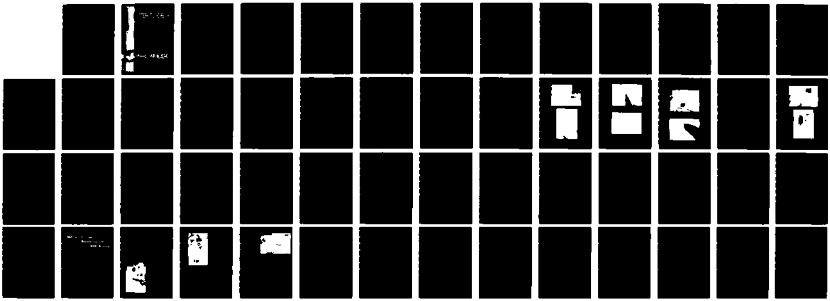
AD-A125 153 MANAGEMENT IMPACT ASSESSMENT OF REFUSE-DERIVED FUEL 1/1
IMPLEMENTATION AT WRI..(U) ULTRASYSTEMS INC FAIRFAX VA
W J HUFF ET AL. 19 MAR 82 AFESC/ESL-TR-81-56

UNCLASSIFIED DACA31-80-D-0020 F/G 21/4 NL



END
FILMED
DTIC

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

AD A125153

ESL-TR-81-56

MANAGEMENT IMPACT ASSESSMENT OF REFUSE-DERIVED FUEL IMPLEMENTATION AT WRIGHT-PATTERSON AIR FORCE BASE

WILLIAM J. HUFF, P.E.
RICHARD K. MCINTOSH

ULTRASYSTEMS, INC.
10340 DEMOCRACY LANE
FAIRFAX, VIRGINIA 22030

19 MARCH 1982

FINAL REPORT
30 SEPTEMBER 1980 - 11 MARCH 1981

APPROVED FOR PUBLIC RELEASE; DISTRIBUTION UNLIMITED

AIR FORCE ENGINEERING AND SERVICES CENTER

AFESC

ENGINEERING & SERVICES LABORATORY
AIR FORCE ENGINEERING & SERVICES CENTER
TYNDALL AIR FORCE BASE, FLORIDA 32403

NOTICE

PLEASE DO NOT REQUEST COPIES OF THIS REPORT FROM HQ AFESC/RD (ENGINEERING AND SERVICES LABORATORY). ