
Cooling Towers
Chromate Reduction
Sludge Drying Beds
Sludge
Sulfide Precipitation
Chromate Reduction
Chromate Holding Tank
Land fill
Grit Separator
Cyanide Oxydation
Batch Cyanide Tank
Bldg. 801

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CASE #2

THE INTERSTATE 675 CONTROVERSY

By

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Captain, USAF

James R. Berry, BS
Captain, USAF

THE PROBLEM

INTRODUCTION

The construction of a bypass around Dayton as a part of the interstate highway system was visualized in 1957. Over twenty years later the highway is still being visualized. The construction of I-675 from I-75 northeasterly to I-70 has met many problems that have delayed its completion. The objectives of the proposed project were increased traffic capacity, safety, and access to a major National Defense facility (Wright-Patterson Air Force Base), and accommodation of the regional transportation plan (10:14). The project has caused much controversy and publicity. The present delay is due to an environmental assessment that has been requested by the Ohio Department of Transportation (ODOT).

BACKGROUND

History

In 1957 the Bureau of Public Roads authorized an urban belt route as part of the interstate highway system. A requirement was made that studies should be conducted to determine the route. In 1959 the State negotiated an agreement with a consulting engineering firm for the preparation

of a Preliminary Engineering Report to investigate the location and to develop a proposed route for I-675. In April of 1960 representatives of the Ohio Department of Highways (currently known as the Ohio Department of Transportation), the Bureau of Public Roads (now the Federal Highway Administration), and the consulting firm met with officials from the Montgomery-Greene County Regional Transportation Committee, Montgomery County, City of Dayton, City of Kettering, and the City of Fairborn to assist in the selection of possible route locations. The following month the consultant submitted to the State a report which discussed a number of different route corridors (see Figure 1). This report recommended that the route be located on the east side of Dayton. In July of that year the Bureau of Public Roads approved the general location. In December of 1961 the consulting firm completed and submitted a Preliminary Draft Report to the State and Bureau of Public Roads. Local officials did not like the recommended route, and the Montgomery-Greene County Regional Transportation Committee developed a "close-in" route through Kettering and the eastern section of Dayton. The State reviewed and concurred with the proposal. However, the Bureau of Public Roads would not approve the "close-in" route since they judged it did not meet the criteria for an interstate belt route (10:1-3).

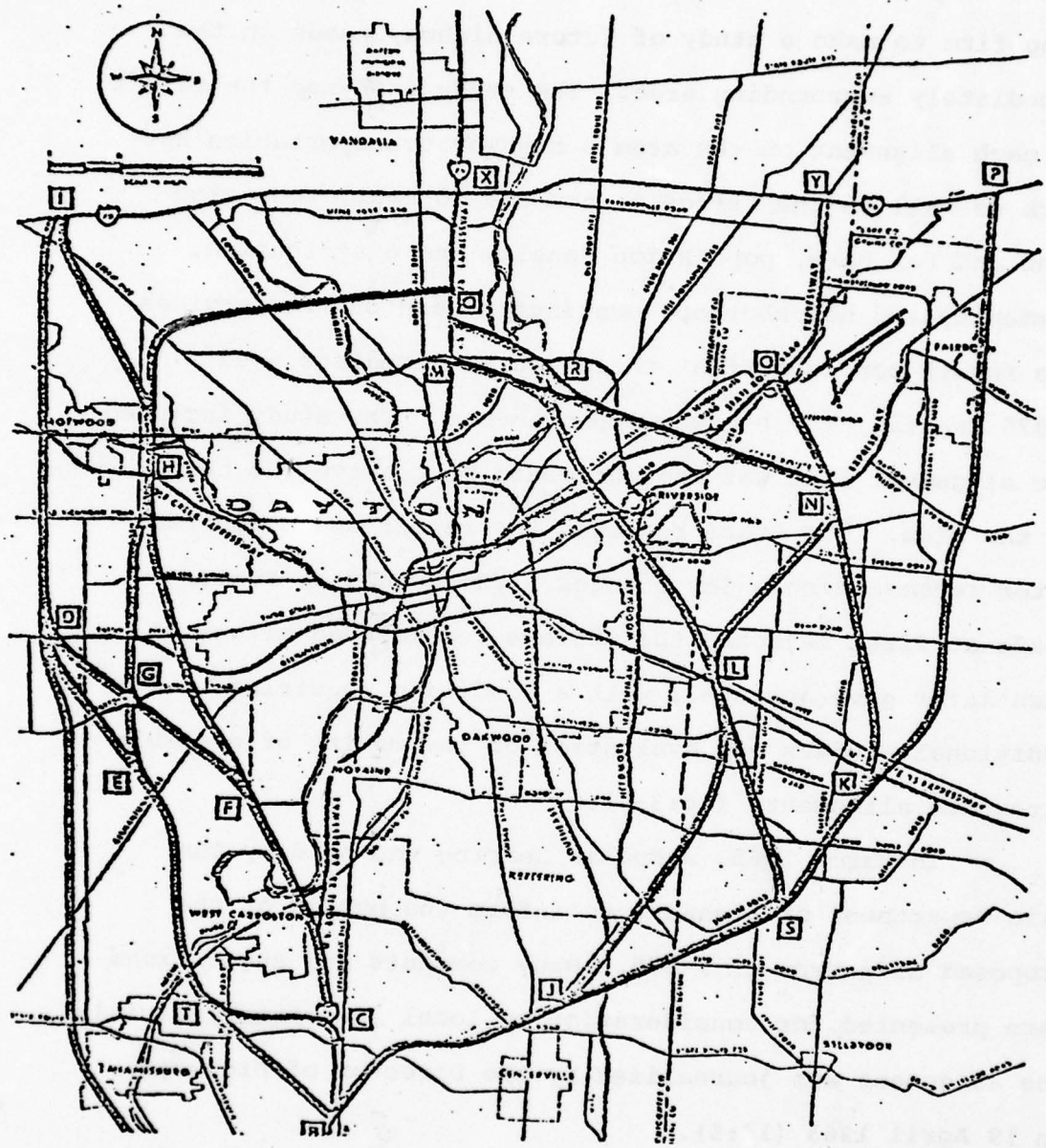

Figure 1: Alternate Route Corridors (14:112)

Late in 1962 representatives of the Regional Transportation Committee, Wright-Patterson Air Force Base, and the new University (presently known as Wright State University) formed a study group and authorized a consulting firm to make a study of future highway needs in the immediately surrounding area. The study analyzed the effect of each alignment on the area's highway transportation network as well as the effect on new development, redevelopment and tax base, population density and distribution, community and neighborhood continuity, and public services. The report concluded that there was an immediate need (1975 traffic) for highway improvements. The study included the alignment that was thought would best serve the needs of the area. The State reviewed the report and concurred after recommending a few changes. The Bureau of Public Roads at first rejected the State's recommended alignment, then later gave approval, with a condition requiring additional studies and evaluation of the merits of possible alternate alignments (14:3-4).

In March 1965, a Public Hearing was held by the Ohio Department of Highways to inform the public of the proposed alignment of I-675. Many comments and suggestions were presented for consideration by local and state officials. The alignment was journalized by the Director of Highways on 19 April 1963 (14:5).

Concurrent with development of the proposed I-675 alignment the Regional Transportation Committee was undertaking the development of a Regional Transportation Plan. I-675, in the corridor proposed, was included in the plan (14:5).

In February 1966, the State hired a consulting engineering firm to develop the construction plans for the portion of I-675 from I-75 to just south of US 35. In May of that same year the State engaged the services of a second consulting firm to develop the plans for the portion from just south of US 35 to I-70. In July a report which took into consideration regional and community growth; public facilities and services; displacement of residents and businesses; fast, safe, and efficient transportation; highway cost; and user benefits was issued for the portion of highway from I-75 to US 35. After reviewing this report the State conducted a second public hearing due to certain alignment changes recommended in the report. Revised alignments were made at the hearing (14:5-7).

Portions of the freeway were let for contract prior to the requirement for preparing an Enviornmental Impact Statement. In 1973, in accordance with the National Environment Policy Act, the Federal Highway Administration Division Engineer conducted a reassessment of the remaining portion of the project. As a result it was determined that an Environmental Impact Statement would be prepared for the

portion of I-675 from I-75 to North Fairfield Road (14:7). The portion from North Fairfield Road to I-70 was opened in two sections, one in October 1974, another in October 1975.

Controversy

Most of the citizen protest about I-675 began in 1972 and 1973. The main areas of citizen concern were the fear of a noise problem in the vicinity of the highway, the destruction of wooded areas in the proposed path, and the fear of the highway increasing the movement of business and people from the city of Dayton.

Members of the I-675 Citizens Information Task Force (composed primarily of Washington Township residents) complained that possible harmful noise levels which could cause loss of hearing could exist for homes along the proposed path of the highway (12:1a). Residents of Oak Creek complained when they learned that the highway construction would destroy a 16 acre wooded area. The residents feel that the trees "make their yards no doubt feel 10 degrees cooler in the summer and probably reduce the chill factor 10 degrees in the winter [1]." The Oak Creek residents were the first group to swing into action against the highway.

The city of Dayton's population has been decreasing in the past years (4). Many feared that the construction of I-675 would increase this population migration. Many feared that Dayton businesses would move from the city and develop around I-675 and its interchanges.

On October 24, 1973, a National Policy Act reassessment was made that concluded the highway construction in the areas of concern had not reached a stage of development where a delay outweighed the benefits to be derived from preparing an environmental statement. It was therefore directed that an environmental statement be processed in accordance with the provisions of the National Environmental Policy Act (14:Page 2 of appendix).

THE ENVIRONMENTAL IMPACT STATEMENT

CONTENTS OF THE STATEMENT

Background

The draft Environmental Impact Statement dated November 10, 1976 was written for the construction of 16.53 miles of limited access highway (I-675) in Montgomery and Greene counties near Dayton, Ohio with 8 interchanges, 3 railroad grade separations, 14 local road grade separations, and 1 pedestrian grade separation. The planned highway begins at existing I-75, 1.14± miles south of State Road 725, and follows a generally northeasterly direction to connect with a completed section of the freeway at a point just west of North Fairfield Road (14:ii). Figure 2 shows the route of the proposed I-675 construction.

The Draft Environmental Impact Statement (EIS) was prepared by King and Gavaris Consulting Engineers, Inc. of Cincinnati, Ohio. Preparers of Environmental Impact Statements are required to consider and analyze alternatives to the proposed action. The EIS prepared for I-675 considered only two alternatives: (1) build I-675 as designed and (2) do not build I-675. The second alternative would entail

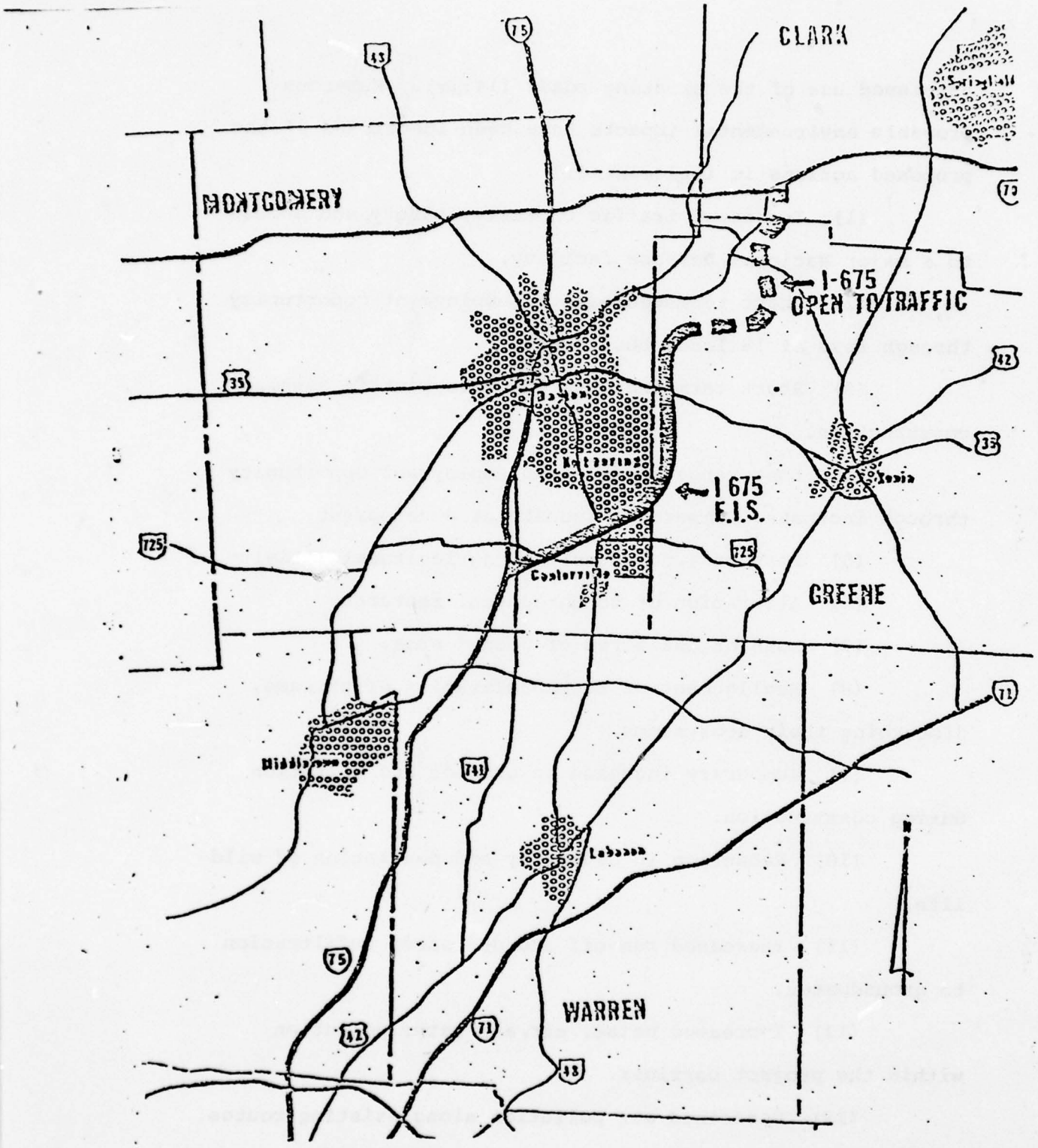

Figure 2: I-675 Route (14:111)

continued use of the existing roads (14:iv). Numerous probable environmental impacts have been identified if the proposed actions is implemented:

(1) Increased traffic capacity, safety, and access to a major National Defense facility.

(2) Short term decrease in employment opportunity through loss of 18 local businesses.

(3) Short term increase in employment in highway construction.

(4) Long range increase in employment opportunity through increased commercial-industrial development.

(5) Loss of 4.36 acres from agricultural activity.

(6) Alteration of topographical features.

(7) Loss of 138 acres of wooded area.

(8) Realignment or rechannelization of streams, disturbing their ecosystems.

(9) Temporary increase in erosion and siltation during construction.

(10) Reduction in diversity and population of wildlife.

(11) Increased run-off and decreased infiltration to groundwater.

(12) Increased noise, air, and water pollution within the project corridor.

(13) Decreased air pollution along existing routes.

(14) Loss of open space.

(15) Relocation of 88 families, 14 businesses, and 6 farm units.

(16) Improved access to recreational areas.

(17) Loss of 0.25 acre of park.

(18) Change in aesthetic conditions.

(19) Accommodation of the regional plan.

(20) Reorientation of traffic.

(21) Relocation of utilities (14:iii).

Construction of I-675 will alter the existing topography by converting approximately 1086 acres of property to highway use. Within the 1086 acres, 138 are woodlots, 105 are agricultural open space, 49 are commercial property, and .036 are institutional property. The remaining acreage (approximately 800) is currently classed as residential property (14:70). When the Environmental Impact Statement was written, the Ohio Department of Transportation had acquired approximately 70 percent of the rights-of-way and had relocated 77 families, 11 businesses, and 5 farm units. (Additional property has been purchased since the writing of the EIS. Through an interview with the Montgomery County Transportation Coordinating Committee Planning Engineer, John Geiger, the authors learned that approximately 90 percent of the rights-of-way had been purchased, and the majority of the remaining 10 percent was being held up because of price differences (4)).

Oak Creek Controversy

Within the corridor of the proposed route for I-675 there are 16 woodlots aggregating approximately 457 acres. As stated earlier 138 of these acres (30 percent±) are included in the right-of-way property required for construction. One of the wooded areas, near Pondview Park and the Oak Creek Subdivision, has been the subject of many meetings and much controversy. The controversy is over the right-of-way acquisition of 11.2 acres of a total of 23 acres (not located within the Pondview Park area). The local residents formed the Oak Creek Environmental Committee and presented alternate alignment schemes to the Montgomery-Greene County Transportation and Development Planning Committee. These alternate routes and other alignments to avoid the wooded area were reviewed and pronounced unacceptable for safety reasons, for effects on a church property located on Wilmington Pike, and for increased costs reasons. It was reported by ODOT that to provide a similarly acceptable highway on an alternate route would increase the engineering, construction, and right-of-way costs for the project approximately $415,000 (14:19-20).

A study was performed by the Miami Valley Regional Open Space Committee Environmental Task Force concerning the ecology of the Oak Creek wooded area. The study revealed that the area was not a high quality or unique natural area and that the woodland had been pastured and

was now in second growth. The report pointed out that the area in question was the only wooded parcel in the general vicinity and could, if well protected, be utilized for its aesthetic beauty, environmental education value, and potential passive recreation. The only notable species of trees were approximately one-half dozen Black Gum trees and a 150 year old Shag Bark Hickory. The study also revealed that the wooded area would probably have been sacrificed to a medium density residential development if it were not for the proposed construction of I-675. The entire parcel was owned by the Oak Creek Development Corporation prior to being sold to the State of Ohio (14:20-22). (Portions of the above mentioned report were included in the Environmental Impact Statement and it is the opinion of the authors of this Case Study that the report seemed to be written with the idea that the construction of the highway was inevitable.)

Grant Park Acquisition

The required acquisition of 0.6 acres (0.25± needed for actual construction area) of right-of-way in Grant Park in Montgomery County presented another major problem. Grant Park consists of two non-contiguous sites containing approximately 164 acres. The portion that will be affected by the construction of I-675 consists of 5.29 acres and is

located on the corner of Normandy Lane and Normandy Ridge Road (14:28). The 0.25 acres permanently lost due to the proposed construction is open space, unimproved level ground covered mainly with meadow grass. The recreational activity of the 5.29 acres affected by the proposed construction is non-organized visits by people using a portion of an access trail to the main park area. The main park area (not affected by the right-of-way acquisitions) usage is mostly that of a Nature Park with planned recreational activities such as Camp Fire Girls, Boy Scouts, Girl Scouts, etc.

Under the 1966 Department of Transportation Act approval of the construction of I-675 is prohibited unless: (1) there is no feasible and prudent alternative to the use of the land and (2) the program encompasses all possible planning to minimize harm resulting from use of the land. During September 1974 and June 1975, Park District personnel held meetings concerning the acquisition of property and planned construction of the highway. The main areas of concern among the park officials were improving the aesthetics and the preservation of a 28 inch Sycamore tree. "Basically, we want them to save a gib tree that was in the right of way [8]." As a result of these concerns the Ohio Department of Transportation revised its construction plans to preserve the Sycamore tree and to make improvements in the other areas of interest (14:Page 1-6 of Appendix).

On June 10, 1975 Mr. William S. Yeck, Secretary-Treasure of the Centerville-Washington Park District, stated in a letter to ODOT, "The acquisition of land for Interstate 675 . . . will have no significant effect on Grant Park [14:Exhibit 4 of Appendix]."

Traffic

One of the prime reasons for the planned construction of I-675 was to alleviate traffic problems. The highway was designed with a 1993 design year, and from analysis of traffic data it is estimated that in 1993 the daily travel demand in the area of the proposed I-675 will amount to approximately 3,320,000 vehicle miles[1] more than the capacity of the presently existing system. It is estimated that up to 830 land-miles of new pavement could be required to relieve the deficiency. Proposed I-675 will provide approximately 100 lane-miles of pavement. Construction of I-675 will not overcome the deficiency totally; therefore, programs like mass transit will be necessary to supplement the transportation system. Analysis of traffic data indicates that the annual traffic on existing facilities in 1993, if I-675 is not constructed, will be approximately 220 million vehicle miles more than if it is constructed (14:33-34).

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[1] Vehicle miles is a term for describing the total distance traveled by all vehicles, i.e., 10,000 vehicles traveling traveling 20 miles equals 200,000 vehicle miles.

Socio-Economic Factors

Data from the 1970 census indicates that the area under question ranks toward the upper levels of the socio-economic hierarchy with persons of higher education and incomes residing in larger and more expensive homes than average. Miami Valley Regional Planning Commission reported that between 1970 and 1973 building permits for 2946 single family dwelling units and 3138 multi-family housing dwelling units were granted in the vicinity of proposed I-675 (14:37). (Note: Further data indicates rapid urbanizing of the entire region southeast of Dayton; therefore, I-675 should not be considered the only factor contributing to the influx of people and business.)

The proposed I-675 will service one of the Dayton area's major employment centers, Wright-Patterson Air Force Base. A second major employment and traffic generator, Wright State University, is adjacent to the Base.

Air, Noise, and Water

An air quality report for proposed I-675 predicted that there would be no significant difference in carbon monoxide and hydrocarbon pollutant loads emitted as a result of the highway use. A noise report revealed that there were 29 areas along the route where the predicted highway-generated noise levels will be greater than the acceptable levels outlined in Federal Highway Administration

criteria guidelines. From a detailed review it was determinded that resulting noise levels could meet the existing criteria if the plans were modified to include the construction of barriers at a cost considered to be disproportionate to the value of the property. Also it was deduced that noise reductions would result with the barriers, however, the result would not be significant; therefore, the reviewers of the study concluded that modification of the plans to include noise barriers would not be prudent (14:84-89).

There are approximately 30 ponds in the vicinity of proposed I-675. Three will be eliminated and seven will receive additional runoff waters. The impact on the water quality will be from chemical runoff of de-icing salts, herbicides, automobile wastes, and accidental spills (14:68). Construction plans include channel widenings and relocations of creeks in the construction area. Preparers of the EIS believe that there will be no adverse impacts due to the construction of I-675.

No-Build Alternative

The only "no-build" alternative considered feasible by the EIS is adding additional capacity through installation of traffic controls or construction of more lanes of pavement on existing hishway (requiring additional acquiring of rights-of-way). The preparers felt that this action would

include many of the same problems as the proposed action, but would not provide as many benefits (14:58-63). At the time of the writing of the EIS, ODOT had acquired 700 acres and had relocated 77 of the 88 families, 11 businesses, and 5 farm units. ODOT had expended $13,801,500 for property acquisition and relocation assistance for the proposed portion of I-675. If the highway were not completed the full value and any positive economic impacts would not be fully realized from the existing completed portion of I-675 from North Fairfield Road to I-70. The $23,177,339 expended on this section for rights-of-way and construction would not return the full value that would be accrued if the project were completed (14:108).

COMENTS ABOUT THE STATEMENT

The Draft Environmental Impact Statement was completed and released in late 1976 and early 1977. Comments were requested from specific groups and copies were made available at Public Libraries for anyone to review. The Regional Air Pollution Control Agency (RAPCA) commented that they were unable to determine the acceptability of the environmental impacts due to a lack of sufficient data describing those impacts in the EIS. A comparison of the impacts with those of other alternatives was not possible because the available alternatives were not sufficiently developed, and some alternatives were not developed at all.

The revisions requested and commented on by the Regional Air Pollution Control Agency were of such an extensive nature that the Agency suggested that the EIS should be recirculated in draft form after the deficiencies were corrected, rather than ODOT having a final EIS prepared (11:1-2).

Air Quality

The Agency pointed out three major areas of concern that the EIS did not address. First was the fact that if I-675 is completed, traffic on the streets intersecting it will increase dramatically. The traffic will increase partly because these streets will become feeder roads for I-675 and partly because of development which will occur in the vicinity of the interchanges. The second area was that completing I-675 will stimulate more urban sprawl. This in turn will increase the dependency on the automobile and cause increasing air pollution, traffic noise, and energy consumption. The highway represents a long-term commitment by the Dayton Region to continued interest in automobile travel. Third, the EIS does not discuss Dayton Area Rail Transit (DART) System, which has been debated for several years (11:2-3).

There are recognized air quality problems in the Dayton area. Realizing this and the fact that I-675 will be a high volume facility, RAPCA believes that a higher level of air quality analysis is warranted than that

presented in the EIS. Three questions in particular need to be addressed:

(1) If I-675 is built, what will be the air quality (carbon monoxide level) along the proposed route in the completion year and in the design year?

(2) What will be the air quality (carbon monoxide level) on each of the streets under the "no-build system" in the completion and design year?

(3) What will be the total pollutant burden (hydrocarbons) emitted under the "build system" and under each alternate for the completion and design year?

Because of these problems and the lack of reasonable alternatives proposed in the EIS, the RAPCA suggests that the EIS should be redrafted (11:17).

No-Build Alternative

The EIS's discussion of the "no-build" alternative is not developed in sufficient detail to allow comparison of the impacts with those of the "build" alternative. The "no-build" alternative seems to assume that the traffic demand will be identical with the "build" alternative. If the highway is not built it is not likely that the development pattern will be the same as if the highway was completed (11:22).

Other Alternatives

As pointed out earlier, one comment that RAPCA made about the EIS was that it did not consider many of the alternatives that were available. Some of these alternatives are construction of light rail transit facilities, purchase of transit buses, constructing I-675 with fewer interchanges, terminating I-675 at US 35, or any combination of these along with local street improvements. RAPCA supports improving the public transportation system of the Dayton area. They feel this action will improve the air quality in the area. The EIS mentions light rail transit facilities and then dismisses them because they would not serve the same travel corridor or serve the same function of I-675, that function being a bypass around Dayton. A traffic study presented in the draft EIS shows that in the completion year of I-675 all of the traffic predicted to be using the highway as a change of direction (Dayton bypass traffic) will amount to less than 10 percent of all of the traffic using the I-675 route. The majority of the traffic will be local (11:23). With this consideration and the growing energy conservation appeals by the federal government, RAPCA believed that the light rail alternative, and others, should be fully developed.

A major factor suppressing the consideration of possible alternatives is the feared loss of federal money set aside for I-675. Under certain conditions, however,

federal money can be used to fund alternatives. This is possible under regulations of the Federal Highway Administration and under the Federal Aid Highway Act of 1976. Under certain provisions the funds for I-675 could be used instead for a mixture of transportation projects, providing public transportation as well as local road improvements (11:25-26).

In response to the EIS the members of the Oak Creek Environmental Committee prepared a 17-page rebuttal. In the response they suggested an alternate route that would shift the freeway enough to miss most of the wooded acreage that the residents feared would be destroyed. In their report they stated, "It is felt the complete failure of the preparers of the draft environmental impact statement to consider the alternate alignment of the road . . . is not only irresponsible, but unlawful [5]." The Oak Creek group indicated in its response that an injunction would be sought to halt the project if the changes were not made.

PRESENT SITUATION

The present situation is one similar to that of the past 25 years that the highway has been proposed - slow in developing. After the release of the Environmental Impact Statement in 1976, state and city officials were expecting to advertise the contract and take bids by the spring of 1977. The contract has not materialized yet. The

present forecast is for some decision concerning the project to be made by the end of this summer (4).

Just prior to the release of the EIS, the firm of King and Gavaris (preparers of the EIS), stated that the study had found no detrimental environmental impact that should hold up the highway (9). Optimism was high around this time among those in favor of completing the highway. Starting dates for construction were published. During this same time frame confidence was high among the members of the Oak Creek Environmental Committee. The committee stated that they were "100 percent sure" they would get the realignment they proposed (5).

Responses to the EIS were forwarded to the Ohio Department of Transportation for review. In July 1977, the word from ODOT was that the deadline of August 1, 1977 for having the final EIS ready would not be met. Reception of over 300 different questions about aspects of the draft EIS prompted the delay. Numerous comments questioning the traffic data resulted in a new computer run and new traffic volume estimates. With the new traffic volume estimates a reassessment of the noise data was required (2). ODOT is presently investigating the responses received from the draft EIS and preparing a final Environmental Impact Statement. Once the final assessment is submitted, the impact statement usually takes six to eight months to get final approval from the Federal Highway Administration. Once this

approval is received construction can begin (7). It seems from this that a hope for a decision by the end of this summer is somewhat too optimistic.

All of the delay and uncertainty over the I-675 project has caused a lot of conflict and local publicity. The majority of the people want to see the project completed; even the Oak Creek group "has never been opposed to the completion of I-675 [5]." The group is concerned, however, with the protection of the "environment of persons living along and using said highway [5]." When the Regional Air Pollution Control Agency published an article asking ODOT to consider the possibility of transferring I-675 funds to some sort of mass transit system, Centerville council members became angered. Some members recommended that the city withdraw its support from those groups opposing I-675. The Centerville-Bellbrook Times quoted one council member saying, "I've always supported mass transit, but I'm ready to withdraw from that position if it threatens to take the place of I-675 [6]."

Your Assignment

The above scenario should be utilized as the basis for a mock public hearing. The participants should be

(1) Chairman, Ohio Dept of Highways (DOH), Representative

(2) Representative, King & Gavaris Consulting Engineers, Inc. (KGCE)

(3) President, Wright State University

(4) Commander, Wright-Patterson AFB

(5) Mayor, Dayton

(6) Mayor, Fairborn

(7) Mayor, Centerville

(8) Chairman, Citizens Information Task Force

The situation is an open public hearing chaired by the DOH Representative. The representative from KGCE will provide the visual aids and an opening statement synopsizing the results of the EIS. Then in turn each participant will state his position and his supporting rationale.

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CASE #3

NEW TERMS IN ENERGY CONSERVATION

By

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First Lieutenant, USAF

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BACKGROUND

Introduction

It is an unusually quiet Friday morning in the Engineering section at Lukewarm AFB, Kansas. Lt. Jack Smith is wondering if the Base Commander's Weekly Update meeting has been cancelled. Normally by this time, 0900, he is running around on the latest hot project. Every Friday it's the same; the BCE, Col. Hagerman, attends the Wing Standup at 0730, then returns by 0830 with a problem which must be resolved by the 1300 update meeting. Col. Hagerman is proud of his reputation as a problem solver and has let Lt. Smith know that he has appreciated his fast staff work on the problems.

Lt. Smith is considering going to the bowling alley for a cup of coffee with the construction management officers when Col. Hagerman comes into his office.

Col. Hagerman explained that Col. Jones, the Base Commander, and Col. Hines, the Wing Commander, have just returned from the annual command wide Commander's Conference. Many of the other attendees had been personally congratulated by General Kirk, the SAC Commander, for their outstanding efforts in support of the Energy Conservation Program.

Although Lukewarm had met all published energy reduction standards, so had every other SAC base. Three terms; 12003, ECIP, and BEAP, had been frequently used during the praise, which were new to both Col. Hines and Col. Jones.

Lt. Smith is to prepare a short 15 minute briefing to bring the

commanders, Colonels Hagerman, Jones, and Hines up to speed on the energy conservation terms.

Col. Hagerman reminds Lt. Smith that his OER is due next week and that this briefing will be an excellent opportunity to earn a high rating and get his name in the spotlight.

Lt. Smith was interested in the energy crisis and its resulting problems for the Air Force, so he had been keeping up to date. He reached into his file drawer as soon as Col. Hagerman left. He extracted the attached information. He reads through it and sits back to contemplate his assignment.

Your Assignment

Prepare and present a 15-minute briefing as if you were Lt. Smith.

USEFUL INFORMATION

SEC. 2. Executive Order No. 11912 of April 13, 1976, is further amended by adding the following new Section:

"Sec. 10. (a)(1) The Administrator of the Federal Energy Administration, hereinafter referred to as the Administrator, shall develop, with the concurrence of the Director of the Office of Management and Budget, and in consultation with the Secretary of Defense, the Secretary of Housing and Urban Development, the Administrator of Veterans' Affairs, the Administrator of the Energy Research and Development Administration, the Administrator of General Services, and the heads of such other Executive agencies as he deems appropriate, the ten-year plan for energy conservation with respect to Government buildings, as provided by section 381(a)(2) of the Energy Policy and Conservation Act (42 U.S.C. 6361(a)(2)).

(2) The goals established in subsection (b) shall apply to the following categories of Federally-owned buildings: (i) office buildings, (ii) hospitals, (iii) schools, (iv) prison facilities, (v) multifamily dwellings, (vi) storage facilities, and (vii) such other categories of buildings for which the Administrator determines the establishment of energy-efficiency performance goals is feasible.

"(b) The Administrator shall establish requirements and procedures, which shall be observed by each agency unless a waiver is granted by the Administrator, designed to ensure that each agency to the maximum extent practicable aims to achieve the following goals:

(1) For the total of all Federally-owned existing buildings the goal shall be a reduction of 20 percent in the average annual energy use per gross square foot of floor area in 1985 from the average energy use per gross square foot of floor area in 1975. This goal shall apply to all buildings for which construction was or design specifications were completed prior to the date of promulgation of the guidelines pursuant to subsection (d) of this Section.

(2) For the total of all Federally-owned new buildings the goal shall be a reduction of 45 percent in the average annual energy requirement per gross square foot of floor area in 1985 from the average annual energy use per gross square foot of floor area in 1975. This goal shall apply to all new buildings for which design specifications are completed after the date of promulgation of the guidelines pursuant to subsection (d) of this Section.

"(c) The Administrator, with the concurrence of the Director of the Office of Management and Budget, in consultation with the heads of the Executive agencies specified in subsection (a) and the Director of the National Bureau of Standards, shall establish, for purposes of developing the ten-year plan, a practical and effective method for estimating and comparing life cycle capital and operating costs for Federal buildings, including residential, commercial, and industrial type categories. Such method shall be consistent with the Office of Management and Budget Circular No. A-94, and shall be adopted and used by all agencies in developing their plans pursuant to subsection (e), annual reports pursuant to subsection (g), and budget estimates pursuant to subsection (h). For purposes of this paragraph, the term "life cycle cost" means the total costs of owning, operating, and maintaining a building over its economic life, including its fuel and energy costs, determined on the basis of a systematic evaluation and comparison of alternative building systems.

"(d) Not later than November 1, 1977, the Administrator, with the concurrence of the Director of the Office of Management and Budget, and after consultation with the Administrator of General Services and the heads of the Executive agencies specified in subsection (a) shall issue guidelines for the plans to be submitted pursuant to subsection (e).

"(e) (1) The head of each Executive agency that maintains any existing building or will maintain any new building shall submit no later than six months after the issuance of guidelines pursuant to subsection (d), to the Administrator a ten-

year plan designed to the maximum extent practicable to meet the goals in subsection (b) for the total of existing or new Federal buildings. Such ten-year plans shall only consider improvements that are cost-effective consistent with the criteria established by the Director of the Office of Management and Budget (OMB Circular A-94) and the method established pursuant to subsection (c) of this Section. The plan submitted shall specify appropriate energy-saving initiatives and shall estimate the expected improvements by fiscal year in terms of specific accomplishments—energy savings and cost savings—together with the estimated costs of achieving the savings.

(2) The plans submitted shall, to the maximum extent practicable, include the results of preliminary energy audits of all existing buildings with over 30,000 gross square feet of space owned and maintained by Executive agencies. Further, the second annual report submitted under subsection (g)(2) of this Section shall, to the maximum extent practicable, include the results of preliminary energy audits of all existing buildings with more than 5,000 but not more than 30,000 gross square feet of space. The purpose of such preliminary energy audits shall be to identify the type, size, energy use level and major energy using systems of existing Federal buildings.

(3) The Administrator shall evaluate agency plans relative to the guidelines established pursuant to subsection (d) for such plans and relative to the cost estimating method established pursuant to subsection (c). Plans determined to be deficient by the Administrator will be returned to the submitting agency head for revision and resubmission within 60 days.

(4) The head of any Executive agency submitting a plan, should he disagree with the Administrator's determination with respect to that plan, may appeal to the Director of the Office of Management and Budget for resolution of the disagreement.

"(f) The head of each agency submitting a plan or revised plan determined not deficient by the Administrator or, on appeal, by the Director of the Office of Management and Budget, shall implement the plan in accord with approved budget estimates.

"(g) (1) Each Executive agency shall submit to the Administrator an overall plan for conserving fuel and energy in all operations of the agency. This overall plan shall be in addition to and include any ten-year plan for energy conservation in Government buildings submitted in accord with Subsection (e).

(2) By July 1 of each year, each Executive agency shall submit a report to the Administrator on progress made toward achieving the goals established in the overall plan required by paragraph (1) of this subsection. The annual report shall include quantitative measures and accomplishment with respect to energy saving actions taken, the cost of these actions, the energy saved, the costs saved, and other benefits realized.

(3) The Administrator shall prepare a consolidated annual report on Federal government progress toward achieving the goals, including aggregate quantitative measures of accomplishment as well as suggested revisions to the ten-year plan, and submit the report to the President by August 15 of each year.

"(h) Each agency required to submit a plan shall submit to the Director of the Office of Management and Budget with the agency's annual budget submission, and in accordance with procedures and requirements that the Director shall establish, estimates for implementation of the agency's plan. The Director of the Office of Management and Budget shall consult with the Administrator about the agency budget estimates.

"(i) Each agency shall program its proposed energy conservation improvements of buildings so as to give the highest priority to the most cost-effective projects.

"(j) No agency of the Federal government may enter into a lease or a commitment to lease a building the construction of which has not commenced by the effective date of this Order unless the building will likely meet or exceed the general goal set forth in subsection (b)(2).

"(k) The provisions of this section do not apply to housing units repossessed by the Federal Government.".

JIMMY CARTER

The White House,
July 20, 1977.

12. FINANCING AIR FORCE PARTICIPATION IN MUNICIPAL/REGIONAL WASTEWATER TREATMENT SYSTEMS: The normal method for financing Air Force participation in the capital costs of municipal/regional wastewater treatment systems is through a lump sum contribution provided by means of the MCP. This promotes better planning and budgeting processes, and is less expensive than financing the Air Force capital share of the costs over a period of years. Therefore, MCP funding will be utilized to finance such costs except under unusual circumstances which will be reviewed and determined on a case-by-case basis.

Early identification of the need for such funding is essential to program an item for inclusion in an MCP. Whenever such a need is identified at base level, appropriate procedures for programming the requirement into the MCP cycle will be promptly followed.

Under unusual circumstances, interim "surcharge" financing (i.e., long-term financing inclusive of interest charges) will require the Deputy Assistant Secretary, Secretary of the Air Force (Installations) approval prior to undertaking such obligation. The "surcharge" method of interim financing is not a substitute for good management planning. Under such interim financing the Air Force will pay, in addition to the normal rate for services rendered, an additional amount to cover the Air Force's capital cost share. Any such arrangement shall include a prepayment option whereby the Air Force, at no penalty, may prepay the outstanding amount of its capital share. Funding for this prepayment will be included in the next possible MCP, provided the prepayment is economically justified. The MCP project must include a detailed economic analysis.

If an Air Force installation is currently under an existing contract for sewage treatment, no lump sum payments nor increased termination liability may be incurred due to capital improvements to the existing system unless specifically provided for in the contract. Under these circumstances, the normal method to achieve Air Force participation in financing capital improvements to existing systems is through a general rate increase to all customers as specified in the contractual provisions.

* 13. ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP):

For the past three years, emphasis has been placed on including Energy Monitoring and Control Systems (EMCS) in the ECIP. For FY 80, a more balanced program is planned with emphasis on building retrofit projects. A recent building survey at one base revealed that there are many energy saving retrofit projects remaining to be accomplished. Furthermore, these retrofit projects should be easier to justify now that criteria is based on MBTU saved per $1,000 investment and payback increased from six years to economic life of the project.

The FY 80 MCP fiscal guidance has $36.1 million included for accomplishing ECIP projects. This OSD guidance is a result of the Presidential Executive Order 12003 relating to Federal Covernment energy conservation. The details of the Executive Order demand prudent investment of retrofit funds which can only be accomplished by making detailed building audits prior to MCP program development. Detailed energy audits to support the FY 80 MCP ECIP items must be accomplished with MAJCOM resources using in-service engineers or contract services. The Air Force-wide facility energy audit program using commercial software is expected to commence in March 1978. OSD has formally rejected the use of MCP advance planning funds (P313) for this.

Beginning with the FY 80 MCP ECIP, the attached form (Atch 3) will be included with the submittal from each base for which ECIP projects are submitted. This will require computer simulation for buildings with over 5,000 sq ft of floor area which are proposed for retrofitting. This form is in addition to documents required by other sections of this letter.

Computer simulation is not required but may be used for projects modifying buildings under 5,000 sq ft, central heating plants, or central heat conduit systems. Additional detailed guidance on the FY 1980 MCP ECIP is contained in Atch 2.

Project Books and DD Form 1391s for the ECIP Program will not be due until 15 Jul 1978. This allows MAJCOMs to complete their facility audits and provide required detailed documentation IAW Atch 2.

ENERGY MONITORING AND CONTROL SYSTEM (EMCS) PROJECTS: When an EMCS is programmed as a line item in the MCP, all existing control devices not directly connected to the system by the contractor must be operative. If any controls, dampers, valves, etc., are inoperative in the control loop, even though no direct connection will be made to these devices, they must be identified in the EMCS project or put in operating condition prior to or during construction. Devices which are inoperative at the time of EMCS installation and not included in the EMCS project must be repaired through O&M resources (in-house or maintenance contract). Funds for the annual EMCS maintenance contract will have to be made available from resources other than MCP.

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) GUIDANCE

1. PURPOSE

The ECIP is a Military Construction (MILCON) funded program for retrofitting existing DOD facilities to make them more energy efficient while providing substantial savings in utility costs. It is an integral part of the DOD Energy Conservation Program and is designed to achieve a major portion of DOD energy conservation goals for existing facilities as required by Executive Order 12003.

2. CRITERIA

a. All projects must be cost effective; i.e., must amortize within their economic life. (See Para. 6)

b. All projects must produce an Energy to Cost ratio (E/C) of MBTUs of energy saved yearly per thousand dollars (K$) of current working estimate (CWE) investment equal to or greater than the minimum values for each program year listed below, viz,

$$E/C = \frac{\text{MBTU Saved/Yr.}}{\text{K\$ CWE}} \geq \text{the minimum values listed below.}$$

Additionally, to meet the required reduction in facility energy use, major participants will attempt to achieve at least the average E/C ratios listed in column 3 below for each year's total program.

FY	Minimum E/C Ratio	Average E/C Ratio
79	23	58
80	22	49
81	20	41
82	19	36
83	18	32
84	17	30

3. OCONUS PROJECTS (OVERSEAS)

OCONUS projects may be included only if they effect savings of U.S. energy sources in FY 79 and FY 80. Therefore, at least 20% of the fuel to be saved must be derived from U.S. refined products. For FY 81 and beyond, this restriction is removed, but OCONUS projects are limited to 10% of the Agency program for each year.

4. NATURAL GAS POLICY

DOD policy requires replacing natural gas heating systems with coal or fuel oil systems where possible except for individual boilers or warm-air furnaces less than five Mega Btu per hour output. Current natural gas heating systems, except as noted above, will be evaluated for energy cost saving on the basis of equivalent fuel oil or coal prices and fuel oil or coal escalation.

5. ENERGY CONVERSIONS

a. For purposes of calculating energy savings, the following conversion factors will be used.

Purchased Electric Power	11,600 BTU/Kwh
Distillate Fuel Oil	138,700 BTU/gal
Residual Fuel Oil	Use average thermal content of residual fuel oil at each specific location.
Natural Gas	1,031,000 BTU/1000 cu.ft.
LPG, Propane, Butane	95,500 BTU/gal
Bituminous Coal	24,580,000 BTU/Short Ton
Anthracite Coal	28,300,000 BTU/Short Ton
Purchased Steam	1,390 BTU/lb

b. Purchased energy is defined as being generated off-site. For special cases where electric power or steam is purchased from on-site sources, the actual average gross energy input to the generating plant plus distribution losses may be used but in no case shall the power rate be less than 10,000 Btu/kwh or the steam rate be less than 1200 Btu/lb.

c. The term coal does not include lignite. Where lignite is involved, the Bureau of Mines average value for the source field shall be used.

d. Where refuse derived fuel (RDF) is involved, the heat value shall be the average of the RDF being used or proposed.

e. When the average fuel oil heating value is accurately known through laboratory testing for a specific military installation, that value may be used in lieu of the amount specified in paragraph 5a.

f. Full energy credit may be taken for conversion from fossil fuels or electric power to solar, wind, RDF, or geothermal energy less the calculated average yearly standby requirement.

6. ECONOMIC ANALYSIS

Executive Order 12003 and recent legislation require an economic analysis based on present worth techniques to determine a benefit/cost ratio for each project. The benefit/cost ratio must exceed 1.0 for each project submitted. Appendix A presents a method for determining the benefit/cost ratio applicable to most ECIP projects which will satisfy this requirement. Where a project requires a more detailed approach, use DoDI 7041.3, Economic Analysis and Program Evaluation for Resource Management, as a guide. Table 2, Appendix B, provides fuel escalation rates which may be used in determining benefits when better data derived from local conditions and experience is not available. Tabel 3, Appendix B, provides single amount and cumulative uniform series discount factors for a discount rate of 10% and differential escalation rates of 0, 5, 7 and 8%. Non-energy connected monetary savings are also appropriate for inclusion in the economic analysis.

7. SYNERGISM

When two or more projects are programed for the same structure, care must be used in computation of energy savings to insure that projected energy savings are not duplicative.

8. PROJECT MONITORING

Monitoring of at least one project of each category of ECIP projects, to include instrumenting and metering where feasible, will be conducted somewhere in the U.S. to determine that the energy and cost benefits

predicted in the design phase will actually accrue. Since instrumenting and monitoring each project would seriously erode the cost effectiveness of the entire program without producing commensurate benefits, representative monitoring only is required. Project categories are defined in Appendix B, Table 4. Army, Navy, and Air Force will furnish the location where monitoring is, or will be, conducted for each category of projects to the Deputy Assistant Secretary of Defense for Installations and Housing by 30 September 1978.

9. FUNDING

The increases result from the 20 July 1977 Executive Order 12003 "Relating to Energy Policy and Conservation" which, interalia, requires Federal Agencies to reduce facility energy consumption by 20% by 1985 compared with that used in 1975. The ECIP plan is designed to furnish 12% of these facility energy savings at the funding levels shown, with the other 8% to accrue from other programs.

10. BUDGET AND POM SUBMISSIONS

a. DD Forms 1391 will include information as to cost and energy savings. Budget submissions to OSD will continue to be submitted in omnibus packages for each Defense Component and Family Housing and will be identified as energy conservation investment projects at various locations. DD 1391's will be accompanied by a line item identification, description, location, CWE, benefit/cost ratio, pay-back period to one decimal point, annual savings in dollars, and MBTU's saved per $1000 of CWE as a minimum regardless of project cost.

Location:_____ FY_____

Project:_____

Economic Life_____ Yrs. Date Prepared_____ Prepared by:_____

COSTS

1. Non-recurring Initial Capital Costs.
   - a. CWE $_____
   - b. Design $_____
   - c. $_____
   - d. Total $_____

BENEFITS

2. Recurring Benefit/Cost Differential Other Than Energy
   - a. Annual Labor Decrease (+)/Increase (-) $_____/Yr.
   - b. Annual Material Decrease (+)/Increase (-) $_____/Yr.
   - c. Other Annual Decrease (+)/Increase (-) $_____/Yr.
   - d. Total Costs $_____/Yr.
   - e. 10% Discount Factor $_____
   - f. Discounted Recurring Cost (d x e) $_____

3. Recurring Energy Benefit/Costs
   - a. Type of Fuel _____
     - (1) Annual Energy Decrease (+)/Increase(-) _____MBTU
     - (2) Cost per MBTU $_____/MBTU
     - (3) Annual Dollar Decrease/Increase ((1) x (2)) $_____/Yr.
     - (4) Differential Escalation Rate (___%) Factor _____
     - (5) Discounted Dollar Decrease/Increase (3) x (4) $_____
   - b. Type of Fuel_____
     - (1) Annual Energy Decrease (+)/Increase (-) _____MBTU
     - (2) Cost per MBTU $_____/MBTU
     - (3) Annual Dollar Decrease/Increase ((1) x (2)) $_____/Yr.
     - (4) Differential Escalation Rate (___%) Factor _____
     - (5) Discounted Dollar Decrease/Increase ((3) x (4)) $_____
   - c. Type of Fuel_____
     - (1) Annual Energy Decrease (+)/Increase (-) _____MBTU
     - (2) Cost per MBTU $_____/MBTU
     - (3) Annual Dollar Decrease/Increase ((1) x (2)) $_____/Yr.
     - (4) Differential Escalation Rate (___%) Factor _____
     - (5) Discounted Dollar Decrease/Increase ((3) x (4)) $_____
   - d. Type of Fuel_____
     - (1) Annual Energy Decrease (+)/Increase (-) _____MBTU
     - (2) Cost per MBTU $_____/MBTU
     - (3) Annual Dollar Decrease/Increase ((1) x (2)) $_____/Yr.
     - (4) Differential Escalation Rate (___%) Factor _____
     - (5) Discounted Dollar Decrease/Increase ((3) x (4)) $_____
   - e. Discounted Energy Benefits (3a(5)+3b(5)+3c(5)+3d(5)) $_____

4. Total Benefits (Sum 2f + 3e) $_____

5. Discounted Benefit/Cost Ratio (Line 4 ÷ Line 1d) _____

6. Total Annual Energy Savings (3a(1)+3b(1)+3c(1)+3d(1)) _____

7. E/C Ratio (Line 6 ÷ Line 1a/1000) _____

8. Annual $ Savings (2d+3a(3)+3b(3)+3c(3)+3d(3)) $_____

9. Pay-back Period ((Line 1a - Salvage) ÷ Line 8 _____

General. The form on page A-1 may be used for determining Benefit/Cost ratios for most projects. In using this form, the cost of construction is the escalated price of construction at the end of the year programed for funding. Similarly the incremental maintenance and repair costs and the cost of energy/fuels are the costs escalated as above for these services and materials. Design costs are escalated to the project year minus one. For a very few projects this simplified method may not be applicable. An example of when this method is not applicable is when a one-time benefit or cost occurs in years after construction is complete; e.g., a major component replacement is required during the economic life of the RETROFIT project or when a one-time benefit is claimed during the economic life of the project such as salvage value at the end of the economic life. If this occurs, or at the option of the analyst, use DODI 7041.3 as a guide for the economic analysis. In practice this will seldom occur because the major component replacement is usually annualized as part of the recurring maintenance and repair costs and credit for salvage value at the end of economic life is usually disregarded because of an unknown market at 12 to 25 years in the future. An example benefit/cost computation for a typical ECIP project is attached.

b. Title Block: Economic life is the period of time over which the benefits to be gained from a project may reasonably be expected to accrue. As such, the economic life may differ from its physical and technological life. It may further be limited by military or political considerations. The analyst determines economic life based on his knowledge of the factors above, often a difficult task. Therefore, the economic lives listed in Table 1 may be used when in lack of better data. Ordinarily, these values will not be exceeded.

c. Line 1: Non-recurring capital costs include Construction; and Supervision, Inspection, and Overhead (SIOH) which together make up the Current Working Estimate (CWE); final design costs; and other initial one-time costs such as the negative cost for the residual value of existing equipment removed during construction. They do not include energy audit costs, preliminary design, nor analysis costs since these efforts are required by Executive Order, legislation, or DoD requirements whether or not the project is approved and thus become sunk costs. This is the basis for initial justification of a project. After final design is complete, the benefit/cost ratio is usually recomputed based on final design. At that time final design is also considered a sunk cost since funds are expended which cannot be retrieved whether or not the project is advertised. Non-recurring capital costs are escalated as in Para. a, above.

d. Line 2: The recurring benefit/cost differentials other than energy are primarily incremental maintenance and repair costs. Savings are a positive value and costs are a negative value. Attach a work

sheet showing computation of this incremental cost if applicable. Escalate as in Para. a only to end of program year of construction. The discounted present worth factor automatically provides for general inflation during the economic life. Ordinarily no differential escalation factor is applicable to these costs. Thus, use the discount factor from Table 3 for a 10% discount rate with a zero differential escalation rate for line 2e.

e. Line 3: By definition ECIP projects must save energy; thus there will always be an overall energy cost decrement. However, the overall decrement may include increases in use of one fuel and decreases in the use of another. Benefits (decreases) are positive and additional costs (increases) are negative. Attach computations to show calculation of energy savings. Use conversion factors in paragraph 6 of basic guidance to convert to MBTU's. Cost per MBTU is the present unit cost of the energy form escalated to the end of the program year by the short term rates in Table 2. The differential escalation rate is defined as the expected annual escalation resulting from factors unique to the fuel market over and above those experienced by the economy as a whole. The long term differential escalation rates in Table 2 may be used or, where local conditions and experience indicate more valid differential escalation rates, these should be used with the project file indicating the basis for the projection. Differential escalation rate discount factors are taken from the appropriate page of Table 3.

f. Line 5: To be eligible as an ECIP project, the project must have a benefit/cost ratio of greater than one.

"It is also important to understand that if a new electric generating technology, such as nuclear fusion or some solar electric technology were to become available and commercially competitive by the year 2000, it would require 40 years just to replace the system existing in the year 2000, even if a new one billion dollar plant were completed each week for those 40 years."

Representative M. McCormack
House Committee on Science
and Technology

"Coal is almost certainly going to become our premier fuel by the end of the century. If we had shown an ounce of foresight in years past, it could already be our premier fuel; can you imagine where this country would be if we had devoted one-tenth of the money and enthusiasm to coal that we have lavished on nuclear energy?"

Senator Dale Bumpers
US Senate Committee
on Armed Services

Contemporary Issues

AIR FORCE FACILITY ENERGY PROGRAM

by Col James R. Hawkins, PE

The Air Force Facility Energy Program is too broad a subject to discuss adequately in one article; however, there are a number of points that are of contemporary interest. As a background for these points, the President's Executive Order 12003 which was released in July 1977 gives the overall direction to the facility energy program. The stated goals are to reduce the consumption in our current facilities by 20 percent by 1985 and, when constructing new facilities, they are to be 45 percent less energy intensive. Both goals use a 1975 base line. The new Department of Energy is expected to publish the final implementing guidance in May 1978. The delay in final guidelines is a result of laws requiring both a financial impact analysis and an environmental assessment. In all probability, the final guidelines will be quite similar to the current draft which forces rather sophisticated analysis of existing building energy use to determine cost effective retrofit investments.

As further background, we should all be aware of the strong support that the Congressional Committees have given to the energy programs of the Military Services. The Senate Armed Services Committee added $100 million to the FY 1978 Military Construction Program (MCP) Energy Investment Program and criticized the internal program cuts on the way to Congress. The Senate Report also included the following suggested goals for the elimination of gas and oil fired energy plants:

"First, the Defense Department should eliminate its reliance on natural gas as a fuel for large energy plants (except in rare special situations) by 1980."

"Second, the Defense Department should eliminate its requirements for oil as a fuel for large energy plants (except in rare special situations) by 1985." With such detailed Congressional Committee interest and Presidentially directed goals, there undoubtedly will be continued investments and related action in the Air Force Facility Energy Program.

There are a number of contemporary issues of interest to Air Force engineers who are associated with facility energy conservation. The resolution of these issues and their spinoff workload will affect each base. The following description of these issues explains how they are viewed in Washington.

1. **"In the near future, we're going to have to eliminate our dependence on natural gas and oil fuel heating. The most likely alternative is coal fired central heating plants with effective stack gas scrubbers."**

Energy economists agree that the end of natural gas supplies is in sight. Furthermore, the world demand for oil is expected to exceed production in the 1980s with accompanying shortages to follow. To satisfy our need for central heat, the nuclear alternative is not practical. Environmental concerns, down time for fuel rod changes, and massive developmental costs in the 50

mega watt range restrict this as an alternative source. With the exception of family housing, central or individual solar systems are unlikely to serve more than a small percentage of the load due to initial expense and requirement for large storage media when a full backup heating system is eliminated. As an interim measure, our plan is to provide oil storage and burner assemblies for 5 MBTU and larger natural gas fired boilers until we can afford the investment for modern coal fired central plants. This interim measure becomes suspect if the initial cost grows much above $500,000 at a base. Economic studies frequently point toward early investment in the more expensive coal fired plant, thus skipping the interim measure. One central coal fired plant is included in the FY 1979 MCP, that being F. E. Warren AFB, Wyoming. Large plants for Malmstrom AFB, Montana, Fairchild AFB, Washington, and Ellsworth AFB, North Dakota, are under design. In addition, conceptual and feasibility studies are under way with MCP funds for nine other major bases.

2. **"Tests by the Michigan Consolidated Gas Company show that oversized flues and standard flue draft diverters waste a large percentage of the fuel consumed in average residential homes equipped with natural gas fired furnaces."**

Those tests demonstrate that automatic flue gas dampers can save approximately 23 percent of the fuel use. In two years of testing in more than 400 metropolitan Detroit homes, Michigan Consolidated found repeated evidence of oversized flues which pull heat out of furnaces. It was also found that replacing pilot lights with an electric ignition system can save an additional three percent of the heating fuel. To take advantage of these savings, the Family Housing Division has obtained funds for 16,700 damper installations and 27,000 electric ignition systems. These initial projects will be completed in time for the next heating season and are expected to save 324 billion BTUs annually or an equivalent of 54,000 barrels of fuel oil.

COLONEL HAWKINS *is Chief, Engineering and Construction Division, Directorate of Engineering and Services, Headquarters US Air Force. He has a bachelor's degree and a master's degree in civil engineering from Purdue University and is a Professional Engineer in California.*

3. **"Our heavy investment (Figure 1) in basewide energy monitoring and control systems (EMCS) has great energy savings potential but its Achilles' Heel is the lack of specialists under MAJCOM control for contract surveillance, operator training, software changes and maintenance troubleshooting."**

Similarly, when we first acquired aircraft arresting systems, the hardware led the manpower until the MAJCOMs recognized the urgency of having a central cadre of specialists to travel and help the bases. As an interim solution, we are offering MCP funds to the MAJCOMs for Title II consulting services by software house and electronic specialists to insure that the system and manufacturer's data provided by the contractor are both equal to the contract provisions and satisfactory for the base's needs. With the newer contracts calling for the vendor to provide complete documentation for both software and hardware, an engineer with graduate level education in digital electronics or data automation would be invaluable in representing the MAJCOM's interests. The newer Energy Monitoring Control Systems (EMCSs) permit software and cathode ray tube graphics changes from the keyboard. The steady hand of a specialist is going to be essential during the early stages to get full use of the equipment.

4. **"To conduct an effective air base energy conservation program, we believe that a reasonable number of building utility meters are required."**

Metered buildings provide bench marks of monthly consumption and related costs, which, at a minimum, encourage analysis of the need for such enterprises. It is recognized that certain process energy consumers such as flight simulators and communications systems have few apparent controllable parameters, but hard knowledge of large annual energy bills in the thousands of dollars stimulates innovative thinking. With minor exceptions, future buildings funded through the MCP will be built with installed metering for electricity, natural gas, oil, high temperature water and condensate. This will require that the occupant read his own meters and then report to the Conservation Committee minimal manpower or administration.

5. **"Our goal is to have at least one solar installation at every air**

(Continued on page 21)

Figure 1: EMCS Program

MCP	New Systems	Major Additions	Funds ($ Millions)
FY 76	3	10	12.4
FY 77	6	12	11.4
FY 77S	3	1	2.2
FY 78	11	3	10.2
FY 79	8	6	18.9
			$55.1 Million

Timber stand improvement is conducted on existing forest stands to improve the quality or quantity of the forest resource. This includes pruning, removing undesirable tree species, the use of chemicals, and precommercial thinnings which improve the growth and quality of the remaining trees.

Forest protection is another vital part of the Air Force forest management program. Through the use of close surveillance, chemicals, prescribed burning, fire breaks, and cutting, forest areas are protected from wild fires and disastrous disease and insect attacks. Properly protected and managed, Air Force forest resources provide additional benefits including erosion control, improved wildlife habitats, outdoor recreation, screening and sound abatement.

Funding

One of the most beneficial facts about natural resource programs is that some of them can pay their own way! Money received from the sale of timber and from the collection of user-fees for hunting and fishing is deposited in separate accounts and may be used for the salaries of natural resources personnel to implement the approved programs, to buy equipment and supplies and to perform contracts in support of management objectives of the respective resource management plans. More information about these programs can be obtained through the major command and from the Natural Resources Section, Environmental Planning Division, HQ USAF/PREV, Washington DC 20330.

An awards program has been established to stimulate command interest and recognize innovative leadership in the conservation and management of natural resources. Annually, the General Thomas D. White Environmental Awards are presented to recognize the efforts of installations in furthering environmental quality and the conservation of natural resources. Winners receive plaques and recognition from the Chief of Staff and are nominated for competition in the Secretary of Defense Natural Resources Conservation Award and the Secretary of Defense Natural Resources Personnel Award. Information about the awards program is contained in Change 2 to **AFR 900-45.**

CAPTAIN WESLEY *is a Staff Biologist, Natural Resources Section, Environmental Planning Division, Directorate of Engineering and Services, Headquarters US Air Force. He earned his bachelor's degree in biology from the University of Florida and his master's degree in wildlife management from Virginia Polytechnic Institute and State University.*

In these days of decreasing operations and maintenance money, a program which uses unimproved areas, establishes the Air Force as a leader in natural resource conservation, provides benefits to base people, and then pays for itself, is indeed a diamond in the rough! Through the development and implementation of these programs the Air Force is doing its part in insuring the protection and proper management of our natural heritage. E&S

Energy Productivity

(Continued from page 8)

programs. Work that can be accomplished by our shops will be expedited.

SUMMARY

The pilot Building Energy Audit Program developed a method for the Air Force to be responsive to the Presidential Executive Order. The motivation and zeal displayed by the team members were instrumental in making a success of the AFLC pilot Building Energy Audit Program. Air Force Engineering and Services has certainly blown its horn—BEAP, BEAP—toward a new direction in energy productivity/conservation for the US Air Force.

A copy of the complete Building Energy Audit Pilot Study performed by AFLC can be obtained through the Defense Logistics Information Exchange, US Army Logistics Management Center, Ft. Lee, Virginia 23801. Study No. LD 40340A. E&S

Contemporary

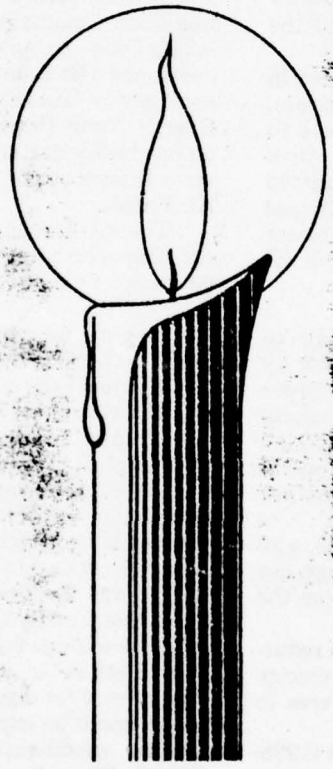
(Continued from page 10)

base. The objective is to enhance staff technical expertise, gain experience in the new technology and collect maintenance and energy savings statistics."

Current economic evidence still points toward our limiting Air Force investments in solar energy except for domestic water heating. However, as the market-tractors become more numerous, the economics should improve. Presently, Air Force investments are dominantly going to be funded from MCP authority vested in Section 607 of PL 95-82 which permits using residual funds to finance solar installations on current year MCP line items. At this time, 27 solar installations are in various stages of design and construction through this provision. Each project will include sufficient metering to permit calculating the actual conventional fuel savings and related cost avoidance. Nominations for adding solar domestic water, space heating and some air conditioning to existing FY 1977, 1978, 1979 and 1980 MCP line items are always welcome. However, use of Non-appropriated Funds to finance solar installations is discouraged due to the inherent unfairness of taking funds from the airmen to finance solar installations in this demonstration phase. E&S

ENERGY PRODUCTIVITY

A major Air Force initiative to light the way...



Headquarters Air Force Logistics Command has developed a Building Energy Audit Program which is responsive to Presidental Executive Order 12003. The program seeks to quantify existing energy consumption rates and then to identify the way to reduce energy usage.

by Col William M. Shaw, PE, John B. Frounfelker, PE, and Robert H. Keggan, PE

BACKGROUND

For several years, the Air Force has promoted effective Energy Conservation Programs while considering all facets of mission operations and the Air Force installation as a community. While concerning itself with energy reducing actions, the Air Force was faced with parameters that were constantly changing. For example, in 1973, a goal was established to reduce the usage of utilities in facilities by seven percent in relation to the previous year. In 1974, the target was increased to 15 percent in relation to 1973. For a few years, the escalation of energy use because of new construction was permitted in order to determine a base line. In FY 1976, the determination was made to use the energy consumed in FY 1975 as a base line, and zero growth was set as the goal.

Initially, simple but effective procedures were implemented to reduce our energy consumption. Belt tightening consisted of turning off excess lights and raising the settings of thermostats during the air conditioning season and lowering them during the winter months. Then, the country was brought face to face with the oil embargoes. At once, what was a utilities conservation program developed into the energy conservation program.

The Energy Conservation Program as outlined in AFM 91-12 is a committee management program. That program is not capable of being responsive to the new guidelines set forth in April 1977 when President Carter's initial energy plan was submitted to Congress. Then, in July 1977, specific additional direction was issued calling for goals far greater than any previously established. The goals call for dramatic initiatives to achieve and sustain.

PRESIDENTIAL DOCUMENT

Executive Order 12003, entitled "Relating to Energy Policy and Conservation," was signed by the President on 20 July 1977. The Executive Order requires that the Administrator of the Federal Energy Administration (FEA) establish requirements and procedures by which each Federal agency would achieve—to the maximum extent possible—the following goals:

- For all Federally owned existing buildings, a 20 percent reduction in the average annual energy use per gross square foot of floor area in 1985 from the average energy use in 1975.
- For all Federally owned new buildings, a reduction of 45 percent in the average annual energy requirement per gross square foot of floor area in 1985 from the average annual use in 1975.
- To meet the above goals, 10 year plans (1975-1985) using life cycle costing techniques must be submitted to the FEA. The initial 10 year energy consumption plan to be developed by each user is to include—to the maximum extent practicable—the results of a preliminary energy audit of all existing buildings with over 30,000 gross square feet of space. These plans are to be submitted to the FEA Administrator no later than six months after FEA guidelines are issued. Approximately 12 months later, facilities with 5,000 to 30,000 square feet of floor space will be audited, with a report of findings submitted to the FEA.
- Each agency shall program its proposed energy conservation improvements of buildings so as to give the highest priority to the most cost effective projects.

HOW TO IMPLEMENT

The Directorate of Engineering and Services at Headquarters US Air Force (AF/PRE) evaluated the Executive Order and in its study came up with the following questions:

- Can the Air Force be responsive to Executive Order 12003?
- Who will perform the Energy Audit for the Air Force? Will it be accomplished through Architect-Engineer services or can it be done in-house?
- Who is capable of performing the Energy Audit?
- Are there computer simulation programs available that can be responsive to the Air Force need?

AF/PRE turned to Headquarters Air Force Logistics Command (AFLC) at Wright-Patterson AFB, Ohio, to answer these questions and commissioned the Command to initiate a pilot energy audit study. This signalled the birth of the Building Energy Audit Program (BEAP), the beginning of a major Headquarters AFLC Engineering and Services energy conservation/productivity step for the Air Force.

The pilot test of BEAP sought to quantify existing energy consumption rates and then to identify ways to reduce energy usage. Its purpose was to:

- Be responsive to the Executive Order;
- Test available simulation programs;
- Evaluate the Air Force's in-house capability;
- Develop a cadre of energy experts; and
- Prepare recommendations regarding Air Force wide implementation.

A building energy audit is the physical inspection of a facility in order to determine what alternatives are available to accomplish energy savings/productivity. As stated in the Executive Order, inspections of Federal facilities are essential to identify the type, size, energy use level and major energy using systems within each building.

A method of calculating the current annual energy rate for a building and the energy reduction which could be expected from various building and system modification schemes was essential to BEAP. The natural conclusion was that available computer simulation programs for heating and air conditioning analysis should be investigated. A simulation program is one in which building and system characteristics can be varied with the total annual effect on energy usage shown by the computer output.

Simulation programs which could support the Air

Force study were screened. Each program investigated was evaluated on the following factors:

- It must calculate cooling and heating loads and annual energy consumption on an hourly basis;
- It had to include the calculation of heat gains and losses from transmission, solar, outside air, people, lighting and equipment.
- It had to be able to analyze by variation of input data such factors as wall and roof insulation, building size and orientation, solar effects, fuel, system components (fans, chillers, pumps, boilers, absorbers, etc.), lighting, fresh air, people and work schedules.
- A printout of economic data was essential which would indicate life cycle cost data for a selected number of years.

Two simulation programs were identified by AF/PRE and AFLC that might be responsive to these needs. The programs had to be evaluated for engineering accuracy and logistic supportability. In other words, would the programs work and could Air Force in-house personnel be trained rapidly to utilize them?

TRACE AND BLAST

The two simulation programs used for the BEAP pilot test were Trane Company TRACE (Trane Air Conditioning Economics) and BLAST (Building Load Analysis and System Thermodynamics). BLAST had been developed by the Construction Engineering Research Laboratory (CERL), US Army Corps of Engineers, Champaign, Illinois.

TRACE and BLAST are computer programs designed as tools to assist building and system designers in the conservation of energy in both new and existing buildings. They provide mathematical simulations of comprehensive building systems and equipment plus energy and economic evaluations. Each program allows a study and comparison of the most important facets of a building that affect energy consumption. From the comparisons, the engineer can determine the most energy efficient and economical building or system retrofit alternatives to reduce consumption. Computer output includes the monthly and yearly energy consumption of the alternatives considered. In addition, consumption figures are converted into such economic factors as owning and operating costs, and return on investment or payback period.

The programs examine the yearly energy and economic impact of such building characteristics as types of glass, insulation factors, lighting, and building orientation. Various heating, ventilating and air conditioning (HVAC) systems and equipment combinations are simulated into the building design over the building/system life.

The TRACE program had been in use for several years, and its communication and computer network could support an Air Force wide energy study. Input could be on remote terminals or by tab cards. A few Air Force engineers were familiar with TRACE. BLAST had also been used on a limited basis in the Air Force. The existing CERL manpower and computer resources for training, program engineering assistance, communications, etc., to support an Air Force wide program were not known.

PILOT STUDY

The pilot test was accomplished at Wright-Patterson AFB in September and October 1977. AFLC Engineering and Services was augmented by engineers from Aerospace Defense Command, Air Force Systems Command, Air Training Command, Military Airlift Command, Strategic Air Command, and Tactical Air Command. Two teams were established, one to utilize the TRACE system and the other to test the BLAST program.

The Civil Engineering School of the Air Force Institute of Technology (AFIT), also located at Wright-Patterson AFB, assisted AFLC by arranging TRACE and BLAST training for the pilot teams. The training sessions for each team were one week in duration.

The building energy survey began with research of as-built drawings for building measurements and construction characteristics, heating and air conditioning system data, and other information applicable to the building survey. Discussions were held with individual building monitors regarding facility use, work schedules, pending projects, and known inefficient energy practices or conditions. Each heating and air conditioning system was inspected. Conditions such as inoperative controls, inefficient use of outside air, improper space temperature settings, inefficient systems, air flow and amperage measurements, and possible alterations were investigated for energy conservation. All this information was required for input to the TRACE and BLAST programs.

The teams then entered the accumulation of information on input data forms. From these forms, inputs were made to the computer by on-line remote terminal, or completed forms were furnished to data automation personnel for keypunching and input to the program.

The initial simulations were utilized to model the facility as it was presently being operated. Follow-on computer runs provided data for comparison of each alternative considered for that individual facility. A printout showing an economic analysis of the alternatives permitted simple decision making regarding the actions that should be accomplished. Some of the alternatives included: returning systems to operate as originally installed; correcting outside air management; updating controls; installing wall and roof insulation, storm windows and window shading; blocking out windows; night and weekend equipment cycling; optimizing space temperatures and connecting to an Energy Monitoring and Control System (EMCS).

Also used by the teams was information obtained from previous infrared surveys. Unusual heat transmission through roofs, walls and windows was clearly shown by infrared scanning devices. These

pinpointed the energy losses and indicated additional building modification alternatives for consideration by the TRACE or BLAST computer runs. The infrared results included those findings from a flyover scan of Wright-Patterson AFB during the winter of 1976. Other infrared systems such as cameras, television and hand-held noncontact temperature sensing devices can be used. While not a requirement for accomplishing building audits, the infrared surveys are certainly useful.

The physical inspections of facilities during the pilot study revealed the need for more than just building and HVAC system modifications. The need for intensified management action became apparent. Many military and civilian employees were neither convinced of the existence of the energy problem; nor were they willing to enforce energy conservation policies. As a result, thermostat settings in the facilities were not in accordance with energy conservation directives. Team members found that room temperatures during the air conditioning season were well below the 80°F standard. As fall approached and the heat was turned on, building temperatures were discovered to be well above the 68°F administrative area standard and the 55°F hangar and warehouse limit. Clearly, Air Force managers must make concerted efforts to better organize, coordinate, and direct the energy conservation program.

Other needed management actions concern the area of HVAC system maintenance. The BEAP teams found disconnected dampers and inoperative thermostats. In some cases, air handling units were blowing cold air while a second air handler was putting hot air into the same area. Obviously, the system was not designed to operate in that manner. Further, thermostats installed in some warehouses and hangars could only be turned down to 65°F. Therefore, compliance with the 55° setting was impossible. Economizer cycles in some facilities were disconnected, and hot water resets were often out of calibration. These are some of the energy related maintenance problems that can be found on a physical audit of a facility. Repairing them is usually quite simple.

AUDIT EXAMPLES

The following are three examples of the 11 buildings audited in the pilot study. Five were studied by the BLAST team and five by the TRACE group. One building was audited by both teams for comparison of the results.

Figure 1: Audit of Building No. 10 (TRACE).

BLDG 30,010 WPAFB
AB WING HQ.

ALTERNATIVES (TRACE)

CONSTRUCTED: 1944
37,752 SQ. FT.

	ESTIMATED ENERGY USE (BTU/FT²/YR)	PERCENT ENERGY REDUCTION	FIRST YEAR ENERGY COST	PROJECT COST ($)	YEARS PAYBACK
1. EXISTING BLDG	113,050	—	$18,357	—	—
2. • ARCH CHANGES * • EMCS • WATTMIZER TUBES	51,644	54.3	$10,598	$115,775	11(X)
3. • ARCH CHANGES * • NEW VAV SYSTEM • SKIN RADIATION • ECONOMIZER • RECIP CHILLER (2) AIR COOLED	56,728	49.8	$11,862	$264,000	18
4. • ARCH CHANGES * • NEW VAV SYSTEM • SKIN RADIATION • ECONOMIZER • RECIP CHILLER (2) WATER COOLED	55,735	50.7	$11,670	$252,764	17

* INSULATE WALLS - .10
INSULATE ROOF - .05
STORM WINDOWS/SOLAR FILM

(X) RECOMMENDED

Figure 2: Audit of Building No. 485 (TRACE).

BLDG 20485
AVIONICS ENG (ASD)

ALTERNATIVES (TRACE)

CONSTRUCTED: 1970
61 794 SQ. FT.

	ESTIMATED ENERGY USE (BTU/SF/YR)	PERCENT ENERGY REDUCTION	FIRST YR ENERGY COST	PROJECT COST	YEARS PAYBACK
1. EXISTING BLDG TSTAT 72°F	374,542	—	$77,174	—	—
2. ACTIVATE ECONOMIZER, REDUCE O.A., TSTAT 68°F YEAR ROUND	314,192	19.2%	$66,143	$480	<< 1 MON
3. ACTIVATE ECONOMIZER, REDUCE O.A. (HIGH EFF DAMPERS), EMCS, TSTAT 68°F YEAR ROUND	163,353	56.4%	$40,838	$29,100	< 1 YR(X)
4. VAV SYSTEM, ACTIVATE ECONOMIZER, REDUCE O.A., EMCS, TSTAT 78°F SUM, 68°F WINTER	114,492	69.4%	$31,545	$171,625	4 YR
5. VAV SYSTEM, SAME AS ALT 4, INSULATE ROOF & WALLS, TSTAT 78°F SUMMER, 68°F WINTER	101,900	72.8%	$30,072	$295,000	5 YR

(X) RECOMMENDED

Figure 3: Audit of Building No. 4024 (BLAST).

BLDG 34024 WPAFB
AIRCRAFT CORROSION CONTROL FACILITY

ALTERNATIVES (BLAST)

CONSTRUCTED: 1963
41,794 SQ. FT.

ALTERNATIVES	ESTIMATED ENERGY USE (BTU/FT²/YR)	PERCENT ENERGY REDUCTION	ANNUAL ENERGY SAVINGS ($/YR)	PROJECT COST ($)	YEARS PAYBACK
1. EXISTING BLDG	114,900	—	—	—	—
2. REDUCE THROTTLING RANGE TO 2°F	108,300	5.7	480	24	0.05
3. REPLACE LIGHTING WITH H.I.D.		11.7	3,497	16,200	4.25
4. INSTALL NIGHT & WEEKEND RESET	75,300	34.5	2,951	900	0.3
5. NIGHT & WEEKEND RESET W/REDUCED TR	68,000	40.7	3,705	924	0.25
6. NIGHT & WEEKEND RESET WITH REDUCED TR & W/H.I.D LIGHTING	54,400	52.7	7,215	17,124	2.4 (X)
7. ADD ONE INCH INSULATION TO WALLS & ROOF	105,100	8.5	2,177	125,100	26
8. ADD THREE INCHES OF INSULATION	98,600	14.2	2,544	183,500	27

(X) RECOMMENDED

Example I (TRACE)

• Building 10, Base Headquarters. Administrative area - 37,752 Sq Ft, Two-story brick, built-up roof, single glazed windows with venetian blinds.

• **Alternatives Evaluated:** Variations of thickness in roof and wall insulation; installation of storm windows; EMCS connection to air handlers, fans, and thermostats; night temperature setback; complete blocking of windows; solar film application; Wattmizer tube installation; replacing of condensers, water cooled as well as air cooled.

• **Recommended Actions:** The architectural changes outlined in **Figure 1**; connection of the HVAC systems to EMCS; and installation of Wattmizer tubes. These will permit an annual energy savings of over 54%.

Example II (TRACE)

• Building 485, Avionics Engineering. Administrative space - 61,794 Sq Ft, Brickfaced concrete block, built-up roof.

• **Alternatives Evaluated:** Reactivate inoperative economizer; repair and setting building thermostats to prescribed temperatures; reducing outside air; EMCS connections; variable air volume (VAV) system; and architectural changes.

• **Simulation Results: See Figure 2.**

• **Recommended Actions:** The combination listed as alternative Number 3 on **Figure 2** which will result in annual energy savings of 56.4%. Note the payback period is less than one year.

Example III (BLAST)

• Building 4024, Aircraft Corrosion Control Facility

Aircraft maintenance facility - 41,794 Sq Ft, Steel frame with corrugated steel wall panels and roof, one inch insulation.

• **Alternatives Evaluated:** }
• **Simulation Results:** } **See Figure 3.**

• **Recommended Actions:** Alternative combination Number 6 provided a 52.7% energy savings with only a 2.4 year payback.

OVERALL TABULATED RESULTS

• A tabulation of the recommended actions for the eleven audited buildings is shown in **Figure 4**. The total cost of these projects is $1,444,000. They should provide an energy reduction for these buildings of 49%. These represent an average reduction of 35 million BTU per $1,000 cost.

PILOT STUDY CONCLUSIONS

The pilot study conducted by AFLC showed that the Air Force can be responsive to the Executive Order. Both the TRACE and BLAST simulation programs provide the engineering tools for simulation and alternative comparisons for decision making. Air Force engineers and technicians can be trained and are capable of accomplishing the required building energy audits.

The Air Force wide initial building audit workload involves 2,360 facilities over 30,000 square feet with about 25 percent being duplicates or very similar.

BLDG. NO.	PROJECT DESCRIPTION	% ENERGY REDUCTION	PROJECT COST ($1000)	YEARS PAYBACK
20010 (ADMIN)	WALL, ROOF INSULATION, STORM WINDOWS/SOLAR FILM, EMCS, WATTMIZER TUBES	54	146.0	[illegible]
20014 (ADMIN)	EMCS CONTROL	[illegible]	27.9	3
20050 (ADMIN)	SPACE TEMPERATURE RESET	[illegible]	36.6	[illegible]
20071/174 (WHSE)	CEILING, WALL INSULATION, BLOCKED WINDOWS, H.I.D. LIGHTING, SPACE TEMP RESET	[illegible]	[illegible]	[illegible]
20127 (CAFE)	ROOF/CEILING INSULATION, EMCS CONTROL, BLOCK WINDOWS, NEW KITCHEN EXHAUST SYSTEM	54	[illegible]	[illegible]
[illegible] (HANGAR)	REMOVE WINDOWS, INSULATE ROOF, WALLS, EMCS CONTROL	[illegible]	[illegible]	[illegible]
[illegible] (WHSE)	RELOCATE OFFICE, NEW LIGHTING, TIMERS, NEW OFFICE AC/HTG SYSTEM, ELIMINATE WHSE HEAT	[illegible]	72.7	[illegible]
20443 (AFIT)	REDUCE LIGHTING	[illegible]	[illegible]	[illegible]
20676 (COMP CENTER)	ENTHALPY ECONOMIZER CYCLE	[illegible]	[illegible]	[illegible]
[illegible] (AVIONICS ENGRG)	HIGH EFFIC DAMPERS, EMCS CONTROL [illegible]	56	[illegible]	[illegible]
[illegible] (CORROSION CONTROL)	[illegible]	[illegible]	[illegible]	[illegible]

Figure 4: Summary of Buildings Audited.

The follow-on requirement will cover approximately 18,000 facilities of between 5,000 and 30,000 square feet, of which 40 percent are similar. The time to survey a building, develop alternatives, and input data to the computer for a 30,000 plus square foot building is five working days. This is based on an optimum team of one mechanical engineer and an engineering technician. An architect and an electrical engineer must be used on a consulting basis. A summary of the Air Force wide workloads and mechanical engineering resources are depicted by MAJCOM or separate operating agency, Figure 5. From this data, it is obvious that in-house forces are adequate to perform the workload.

Estimates of obtaining the required energy audits by Architect-Engineer services and by in-house forces showed a three to one cost ratio in favor of in-house accomplishment. In addition, our engineers are more familiar with Air Force facilities.

While both the TRACE and BLAST programs could perform the required simulations, BLAST could present a logistical problem in an Air Force wide application. At present there is not sufficient CERL instructor personnel or adequate functional user data for an Air Force wide training program. Further, direct expansion air conditioning systems cannot be simulated by BLAST. Complete computer support is not predicted to be available before the summer of 1978. Based on these conclusions, AFLC recommended to AF/PRE that the audits be performed in-house using the TRANE Company's TRACE program.

THE AFLC APPROACH

There are numerous approaches to implementing the BEAP in each command. AFLC will accomplish its audits in the following manner. The command has 51 civil engineering and services mechanical engineers and 406 facilities of over 30,000 square feet to be audited. Approximately one-half of the engineers have been trained on TRACE by the Trane Company in one week at Headquarters AFLC. The remaining mechanical engineers will be

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available at the bases for continuance of the O&M, MCP and day-to-day engineering workload. The 25 engineers, each with an engineering technician, will complete their building audits, determine the energy reducing alternatives, and prepare audit information booklets. These booklets will be forwarded to AFLC for central input to the computer system for simulations. The whole process, including selection of the optimum plan of actions, should be completed in 18 weeks. Cost effective projects will be prioritized in the O&M and MCP

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Figure 5: Workloads and Mechanical Engineering Resources.

COMMAND	MECHANICAL ENGINEER	30,000+ SF BLDG	BLDGS PER ENGR 30,000+ SF	5,000 - 30,000 SF BLDG	BLDGS PER ENGR 5-30,000 SF
(AAC) ALASKAN AIR COMMAND	10	71	7+	887	88+
(ACD) USAF ACADEMY	4	16	4	39	10
(ADC) AERO DEP. COMMAND	20	67	3+	1257	63
(AFE) USAFE	30				
(AFR) HQ AF RESERVE	21	67	3+	428	20+
(ANG)		133		902	
(ATC) AIR TRAINING COMMAND	43	235	5+	1926	31+
(AU) AIR UNIVERSITY	4	27	7-	309	77+
(CSV) AF COMM. SERVICE	10	10	1	60	6
(DAA) AF DATA AUTO. AGENCY	2				
(ESA) E & S AGENCY	13				
(HAF) HQ USAF	6				
(LOG) AF LOGISTICS COMMAND	51	406	8	1223	24
(MAC) MIL AIR COMMAND	53	234	4+	2125	92
(PAF) PACIFIC AIR FORCE	39	66	2+	560	15
(SAC) STRATEGIC AIR COMMAND	72	443	6	4480	67
(SYS) AF SYSTEMS COMMAND	40	363	9	1313	33
(TAC) TACTICAL AIR COMMAND	50	217	4+	2293	46
(USS) SECURITY SERVICE	12	3	1-	52	4+
		2,360		17,878	

Timber stand improvement is conducted on existing forest stands to improve the quality or quantity of the forest resource. This includes pruning, removing undesirable tree species, the use of chemicals, and precommercial thinnings which improve the growth and quality of the remaining trees.

Forest protection is another vital part of the Air Force forest management program. Through the use of close surveillance, chemicals, prescribed burning, fire breaks, and cutting, forest areas are protected from wild fires and disastrous disease and insect attacks. Properly protected and managed, Air Force forest resources provide additional benefits including erosion control, improved wildlife habitats, outdoor recreation, screening and sound abatement.

Funding

One of the most beneficial facts about natural resource programs is that some of them can pay their own way! Money received from the sale of timber and from the collection of user-fees for hunting and fishing is deposited in separate accounts and may be used for the salaries of natural resources personnel to implement the approved programs, to buy equipment and supplies and to perform contracts in support of management objectives of the respective resource management plans. More information about these programs can be obtained through the major command and from the Natural Resources Section, Environmental Planning Division, HQ USAF/PREV, Washington DC 20330.

An awards program has been established to stimulate command interest and recognize innovative leadership in the conservation and management of natural resources. Annually, the General Thomas D. White Environmental Awards are presented to recognize the efforts of installations in furthering environmental quality and the conservation of natural resources. Winners receive plaques and recognition from the Chief of Staff and are nominated for competition in the Secretary of Defense Natural Resources Conservation Award and the Secretary of Defense Natural Resources Personnel Award. Information about the awards program is contained in Change 2 to **AFR 900-45**.

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In these days of decreasing operations and maintenance money, a program which uses unimproved areas, establishes the Air Force as a leader in natural resource conservation, provides benefits to base people, and then pays for itself, is indeed a diamond in the rough! Through the development and implementation of these programs the Air Force is doing its part in insuring the protection and proper management of our natural heritage. E&S

* Energy Productivity

(Continued from page 8)

programs. Work that can be accomplished by our shops will be expedited.

SUMMARY

The pilot Building Energy Audit Program developed a method for the Air Force to be responsive to the Presidential Executive Order. The motivation and zeal displayed by the team members were instrumental in making a success of the AFLC pilot Building Energy Audit Program. Air Force Engineering and Services has certainly blown its horn—BEAP, BEAP—toward a new direction in energy productivity/conservation for the US Air Force.

A copy of the complete Building Energy Audit Pilot Study performed by AFLC can be obtained through the Defense Logistics Information Exchange, US Army Logistics Management Center, Ft. Lee, Virginia 23801. Study No. LD 40340A. E&S

Contemporary

(Continued from page 10)

base. The objective is to enhance staff technical expertise, gain experience in the new technology and collect maintenance and energy savings statistics."

Current economic evidence still points toward our limiting Air Force investments in solar energy except for domestic water heating. However, as the market-tractors become more numerous, the economics should improve. Presently, Air Force investments are dominantly going to be funded from MCP authority vested in Section 607 of PL 95-82 which permits using residual funds to finance solar installations on current year MCP line items. At this time, 27 solar installations are in various stages of design and construction through this provision. Each project will include sufficient metering to permit calculating the actual conventional fuel savings and related cost avoidance. Nominations for adding solar domestic water, space heating and some air conditioning to existing FY 1977, 1978, 1979 and 1980 MCP line items are always welcome. However, use of Non-appropriated Funds to finance solar installations is discouraged due to the inherent unfairness of taking funds from the airmen to finance solar installations in this demonstration phase. E&S

Facilities Management

Computers Cut Energy Costs In Buildings

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HIGHLIGHTS

• Federal agencies and many State governments are specifying a detailed economic and energy analysis of all new and a growing number of existing structures.

• What is making such analyses possible and effective is their adaptation to computer systems.

• And it is even possible to cut energy costs for a building by as much as 60%.

An architect/engineer working for a government agency often finds that he is confronted with an energy and economic analysis requirement in his scope of services.

Many federal agencies have implemented energy and economic analysis requirements for new construction, renovation or the leasing of facilities.

The architect/engineer has traditionally made his calculations manually. Now the computer has opened the door to rapid evaluation of building architectural, system and equipment alternatives to determine those alternatives with the lowest energy costs.

TRACE Applies

The Trane Company, a major manufacturer of air conditioning, refrigeration and heat transfer equipment, has made Trane Air Conditioning Economics—TRACE—available to the government for the past three years. This computer program is available to registered consulting engineers and government design engineers (PE) at facility and administrative levels. The program can be accessed through Trane directly or through two commercial time sharing networks: Boeing Computer Services and McDonnell Douglas Automation.

TRACE uses standard ASHRAE (American Society of Heating, Refrigerating and Air Conditioning Engineers) techniques and procedures for evaluating energy consumption and the economic impact of building systems alternatives. It can perform 16 million calculations for each building and provides meaningful energy and economic data to be used by engineers and financial managers in determining the best options for each building.

Federal government agencies have stimulated economic and energy analysis of buildings through changes in their architect-engineer scope of services. This policy is consistent with a general trend toward life-cycle cost procurements. A brief summary of the requirements shows the government commitment to have energy efficient buildings which are economically justifiable.

Summary:

• **Department of Defense** requires a life-cycle cost analysis on all Army, Navy and Air Force construction with a cost of $300,000 per project or greater. The requirement is contained in the *Department of Defense Construction Criteria Manual, DOD 4270.1M, dated October 1, 1972.*

• **Air Force** requires a computer economic and energy analysis for all construction over 10,000 square feet (heating and cooling) or 40,000 square feet (heating only). The requirement also applies whenever construction value is over $1 million or where a total energy, selective energy or heat pump system is to be evaluated.

• **Army** follows the DOD requirements described above and requires a procedure specified in the *Corps of Engineers Life Cycle Costing Manual.*

• **Navy** requires that a computer energy system analysis be performed on all new and major rehabilitated buildings which have 10,000 square feet or more gross area with cooling or 40,000 square feet or more gross area for heating only.

• **Army and Air Force Exchange Service** requires a computer energy analysis over the life of a facility on all new construction over 30,000 square feet.

• **Energy Research and Development Administration** (formerly the Atomic Energy Commission) requires an energy consumption analysis on all new and existing facilities.

• **General Services Administration,** responsible for federal office building construction, encourages energy analysis in several handbooks. The guideline for new office buildings sets a target energy budget of 55,000 BTU per gross square feet per year. The target for existing buildings is 75,000 BTU per gross square feet per year. Design consultants must perform energy consumption calculations. The guidelines state: "For buildings in excess of 20,000 square feet, it is unlikely that sufficiently accurate calculations can be made without a computer. A major advantage in the use of a computer program is the ability to analyze a large number of alternative measures for the same building."

• **Department of Health, Education and Welfare** requires a computer life-cycle cost analysis on all federally-assisted projects over 50,000 square feet. Reference: *"Technical Handbook for Facilities Engineering and Construction Manual," dated May 1975.*

• **NASA** encourages life-cycle costing as a means to reduce energy consumption. Reference: *"NASA Facilities Engineering Handbook," dated May 1974.*

• **Postal Service** requires that an energy and economic analysis be performed for all buildings. The format for these analyses is defined in *P.S. forms 2215* and *2238*, which must be used by consulting engineers. Computer simulation is acceptable for computation.

• **Veterans Administration** requires an economic analysis for selection of water chillers and air conditioning systems. A comparison of owning and operating costs must be included. Computer analysis is accepted and encouraged.

Arab Help

The use of computer economic and energy analysis, such as TRACE, has increased at a rapid pace since the energy crisis in 1973. For example, in 1973 nine buildings were evaluated with TRACE for

federal agency construction. In 1974, 79 buildings were analyzed. 1975 again saw growth in use with 198 buildings evaluated. TRACE has been used by the Air Force, Army & Air Force Exchange Service, Bureau of Indian Affairs, Coast Guard, Army Corps of Engineers, ERDA, FEA, GSA, HEW, HUD, NASA, NAVFAC, Postal Service and the VA. As energy costs continue to rise, more and more federal buildings will be analyzed and evaluated with computer programs.

States Too

Three states, Florida, North Carolina and Washington, have enacted laws requiring energy and economic analyses of state-owned and leased facilities. Other states are drafting legislation. These include New York, Colorado, Utah and Hawaii. In Florida, all new government buildings 5,000 square feet or greater and leased buildings 20,000 square feet or greater must have an analysis prepared to show the energy life-cycle cost for each facility. North Carolina requires all government buildings, owned or leased, of 40,000 or more gross square feet to have an energy and economic analysis. In Washington, all government buildings with 25,000 square feet or more of usable space must be analyzed for energy consumption and life-cycle cost.

The computer calculates energy consumption and economic costs through a series of phases shown in the chart.

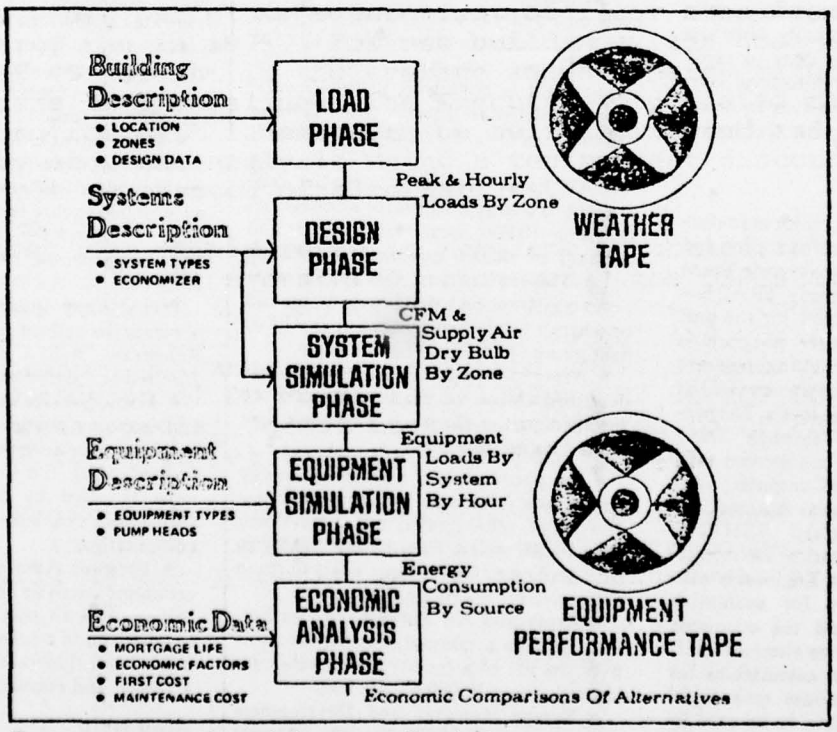
are factors which enter into this calculation. The building shell and its construction can greatly affect the building load. Statistical weather data tracks outdoor temperature effects on the building.

The *design phase* sizes equipment to meet the loads computed in the load phase and computes design conditions for the building.

The *system simulation phase* tracks the flow of air throughout the building for a full year of operation. Twenty-three generic air conditioning systems can be evaluated into this phase. The system simulation phase is the heart of the analysis and requires most of the computer time. It also has a major impact on program accuracy.

The *equipment phase* computes energy consumption for each piece of equipment selected for the building. This includes boilers, central chillers, terminal units, fans and all auxiliary equipment needed to operate the HVAC system. The output of this phase is energy consumption by equipment source.

The *economic phase* applies local utility rates to the energy consumption profile to determine energy costs. The owning and operating cost data provides a stream of cash flows and net present values for the various alternatives being evaluated. Up to four alternatives are then compared against each other to show incremental return on investment. Economic computations can be made for up to 75 years of



Energy and economic analysis program flowchart

The *load phase* calculates the thermal loads on the building. Such factors as solar gain, people occupancy and lighting levels

building life.

With all of this information in hand, the

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Cities . . .

Before actually approaching private investors, city officials should prepare two separate plans, one that establishes long-range goals based upon an understanding of the city's market position relative to the entire metropolitan area and a second short-range plan (one to three years) that proposes specific areas and projects.

The second plan requires the combination of a management program defining the city's involvement in the redevelopment process and specific projects which it wishes to encourage. The city should have carefully planned the process to insure the timely flow of project proposals from initiation to implementation.

To accomplish this task, specific sites should be identified as short term priorities for the implementation of specific development concepts.

Also, the city's public investment program should be coordinated with the redevelopment program to assure that maximum market potential is focused on the priority areas.

Obstacles to proper site selection can be physical or political. Haphazard street patterns and small parcel ownerships can pose serious problems—problems that can only be solved through creative use of the city's governmental powers. On the political side, neighborhood groups, particularly in older cities, may resent large expenditures for the downtown area.

To help smooth the way when such difficulties arise, a committee of government, business and community leaders should spearhead the project.

One means of intelligent site selection is to make use of existing facilities that are independent generators of traffic. Facilities such as hospitals, court houses, and other public agencies generally meet this criteria.

Although city officials must become, in a word, salesmen, as they identify and cajole major investors, pointing out profit opportunities, they must not forget that the ultimate goal of any redevelopment program must be the long-range welfare of the city itself.

Investors often will be eager to create first class office space. Hotel and retail development are also highly profitable if the right environment can be created to insure a market. Creation of this environment many times requires the development of attractive parks and recreation areas combined with significant in town housing developments.

Investors generally shy away from residential development because of its low returns. We recommend that governments require that every significant urban development include a mix of uses required to create a total living environment in the city. Though less profitable in the short run, residential projects in business areas improve the financial stability of total projects during periods of uncertain market conditions.

Incidentally, this kind of mix can only be obtained with the cooperation of business. Often the role of Development Research has been to provide an understanding of real-world necessities of both business and government and thereby pave the way for a partnership.

The era of disposability is not yet ended, but for many cities an opportunity exists to reverse the trends. Now, if city governments will recognize these opportunities and if suburban governments can perceive their own interdependence with the central city, we believe a new era can begin—one in which urban revitalization and environmental preservation will coexist to the benefit of the metropolitan area.

Facilities . . .

architect/engineer can write a design report and recommend various systems and equipment to the government. The architect gains because he can readily evaluate architectural changes such as glass area, building orientation and dimensions.

The engineers gains because he has a detailed computation of load in the building and can pinpoint the energy effects of various buildings alternatives.

The financial manager gains because he has an accurate profile of the costs associated with operation of a building through its economic life.

The computer can predict, for example, what the energy costs will be in the year 2000, if the input data is valid and accurate.

Simulating the operation of a building is much like gazing into a crystal ball. However, when comparing one alternative to another, common assumptions give an accurate comparative analysis. Computer economic and energy analysis is certainly more accurate than manual computations when evaluating many alternatives.

The average TRACE run takes eight minutes of central processor time. It has been estimated that an engineer with a slide rule working on the full range of calculations in a typical TRACE run would take 53 years to perform the analysis. As with many other calculations in construction, the computer is now providing useful data to select energy-efficient building alternatives.

During early testing of TRACE in 1973, Trane evaluated its own 7year-old, 170,000 square-foot existing Administration Building in La Crosse, Wisconsin. The computer calculated utility expenses to within two percent of the actual utility bills. Energy conservation alternatives were then evaluated and $16,000 of control and system changes were made to the building. The changes resulted in an annual energy consumption decrease of 61%. The subsequent first-year energy cost saving was $93,590.

Government agencies with large existing building inventories see computer energy analysis as a means to reduce rising utility expense. New government construction is now being guided toward energy-efficient designs.

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS UNITED STATES AIR FORCE
WASHINGTON, D.C. 20330

24 JAN 1978

REPLY TO ATTN OF: PRE

SUBJECT: Planning Guidance, Building Energy Audit Program

TO: HQ AFLC, HQ AFSC, HQ ADCOM, HQ PACAF, HQ USAFE, HQ SAC, HQ MAC, HQ AFRES, HQ USAFSS, HQ AU/LGD, HQ ATC, HQ TAC, HQ AAC, HQ USAFA

(Engineering & Services)

1. Reference:

a. HQ USAF/PRE Ltr, 30 Nov 77, Design Instruction No. 1, FY 80 MCP, Atch 1, Para 18f(3).

b. HQ USAF/PREE Ltr, 17 Nov 77, Design Instruction No. 1A, FY 79 MCP, Atch 1, Appendix A, Economic Analysis Computation.

2. As part of the National Energy Program, the President signed Executive Order 12003 in July 1977. The Executive Order establishes goals to be reached by 1985. For existing buildings, the goal is a reduction of 20 percent in the average annual energy use per gross square foot of floor area from the average energy use in 1975. For new buildings, the goal is a reduction of 45 percent in the average annual energy requirement using the same 1975 baseline. The Executive Order also mandates that building retrofit investments be self amortizing and supported by economic analysis using a ten percent discount rate and life-cycle comparison of alternatives.

3. Realizing that timely retrofit programming action is necessary to meet the 20 percent reduction goal, the OSD staff has set aside $45 million for the FY 80 Air Force Energy Conservation Investment Program (ECIP). OSD has also established detailed FY 80 programming guidance which requires detailed energy audits prior to submission of DD Forms 1391/1391c. FY 80 MCP DD Forms 1391/1391c with special format must be submitted to AF/PREP by 15 July 1978 to be competitive for the $45 million.

4. At the Engineering & Services World-wide Conference in November, a concept of using in-service engineers to perform detailed building energy audits on large buildings was presented.

Acknowledging that there has been some slippage, this concept (Atch 1) is still valid and will meet both the OSD FY 80 MCP format and provide baseline data for establishing goals for new building designs. Details concerning a GSA central requirements style contract for commercial computer services is included as Attachment 2.

5. It is our objective to get as many as possible of the detailed audits completed on 30,000 sq ft and larger buildings by the end of July 1978. All of the large buildings should be completed six months after the computer services contract is available. A revised schedule for the building energy audit program has been prepared (Atch 3). Based upon this schedule, commercial computer services will be available in mid-March 1978; thus, still permitting submission of cost-effective FY 80 ECIP projects. A proposed designation of prime and satellite contract users is indicated in Attachment 4.

6. It is estimated that commercial computer services for an average large building (above 30,000 sq ft) will cost approximately $900; however, taking advantage of the GSA discounts and delayed overnight computer output, we hope to reduce this price. With initial fiscal commitments for delivery orders needed here in late February 1978, this investment is recognized to be a burden to some MAJCOMs. Deferral of certain important AF/PRE Investigational Engineering Projects can provide some relief to this burden. However, to get the financial situation in perspective, request that you respond by message prior to COB 6 Feb 1978 and advise if all or part of your needs can be met by your own O&M resources. In view of the significant utility savings that can be realized from just the detailed audits, diverting maintenance and operating funds would be appropriate.

7. The plan to use commercial computer services in excess of MAJCOM authority is contingent upon the approval of the Assistant Secretary of Air Force (FM) and GSA. Both approvals are currently

being sought. You will be kept advised as further details develop and of the availability of computer service funds.

FOR THE CHIEF OF STAFF

William D. Gilbert

WILLIAM D. GILBERT
Major General, U.S. Air Force
Deputy Director, Engineering & Services

4 Atch
1. Detailed Bldg Energy Audits Oct 77
2. Central Requirements Style Contract
3. Audit Schedule 23 Jan 78
4. Central Contract Users

Cy to: HQ USAFE/DER
AFCEC/DEM
AFIT/DE
ANG/DE

ENERGY CONSERVATION

EXECUTIVE ORDER 12003

DETAILED BUILDING ENERGY AUDITS

ENGINEERING & SERVICES
WORLDWIDE CONFERENCE

HQ USAF(PREE)
OCTOBER 1977

BACKGROUND:

Why Building Detailed Energy Audits?

- Executive Order 12003 dated 20 July 1977 sets a goal of 20% energy reduction in all federal buildings by 1985 using a 1975 baseline.

- A detailed budget submission must be made to the Department of Energy six months after guideline publication date.

- Funds to provide the energy retrofits will be obtained ultimately through an MCP-style submission with detailed backup data.

- Provisions of Executive Order demand prudent, economic investments with audit trail.

AF/PRE directed pilot energy audit program conducted by HQ AFLC proved technical feasibility of using in-service mechanical engineers for audits. AFLC's successful pilot study concluded:

- An aggregate 49% energy savings can be achieved in the 11 buildings studied and still remain within 25 year self-amortizing life cycle cost criteria.

- The cost of the building audits are easily offset by discovery of easily corrected energy waste due to failed mechanical systems and erroneous thermostat set points.

- MAJCOM junior officer and civil service engineers who participated displayed enthusiasm and left highly motivated.

- On site building surveys followed up by building energy simulation computer program (Trane Corp TRACE V-200) gave excellent hard copy results using full life cycle cost methodology.

- The Corps of Engineer's BLAST Computer Program gave equal results but is not logistically supportable. A major program of audits during the next 9 to 12 months should use a commercial program which has a field engineer assistance organization.

- Audits can be accomplished by in-service mechanical engineers (team composition should be one mechanical engineer with one technician; teams can complete a major building in 5 days).

Concept for MAJCOMS:

- Each MAJCOM will be responsible for conducting their own detailed building energy audits. During the first 6 months, only buildings over 30,000 SF will be studied. A follow-on program for buildings of 5,000 to 30,000 SF will be conducted during the following year. Recommended procedure:

  - Select mechanical engineers (HVAC background) from assigned officers and civil service employees.

  - Fund and arrange for central training in computer simulation (Trane Corporation can provide 5 day training at MAJCOM with hands-on computer remote input and actual building survey).

  - Fund and procure computer time through GSA contract. (TRACE V-200 due on GSA schedule in ~~December~~ 1 FEBRUARY 1978 for cost savings).

  - Obtain use of or lease two remote computer terminals with high speed printer output.

  - After training send teams to bases to make actual building surveys and complete computer input books. Submit them to MAJCOM headquarters for technical review and remote computer input.

  - MAJCOM project office reviews computer output and returns to base for preparation of written report of assumptions, findings, and recommendations.

  - MAJCOM representatives who served in the pilot program at HQ AFLC can assist in developing the Command program. Consultation with HQ AFLC (DEM) and AFIT (DE) mechanical engineering staff is encouraged.

Concept for HQ AF/PREE:

- Implementation guidance will be provided including standard fuel cost escalation prices, discount rate, formats for reporting, timing, etc.

- Asaist with obtaining data automation cooperation and help in obtaining leased remote terminals.

- Conduct "how goes it" meetings to insure cross feed and sharing of output on appropriate like type definitive structures.

Submission from Bases:

- Final individual reports by base will include:

  - Description of building with single line diagram, type of mechanical systems, gross square feet.

  - Energy reduction items studied with percentage energy reduction and energy saved, dollar savings, MillionBTU/$1000 dollars invested, project cost, and payback. Also, show current annual energy use and cost from computer simulation output.

  - Recommendations for energy investment item and management or maintenance initiatives needed.

  - The computer run.

A monthly progress report will be submitted to AF/PREE showing number of buildings under investigation and number completed with base, building number, floor area, and real estate category code.

Projects developed from this program will be FY 80 through FY 84 MCP candidates and should be submitted from base level along with the normal DD Form 1391 submission. (Subsequent MCP design action will use these reports as a basis for design without further formal economic validation).

May 9, 1977

Dear Sir:

Thank you for your inquiry about our solar energy products mentioned recently in I am enclosing brochures describing both our domestic water heating system and general applications.

space heating and domestic water heating systems have both been approved by ERDA as technically acceptable. We offer packaged systems--collectors, air handlers, and controllers--through local HVAC wholesalers at over 150 locations throughout the United States and Canada. Of particular importance to the architect, engineer, contractor and owner is the fact that our system is based on over 30 years of development and test and is backed by thorough engineering and performance data and a ten-year limited collector warranty.

Reliability is a key factor too. Our system uses air as the collector transfer medium, thus avoiding many of the problems associated with liquid collectors. Recent independent test results have shown air systems to be superior to liquid systems in terms of BTU's delivered. Let me know if you'd like a copy of these test results.

If you are currently considering the applicability of solar energy for one of your projects, we'd be pleased to assist in any way possible. We can provide application engineering data, design review, computer-based thermal and economic analyses and hardware and installation quotations through our local HVAC distributors and dealers. We are also heavily involved in the residential and commercial hardware demonstration programs funded by HUD and ERDA. We'd be glad to explain to you how you can participate in these important programs.

We at are convinced that the widespread acceptance and use of solar energy in industrial, commercial and residential applications begins with the architect, engineer and contractor. It's our goal therefore to provide all necessary assistance to people like yourself.

Let me know if I can be of any assistance at this time.

Sincerely yours,

Vice President, Marketing

RWB/jw
enclosures

CASE #4

WRIGHT-PATTERSON AIR FORCE BASE

AIR POLLUTION--A CASE STUDY

By

James R. Holt, BS, PE
Captain, USAF

Richard W. Laske, BS
Captain, USAF

BACKGROUND/PROBLEM

UNITED STATES AIR FORCE PLEDGE
TO
ENVIRONMENTAL PROTECTION

The United States Air Force is dedicated to National Defense. Inherent in this dedication is the commitment to protect our environment, to conserve energy and to preserve our natural resources. To this end, each of us pledge to . . .

Wholeheartedly support and demonstrate leadership for National Objectives to protect, preserve and enhance the environment.

Evaluate honestly and conscientiously each proposed Air Force action for environmental consequence as an integral part of the decision process.

Comply fully with the most stringent Federal, State and local environmental quality standards.

Actively support and participate in Air Force programs for environmental protection--a goal as fundamental as life itself.

Reverse trends in growing energy use without compromise of readiness, or lessening of our ability to fly and fight.

Encourage cooperation in community efforts to control and abate pollution both on and off our Air Force installations.

Secretary of the Air Force Chief of Staff, USAF

16 January 1974

(8:back cover)

OVERVIEW

This report studies the problems and efforts in the area of air pollution control at Wright-Patterson Air Force Base (WPAFB) in the 1970's. Part One of this case study reviews the formulation and application of current legislation and policy regarding the role of WPAFB in air pollution control in the Dayton, Ohio vicinity. Part Two reports actions taken by the base to improve air quality, including construction in progress. Part Three examines the resulting base status with respect to applicable standards and the continuing efforts required to fulfill Air Force policy on environmental protection.

EFFECTS OF AIR POLLUTION

Air pollution has long been recognized as hazardous to man. This is a fact borne out by many examples of the cost of air pollution measured in terms of property damage, ill-effects on health, and loss of human lives. Significant quantities of harmful pollutants are injected into the atmosphere by man resulting in concentrations greater than the earth's capacity to absorb. It is these concentrations in civilized regions of the world which result in damaging effects (3:18-28).

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CASE STUDIES - ENVIRONMENT AND ENERGY. VOLUME I. HANDBOOK,(U)
APR 78 P J SWEENEY

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DEVELOPMENT OF POLLUTION LEGISLATION

In recognition of the harmful effects of pollution, four U.S. Government committees were appointed between 1962 and 1967 to analyze the deterioration of the environment. Reports from all committees emphasized the urgency of the situation and urged full and immediate application of existing technology and scientific and management research to the pollution issue (1:15-16).

Much significant legislation followed this period of serious study, lending viability and power to Federal and state environmental programs. The Clean Air Act of 1963 authorized Federal financial assistance for state pollution control efforts. The Air Quality Act of 1967 further defined the Federal Government's role in financing, researching, and developing pollution control programs and empowered the Government to enforce against any air pollution that "endangers" health or welfare. A set of amendments known as the Clean Air Act of 1970 established national air quality standards, defined geographic control regions, and compelled states to establish environmental implementation plans (3:31). This Federal legislation committed the United States Air Force (USAF) to a role in cleanup of the atmosphere.

AIR FORCE POLICY ON AIR QUALITY

Air quality improvement is a national goal and Air Force participation in this effort is required as an extension of Federal power. The Clean Air Act specifically requires Federal agencies to comply with Federal, state, and local legislation with respect to control and abatement of air pollution (9:1).

Furthermore, Air Force policy assumes a leadership role in protection and enhancement of the environment. Air Force Regulation 19-1 specifies responsibilities in this regard. It requires all Air Force installations to provide air pollution control measures for USAF buildings. Additionally, bases must comply with the more stringent of Federal or state air quality standards (7:2-3).

AIR QUALITY STANDARDS

Ambient air quality standards applicable to WPAFB were established by the U.S. Environmental Protection Agency and the Ohio Environmental Protection Agency. The standards identify six air pollutants known to be harmful to public health and welfare: suspended particulates, sulfur dioxide, carbon monoxide, hydrocarbons, nitrogen oxides, and photochemical oxidants (6:3).

Suspended particulates are airborne solid or liquid particles having a diameter of less than 100 microns

(.00004 inches). These particulates may consist of microscopic aerosols, visible particles, fumes, soot, oil, and grease. Particulates are hazardous to health in two ways. First, they penetrate the respiratory system causing mechanical irritation which can destroy lung tissue. Second, they can absorb other harmful substances, such as sulfuric acid, and provide a vehicle for transporting these dangerous substances deep into the lungs. Major sources of particulates are power plants and open fires (6:3; 3:23).

Sulfur dioxide is a colorless gas formed by union of sulfur and oxygen in combustion processes. This pollutant is harmful to health and property because it transforms into an acid (sulfuric) on contact with water. The acid promotes corrosion, dries the surfaces of respiratory systems, and destroys body tissue outright. The primary source of sulfur dioxide is combustion of fossil fuels (6:11; 3:24).

Carbon monoxide is an odorless, colorless gas formed by incomplete combustion. It is hazardous to health due to its strong affinity for hemoglobin, the oxygen carrying agent of blood. The resultant physiological effect causes the heart to pump faster, a heavy burden to persons with heart disease. Primary sources of carbon monoxide are motor vehicles (6:11; 3:23).

Hydrocarbons are created by evaporation of fuel and solvents, incomplete combustion, and decay of all life forms. Hydrocarbons are suspected cancer causing substances and

constitute a primary ingredient of photochemical oxidants. Primary sources of hydrocarbons are gasoline powered engines (3:23-24).

Nitrogen oxides are gaseous substances formed by high temperature combustion. Nitrogen oxides, when combined with water, form an acid (nitric) and produce harmful effects in a manner similar to sulfur dioxide. In addition, nitrogen dioxide forms peroxyacetl nitrate, a cancer-causing compound, in the presence of ultraviolet light. Oxides of nitrogen also constitute a primary ingredient in the production of photochemical oxidants. Primary sources of nitrogen oxides are motor vehicles (6:19; 3:24).

Photochemical oxidants (SMOG) are formed by union of heavy concentrations of hydrocarbons and nitrogen oxides in the presence of sunlight. Complex chemical reactions occur which produce the oxidants. These substances are harmful because they dry out protective moist tissue in the body causing eye, skin, and lung irritation. Specific oxidants are cancer-causing agents (6:24).

Ohio and Federal standards for the six major pollutants are detailed in Table 1. Federal standards for particulates and sulfur dioxide are separated into primary and secondary standards. Primary standards are levels above which human health is endangered. Secondary standards are levels above which welfare is endangered due to damage to plants, animals, or property. Where Ohio and Federal

POLLUTANT	CONCENTRATION	REMARKS
Suspended Particulates	60 micrograms/m^3 (75 primary, 60 secondary)	Maximum annual geometric mean at any sampling site.
	150 micrograms/m^3 (260 primary, 150 secondary)	Maximum 24-hour concentration not to be exceeded more than 1 day per year.
Sulfur Dioxide	60 micrograms/m^3 (80 micrograms/m^3)	Maximum annual arithmetic mean concentration.
	260 micrograms/m^3 (365 micrograms/m^3)	Maximum 24-hour concentration not to be exceeded more than 1% of the time on annual basis.
Carbon Monoxide	10 milligrams/m^3 (10 milligrams/m^3)	Maximum 8-hour arithmetic mean concentration not to be exceeded more than one eight-hour period per year.
Photochemical Oxidants	119 micrograms/m^3	Maximum 1-hour arithmetic mean.
	(160 micrograms/m^3)	
	79 micrograms/m^3	Maximum 4-hour arithmetic mean not to be exceeded more than one consecutive 4-hour period per year.
	40 micrograms/m^3	Maximum 24-hour arithmetic mean not to be exceeded more than one day per year.
NON METHANE Hydrocarbons	126 micrograms/m^3 (160 micrograms)	Maximum 3-hour arithmetic mean concentration between the hours of 6 a.m. & 9 p.m.
	331 micrograms/m^3	Maximum 24-hour arithmetic mean concentration not to be exceeded more than one day per year.
Nitrogen Oxides	100 micrograms/m^3 (100 micrograms)	Annual arithmetic mean.
(Federal standards in parentheses)	250 micrograms/m^3 (250 micrograms)	24-hour concentration not to be exceeded more than one time per year.

Table 1 STATE OF OHIO AIR QUALITY STANDARDS

standards differ, WPAFB is committed to the more strict. While there have been minor changes in the standards from 1970 to 1977, the standards applicable in this case (the more strict value of pollutants measurable by the Regional Air Pollution Control Agency, RAPCA) have not changed (4:4; 5:79; 6:29).

Point source emission standards are computed from mathematical models based on such factors as capacity of the rated equipment, stack height, and surrounding terrain (2). As such, standards vary from source to source. Standards for particulate and sulfur dioxide emissions are available for WPAFB heating plants and incinerators and are detailed later.

Area source emissions, produced by transportation and population dispersed sources such as home heating and open fires, are not subject to specific emission standards. These sources do contribute to pollution measured against ambient air standards and are regulated by appropriate legislation as in the case of Federal automobile emission standards and local open-burning ordinances.

MEASUREMENT AND COMPLIANCE

Air quality standards are monitored and enforced by the Regional Air Pollution Control Agency (RAPCA). RAPCA maintains several ambient air measuring stations throughout the Dayton area and monitors point and area emissions (6:3-4).

In terms of proximity to the base, and orientation to prevailing winds, two stations are applicable to measurement of ambient air quality in the area of and resultant to operations at WPAFB (1:passim). These stations are located at 50 Dayton-Yellow Springs Road, Fairborn; and the Service Club (Kittyhawk Center), WPAFB.* Each station measures suspended particulates, sulfur dioxide, and nitrogen oxide levels on an intermittent basis (6:4).

Suspended particulates are measured at each station by a high volume sampler which draws a measured volume of air through a glass fiber filter over a 24-hour period. The samplers operate every six days. The level of pollution is measured in terms of particulate weight deposited on the filter (6:5).

Sulfur dioxide is measured by a bubbler sampler which bubbles measured volumes of ambient air through a solution over a 24-hour period. Spectrographic analysis of the solution reveals the sulfur dioxide content. The bubbler samplers operate every six days (6:11).

Nitrogen oxides are measured by a similar bubbler technique every six days (6:19).

The intermittent nature of the air quality measures provide adequate estimators of the yearly mean ambient air

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*The Service Club station operated only from 1973 to 1977. Its removal in 1977 was due to estimates that its proximity to the base heating plants caused erroneous readings (2).

quality (1:104). Standards based on 24-hour or shorter intervals cannot be adequately measured. Excess 24-hour concentrations are evidenced only if the period of high concentration coincides with station test periods.

Ambient air measurement results indicate marginal compliance to non-compliance locally with standards for particulates and compliance well within standards for sulfur dioxide and nitrogen dioxide. Measurement readings remained consistent in this regard from 1971 to 1976 (4:16-33; 5:15-66; 6:10-22).

RAPCA has published annual air quality reports from 1971 to 1976. Excerpts from the 1976 report, showing 5-year averages, are contained in Tables 2, 3, and 4.

Compliance with point source emission standards on WPAFB is measured at each significant source. Sources tested are the five base central heating plants and the film burning incinerator at Building 294. Tests have proven general non-compliance with the pollution standards tested, particulates and sulfur dioxide. Table 5 lists current point source standards and most recent measurements for WPAFB point sources (2).

An additional measure of area pollutants was provided in G. V. Harkcom's Master's thesis in the form of inventories for pollution sources in the Dayton area. The accompanying tables for 1973 (Appendix A) graphically show WPAFB as a significant source of particulates (3600 tons/year or 14

SUSPENDED PARTICULATES
HIGH VOLUME METHOD

Reported as: micrograms per cubic meter of air

Site No.	Location	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	1976 Geometric Mean	1975 Geometric Mean	5 Year Average
														(State Standard — 60 μg/m³) (Federal Standard — 75 μg/m³)		
		61		31												
608	Fairborn, Ohio	39	35	94	79	206	64	61	100	86	48	41	52			
	Dayton-Yellow	27	40	44	46	66	137	70	68	105	41	39	50			
	Springs Rd.	28	29	30	109	42	79	36	50	108	125	85	43	58	57	60
		42	36	72	129	47	66	69	100	42	54	119	36			
		42		72	124	91	70	44	66	49	53	27	47			
		66		48												
614	Wright Patterson	34	37	117	101	103	69	59	100	91	51	70	47			
	Air Force Base	51	98	33	—	68	150	76	81	87	25	167	43			
		35	50	27	96	38	78	52	43	81	125	97	75	67	70	69
		47	96	109	98	51	69	76	91	48	48	127	37			
		44		92	85	103	73	62	76	47	33	148	50			
		80		58												

— Data Not Available

Table 2 RAPCA ANNUAL REPORT, 1976

SULFUR DIOXIDE
24-HOUR BUBBLER — WEST-GAEKE METHOD

Reported as: micrograms per cubic meter of air

Site No.	Location	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	1976 Arithmetic Mean	1975 Arithmetic Mean	5 Year Average
														(State Standard — 60 μg/m³)		
														(Federal Standard — 80 μg/m³)		
608	Fairborn, Ohio	—	3	17	21	11	12	11	23	21	3	17	16			
	50 Dayton-Yellow	—	32	3	3	10	26	7	9	14	0	1	24			
	Springs Rd.	15	10	3	14	1	11	4	4	11	22	35	36	13	13	15
		—	26	2	103	1	12	7	6	3	21	11	3			
		7		22	1	8	18	2	13	8	1	1	14			
		8		2												
614	Greene County	—	—	—	42	29	5	1	31	13	2	63	17			
	Wright Patterson	117	—	11	9	2	32	1	4	19	7	34	13			
	Air Force Base	8	—	3	38	6	0	4	6	12	40	29	68	19	37	30
		0	—	73	23	3	—	—	3	16	19	23	2			
		0		19	1	5	3	4	21	6	14	53	29			
		—		28												

— Data Not Available

Table 3 RAPCA ANNUAL REPORT, 1976

NITROGEN DIOXIDE
24-HOUR BUBBLER — ARSENITE METHOD

Reported as: micrograms per cubic meter of air

Site No.	Location	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	1976 Arithmetic Mean	1975 Arithmetic Mean	5 Year Average
														(Standard — 100 $\mu g/m^3$)		
608	Fairborn, Ohio	—	0	22	6	30	38	4	49	36	54	22	24			
	Dayton-Yellow	—	24	22	35	39	40	13	58	39	36	31	41			
	Springs Road	30	8	9	30	27	61	43	43	46	31	55	38	33	25	37
		—	19	14	24	19	29	36	56	56	30	58	83			
		28		20	42	34	53	29	33	46	41	9	18			
		40		17												
614	Greene County	—	0	—	75	34	30	8	74	37	44	48	19			
	Wright Patterson	68	0	47	52	45	55	19	21	54	29	29	42			
	Air Force Base	6	—	14	58	28	63	30	37	49	39	59	51	42	53	53
		0	—	246	36	20	14	—	48	58	24	64	82			
		5		41	30	41	62	47	43	42	41	40	22			
		—		38												

— Data Not Available

Table 4 RAPCA ANNUAL REPORT, 1976

Table 5. POINT SOURCE EMMISSION STANDARDS

WRIGHT PATTERSON AFB, OHIO

HEATING PLANTS JANUARY, 1978

Particulates:

Bldg #	std	actual
66	.12 lb/MBTU	2.19 lb/MBTU
770	.17 lb/MBTU	1.14 lb/MBTU
271	.19 lb/MBTU	.99 lb/MBTU
1240	.17 lb/MBTU	.08 lb/MBTU
170	.12 lb/MBTU	1.20 lb/MBTU

Sulfur Dioxide:

66	.33 lb/MBTU	1.47 lb/MBTU
770	.81 lb/MBTU	1.30 lb/MBTU
271	.38 lb/MBTU	1.40 lb/MBTU
1240	.79 lb/MBTU	1.43 lb/MBTU
170	.93 lb/MBTU	1.31 lb/MBTU

INCINERATORS

Particulates:

ALL	.2 lb/100 lbs waste	tests to date only on film burning incinerator (bldg 294); results: test 1: 2 lb/100 lbs waste test 2: 2.6 lb/100 lbs waste

source: Mr.Tom Shoup, 2750th CES (DEEC)

Table 6

Air Pollution Sources at WPAFB--Heating Plants (2)

Building 1240 (Kittyhawk Center)

3 Boilers High Temperature Hot Water
Total capacity - 140 million BTUh

Building 271 (Area A)

3 Steam Boilers
Total capacity - 90 million BTUh

Building 170 (Area C)

5 Steam Boilers
Total capacity - 478,400 lbs/hr

Building 66 (Area B)

7 Steam Boilers
Total capacity - 200,000 lbs/hr

Building 770 (Area B)

2 Steam Boilers
Total capacity - 160,000 lbs/hr

Major Pollutants - Particulate
- SO_x

Table 7

Air Pollution Sources at WPAFB--Incinerators (2)

Building 830 (Area C)

Pathological capacity - 100 lbs/hr

Building 838 (Area B)

Pathological capacity - 75 lbs/hr

Building 305 (Area B)

Classified paper waste capacity - 800 lbs/hr

Building 294 (Area C)

Classified paper waste capacity - 500 lbs/hr

Building 294 (Area C)

Filmburner/Silver Recovery Unit
Capacity - 600 lbs/day (24-hour cycle)

Major Pollutants - Particulate (condensable and non-condensable particulate)

Table 8

Air Pollution Sources at WPAFB--Other (2)

Fire Training Facility

Southeast end of air field
Approximately 300 gals. of JP4 per burn

Major Pollutants - Smoke, Particulate

Spray Paint Booth

7 each located over base area

Major Pollutants - Hydrocarbons

Fuel Oil and Natural Gas Heating Systems

Approximately 30 base facilities and 2100 military family housing units spread over base area with no major pollutants

Jet Engine Test Cell

10 facilities in Area B, 5 facilities in Area C

Major Pollutants - HC, NO_x (exempt from control)

Aircraft

Approximately 1000 aircraft/month

Major Pollutants - HC, NO_x (exempt from control)

Automobiles

Approximately 30,000 automobiles/day

Major Pollutants - HC, NO_x, CO_x (controlled by EPA at manufacturer)

percent of area total), sulfur dioxide (2270 tons/year or 5 percent of area total), and nitrogen oxides (463 tons/year or 2 percent of area total) in the general area. Relative contribution in the immediate Fairborn area is even more significant (1:50-57).

The scope of WPAFB's industrial and research missions suggests other, yet unmeasured, sources in the form of hydrocarbons, nitrogen oxides, and other gaseous emissions from Aeronautical Systems Division labs and test facilities, paint spray booths, engine test cells, and other base industrial activities (2).

SUMMARY AND PROBLEM STATEMENT

The hazards and national concerns involved with air pollution are well established facts. Air Force support of clean air programs and leadership in the effort to cleanse the environment is a matter of policy. Significant levels of air pollution exist in the area and WPAFB is identified as a significant contributor of harmful emissions. A problem facing WPAFB in the 1970's is how to comply with environmental standards and exhibit leadership in the effort to clean the environment. State what WPAFB should do and how it should be accomplished.

APPENDIX A

SOURCE INVENTORY

Table 4-1. Particulate Point Sources--1973.

I.D.	Category	Company	Stacks	Emissions (TPY)
	100 TPY	Ohio Edison	4	2718
B	"	Delco Moraine	2	280
		Montgomery Co. Reduction Plants		
C	"	-North Plant	2	948
D	"	-South Plant	2	948
E	"	Wright-Patterson AFB	10	3600
F	"	Dayton State Hospital	2	378
	"	Piqua Power Plant	3	5200
H	"	Oxford Paper Co.	1	119
		Dayton Power and Light Company		
I	"	-Tait Station	6	8417
J	"	-Longworth Street	3	518
	25-100 TPY	15 Companies	41	2119
	25 TPY	31 Companies	154	1107
			TOTAL	26,352

(1:50)

Table 4-2. Sulfur Dioxide Point Sources--1973.

I.D.	Category	Company	Stacks	Emissions (TPY)
E	100 TPY	Wright-Patterson AFB	11	2270
B	"	Dayton State Hospital	2	328
	"	Piqua Power Plant	3	7300
D	"	Veteran's Admin. Hospital	3	547
		Dayton Power and Light Company		
A	"	-Tait Station	6	24,000
F	"	-Longworth Station	4	1452
G	"	Delco Moraine	1	139
		Montgomery County Reduction Plants		
H	"	-North Plant	2	102
I	"	-South Plant	2	102
J	"	Oxford Paper	1	554
		Ohio Edison		
	"	-Rockaway Plant	1	309
	"	-Mad River	4	4000
	25-100 TPY	6 Companies	17	897
	25 TPY	43 Companies	62	180
			TOTAL	42,180

(1:51)

Table 4-3. Nitrogen Oxide Point Sources--1973.

I.D.	Category	Company	Stacks	Emissions (TPY)
	100 TPY	Piqua Power Plant	3	1,375
E	"	Wright-Patterson AFB	4	463
	"	Ohio Edison -Mad River	4	925
A	"	Bergstrom Paper	2	555
B	"	Frigidaire-GMC	12	3,660
J	"	Oxford Paper	1	342
G	"	Delco Moraine	1	139
		Dayton Power and Light		
C	"	-Hutchings	6	7,409
K	"	-Tait	6	7,717
D	"	-Third Street	2	366
F	"	-Longworth	1	158
	25-100 TPY	7 Companies		1,542
	25 TPY	462 Companies		834
			TOTAL	25,485

(1:52)

Table 4-4. Carbon Monoxide Point Sources--1973.

I.D.	Category	Company	Stacks	Emissions (TPY)
	100 TPY	Cedarville Village Incinerator	1	106
	"	Hobart Manufacturing	1	308
	"	White Superior	1	531
	"	O.S. Kelly	2	474
A	"	Dayton Power and Light -Tait Station	2	341
		Montgomery County Reduction Plant		
B	"	-North Plant	2	204
C	"	-South Plant	2	204
	25-100 TPY	6 Companies		780
	25 TPY	21 Companies		403
			TOTAL	3,351

(1:53)

Table 4-5. Hydrocarbon Point Sources--1973.

I.D.	Category	Company	Stacks	Emissions (TPY)
A	100 TPY	Montgomery County -North Reduction Plant	2	2,370
B	"	-South Reduction Plant	2	2,370
	"	Springfield Gravure	2	389
C	"	McCall Printing Co.	22	5,806
D	"	Chrysler Corporation	7	1,773
K	"	Inland Manufacturing	13	10,680
F	"	Frigidaire	8	2,631
G	"	GHR Division-Dayton Mulleable Iron	1	343
H	"	Lau, Inc.	1	114
I	"	Dayton Tire	2	490
J	"	Delco Products	2	1,007
	"	Brown Bridge Mills	2	1,095
	"	Laminated Coated Products	2	1,100
	25-100 TPY	47 Companies		3,800
	25 TPY	22 Companies		678
			TOTAL	34,646

(1:54)

Table 4-6. Area Source Emissions--1973.
(Dayton and Vicinity)

Source Category	Particulates (TPY)	SO_2 (TPY)	NO_x (TPY)	CO (TPY)	Hydro-carbons (TPY)
Vehicles	6,732	67,003	110,122	504,659	129,481
Aircraft	458	3,972	1,990	29,073	5,848
Railroads	13	38	38	26	25
Population-distributed Emissions	28,431	9,422	9,422	31,245	38,500
TOTALS	35,634	80,435	121,572	565,013	173,854

(1:56)

Table 4-7. Total Emissions--1973.
(Dayton and Vicinity)

Pollutant	Emissions (TPY)	% Contribution
Particulates	61,986	5.6%
Sulfur dioxide	122,615	11.0%
Nitrogen oxides	147,057	13.3%
Carbon monoxide	568,364	51.3%
Hydrocarbons	208,500	18.8%
TOTAL	1,108,522	

(1:57)

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CASE #5

A CASE STUDY OF MONTGOMERY COUNTY'S SOLID WASTE PROBLEM

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THE EVOLUTION OF A PROBLEM

Overview

This term paper is a case study of Montgomery County's solid waste management problem-- specifically, the Montgomery County Commissioners actions to correct the current violation of state and federal airborne emissions standards by the two county refuse incinerators. This case study developes the background of the problem. Next, the possible solutions are critically reviewed and the final decision analyzed. The case study ends with a critique of the technical review and decision-making process used by the Commissioners.

Background

Montgomery County first attacked the solid waste problem in May of 1961 when the "County Commissioners . . . adopted a general plan providing for the use of incinerators in the county garbage and refuse disposal [3:24 May 1961]." The County's initial involvement was in the form of regulations applied to private refuse collectors hauling to landfills; but in August of 1967, International Incinerators Incorporated was awarded a contract providing for the construction of two incinerators in Montgomery County (3:8 Aug

1967). At that time, there existed considerable optimism about the economic solvency of the incinerator operation. Estimates for "profit" using incinerators with current tipping fees ran as high as 45 percent of the anticipated rates (3:10 Aug 67). The ground-breaking on the largest incinerator activity in any county in the United States took place in November, 1967 (3:3Nov 67). Initial testing and Federal Environmental Protection Agency certification took place in 1971 (3:10 Mar 71). The two Montgomery County incinerators have the following primary features:

1. Refuse trucks enter the plant at a weigh scale where weight and hauler identification are recorded for billing and accounting purposes.

2. Trucks proceed to a covered concrete dumping apron.

3. Refuse is dumped into a holding pit which is 40 feet deep and has a volume of 10,600 cubic yards when filled level with the tipping floor. This represents approximately three days' receipts of refuse during peak times.

4. Each plant presently has two identical rotary kiln incinerators with rated capacities of 300 tons per day. Each incinerator is charged through a hopper and feed chute by an overhead crane. Two cranes are available at each plant but only one is normally required to feed the incinerators.

5. The incinerator building was designed so that a third incinerator could be installed alongside the original two, if needed. A charging hopper for this third unit was constructed and a section of the building was left available for this expansion.

6. Unburned residue from the incinerators is hauled by truck to a landfill site on the North Plant property, and some is dumped near the South Plant.

7. Gaseous effluents from the incinerators are passed through wet scrubber systems /7:153/.

The early use of the Montgomery County North and South Incinerators was viewed by many as a model solution to the garbage problem during the early years of the 1970's when environmental concern became popular. Books like Rachel Carson's Silent Spring (1) and Dr. Ehrlick's Population Bomb (4) provided the stimulus for a movement of ecological awareness that resulted in the National Environmental Policy Act of 1969 and the Clean Air Act of 1970. During this initial period of increased awareness, Montgomery County was praised for its foresight and implementation. Its program of solid waste management was fully operational while other governmental bodies were still wondering what to do.

Storm Clouds On The Horizon

In the mid-1970's, the Montgomery County incinerators began to attract increasingly unfavorable critisism from refuse collection agencies and environmentalists. Higher-than-expected bond retirement costs, unanticipated major repair and operating costs, and the cost of installing new air pollution control equipment forced the Montgomery County Commissioners to continually raise the rates for use of the incinerators (3:20 Jun 73). These rate hikes irritated garbage collection agencies and some agencies went back to using legal and illegal landfills (2).

In addition to user complaints, the increasingly

zealous environmentalists began to find fault with the incinerators. Their complaints centered on the airborne emissions from the incinerators. The incinerators had been designed in the mid-1960's when socially acceptable air pollution levels were ten or more times lenient than their current level (2).

Because the incinerators were also designed for long term use (more than 20 years), rebuilding or extensive modification prior to the retirement of the 20-year municipal bonds which were used to construct the facilities would prove to be costly propositions (3:10 Apr 73). Thus the Montgomery County Commissioners were hesitant to make changes.

Rather than doing nothing, the County Commissioners decided to have the problem studied by experts. This was one way to "buy time" and not be criticized. The Research Institute for the University of Dayton was contracted to do this study. In July, 1974, the findings of this research effort were published (5). The study recommended the use of a resource recovery plant.

The proposed system would work like this:

> A series of screenings and shreddings would reduce the refuse to a fine size, remove the ferrous metals, glass and other items and leave shredded organic material, which is useful as a fuel. Organic matter comprises 82% of the refuse /3:11 Oct 74/.

Having been identified, the problem should have been solved; but it was not. The resource recovery program was not started possibly because the Environmental Protection Agency was too lenient in granting extensions to Clean Air

standards or because not enough political pressure was generated from the local populace to implement the recommended resource recovery system.

Since 1974, economic, legal, and political aspects concerning the choice of a waste disposal system in Montgomery County have changed significantly. Politics changed first. The new Commissioner elected in the fall of 1976 had based her platform on the promise to clean up the County's solid waste problem. Since she had one-third of the say in running the Montgomery County government, this new Commissioner had a dramatic effect upon the future settlement of solid waste problems.

Legal changes followed. Environmental Protection Agency (EPA) extensions, which are for fixed periods of time, became harder to justify upon each subsequent renewal request. In October, 1977, the Chicago Regional Office of the Federal Environmental Protection Agency issued a draft consent order to Montgomery County, directing the county to make prompt and appropriate decisions toward the solution of the particulate emissions problem created by the Montgomery County Reduction (Incineration) Plants. The consent order gave the county until April 15, 1980, to solve the problem (11). This is not much time if a major industrial plant is involved in the solution of the problem.

Finally, the economic aspect of this problem changed. The ratio of operating and maintenance costs of current plants to investment and operating costs of resource recovery

plants increased, making a change to resource recovery plants more desirable.

It was the changing nature of these three aspects that elevated the status of solid waste management from being a minor nuisance to being a major problem worthy of considerable attention. Montgomery County now finds itself faced with a serious solid waste management problem.

Statement Of The Problem

For the purposes of this case study, the problem involved the general resolution of solid waste management problems confronting Montgomery County, Ohio. Because there were many problems in today's solid waste arena, this case study specifically examines Montgomery County's dilema concerning the selection of a new method for solid waste processing.

THE PROPOSED SOLUTIONS

The Alternatives

The solid waste treatment techniques that Montgomery County could select were numerous. The County could:

1) use sanitary landfill

2) use existing incinerators and pay EPA fines

3) use existing incinerators after extensive modification

4) use compactors prior to sanitary landfill

5) manually separate and reuse/recycle refuse

6) build a new pyrolysis plant

7) build a new energy recovery plant

8) build a new resource recovery plant

9) do a combination of any of the above [10].

Before Montgomery County was able to investigate all of these ideas thoroughly, the United States Environmental Protection Agency issued a notice of intent to issue a consent order that would force Montgomery County to select one of four alternative courses of action that are judged by EPA to be acceptable. In response to this development, the County Commissioners issued the following press release:

> The four alternatives the commission is considering to comply with the EPA order are: a full resource recovery system, conversion of the incinerators to transfer stations for landfill delivery,

modified (partial) resource recovery and continued use of the incinerators after extensive improvement to meet clean air standards /3:3 Jan 78/.

These four alternatives became known as Plans A, B, C, and D. The Plans entail the following courses of action.

Plan A - Landfill to replace North and South Incinerator facilities.

Plan B - Repair and upgrading of the North and South Incinerators to meet emission standards.

Plan C - Retrofit the North Incinerator to meet emission standards, produce steam, and operate with expanded capacity to facilitate the disposal of all the County's refuse. Convert the South Incinerator facility to a transfer station.

Plan D - Construct a new Resource Recovery Facility to handle all the County refuse. This Facility would use a waterwall system for steam generation. Close the North Incinerator and convert South Incinerator to a Transfer Station /5/.

With this limited number of feasible solutions to solve the problem, it is important to review Montgomery County's comparative analysis of these four alternatives.

Comparing The Alternatives

Montgomery County took numerous steps to insure the appropriate selection of an alternative. These efforts follow:

1. The establishment of the (EPA) Consent Order itself.

2.. The development of the "Gray Matter Network" including a) the engagement of the MITRE Corporation/ Peat, Marwick and Mitchell as the County's overall "Advisor" on solid waste management/resource recovery; b) the forming of the Administrative Panel for Waste Management and Resource Recovery (comprised of senior managers from the public and private sector); c) the forming of the Technical Advisory Group (comprised of scientists and engineers from local business and

educational organizations); and d) the acceptance of support from such organizations as the National Science Foundation and Public Technology, Inc.

3. The engagement of consulting engineers to perform analyses of present waste management operations in order to improve management effectiveness.

4. The engagement of consulting engineers to analyze the waste disposal service charge system and make recommendations for improvement.

5. The engagement (pending) of consulting engineers to provide objective technical and economic evaluation of Option B and C of the Consent Order (electrostatic precipitators and Modified Resource Recovery).

6. Expenditure of substantial "person-hours" to ensure the passage of Senate Bill 303 which enhances significantly the County's ability to procure a resource recovery system (including sponsorship of a S. B. 303 workshop for jurisdictions throughout the State of Ohio).

7. Negotiation for and acceptance of additional technical support from USEPA at no cost to the County. (Development Sciences, Inc.)

8. The extensive preparation of materials for judicial action/relief on matters germane to the issue being addressed.

9. The engagement of a nationally recognized accounting firm to prepare a complete financial history of incinerator operations /12:2-3/.

The Montgomery County Commission

. . . has attempted to establish a systematic decision-making process, supported by extensive professional expertise, in order that (they) may assure the citizens of Montgomery County that (they) will have fully met (their) responsibilities for cost effective and environmentally sound solid waste management /12:3/.

The preceding information provides a good understanding of the intentions of the Commissioners, but what about the specifics involved in the trade-off analysis of the four plans?

Although the County Commissioners never specifically identified any parameters or criteria for analysis, there were several constraints placed on the analysis. From a veiwpoint of ordinary common sense, the analysis had to be:

1. Conservative/Pessimistic--to prevent adoption of a plan that would end up overtaxing and dissappointing the county residents.

2. Long-range--to prevent the early recurrence of solid waste crisis.

3. In Constant Dollars--to permit comparisons between plans.

4. Expressed in Understandable Terms--to permit public understanding of the shape of things to come.

5. Timely--to expedite selection and implementation of the best solution.

Some of the situational constraints facing the Commissioners were:

1. Schedule requirements:

   A. Cargill needed a commitment

   B. EPA Consent Order had numerous deadlines.

2. Judicial determination dictated ceasing incineration operations.

3. Cargill needed assurance that steam production would be reliable.

4. Willingness of adjacent counties to participate had to be determined.

5. Payments on existing bond issues had to be made regardless of the alternatives chosen.

6. South incinerator had to be closed (for political reasons).

7. Some landfill capability was required regardless of the alternative chosen [57].

In addition to these constraints, several facts concerning

local solid waste collection were known. For example, in 1975, 1976, and 1977 Montgomery County handled 288,554 tons, 350,273 tons, and 360,624 tons, respectively (6:4). Also, over seven million dollars remained to be paid on the municipal bonds written to finance the original North and South incinerators (6:2). Finally, although refuse generations are highly variable, all projections were based on a waste generation rate of approximately 3.25 pounds per person per day.

Confronted with these facts, consulting firms and advisors began to make educated projections into the future. For most of the projections, a rate of inflation of 6 percent was used. This rate was applied to operating and maintenance costs, personnel costs, landfill costs and recovered resource prices. The Technical Advisory Group (TAG) projected future annual refuse collection rates for 1980 and 2000 of 644,000 tons and 792,000 tons respectively (6:4). The TAG also projected refuse generation rates to grow from 3.22 pounds per person per day in 1980 to 3.9 pounds per person per day in 2000 (6:4). Based on the author's experience, this growth rate seems very conservative given the historical rate of growth in generation rates.

All these considerations were carefully examined in each of the four proposals on solid waste systems. The following discussions elaborates on the advantages and disadvantages of each plan.

Plan A called for the use of landfill only after

conversion of the two existing incinerators into transfer stations. The relative advantages and disadvantages of landfill are elaborated on in Appendix A, pages 25 to 34. Landfill has a low investment cost ($896,000), moderate transportation costs ($3,021,689 per year), and increasing cost per ton delivered, ranging from $15.97 per ton in 1981 to $55.00 per ton in 2000 (6:6). This total landfill plan is cost effective in the short-run analysis, but ever-increasing costs make it an infeasible long-term solution.

Plan B suggested the repair of the two existing incinerators. The advantages and disadvantages of this plan are listed in detail in Appendix B, pages 35 to 38. Essentially, Plan B required a minimum amount of construction which would have resulted in continued use of the incinerators. The entry arch and chute were to be redesigned to improve combustion. A new water spray cooling chamber with an electrostatic precipitator and associated fans and stack were to reduce particulate emissions. This would have been the most palpable from the general populace's viewpoint; but a select portion of Montgomery County's population was against the continued operation of the South incinerator. Therefore, this option was highly unlikely. It was also determined that the capacity of the two incinerators would be exceeded within the next few years (6:7). The projected cost per ton of waste disposal by year 2000 was estimated to be $20 (6:6).

Plan C would solve the political requirement for closure of the South Incinerator, but the initial investment cost was estimated to be 25 to 26 million dollars if the two existing rotary kilns were removed and replaced with three refractory wall incinerators using waste heat boilers and electrostatic precipitators. If four combustion units had been choosen to accomodate the market demand of 320,000 pounds of steam per hour, the cost would have been 40 million dollars. This option required the use of supplemental coal (6:8). The mixture of new and old equipment in Plan C would have resulted in significant uncertainty in the future operation of the plant. Although this plan closed the South incinerator, there was a growing vocal concern about the continued operation of the North incinerator. Finally, the location of the North incinerator vis-a-vis the Cargill plant would have resulted in significant line losses of steam when compared with Plan D.

Plan D directed the construction of a new resource recovery plant near the Cargill plant. Like the other plans, the advantages and disadvantages of Plan D are listed in an appendix (Appendix D, pages 42 to 45). To its disadvantage, Plan D had the largest estimated capital investment pricetag (72 million dollars). The use of waterwall incinerators for the combustion of refuse is more efficient than the refractory wall incinerators. (6:10). However, Plan D was the most environmentally sound plan because it returns to the ecology of man the largest portion

of energy of all the plans. Additionally, Plan D involved a progressive decrease in net disposal costs. The TAG report indicates that the net disposal costs by the year 2000 should be between $10--$14 per ton (6:10). When this was consolidated over a twenty year life cycle, Plan D came up with the lowest total cost of operation. Another consideration was that the new plant would be more attractive to potential full service contractors so that the County could get out of the garbage business (6:11).

Your Assignment

Select a course of action for Montgomery County and provide a list of events necessary to assure success for your choice.

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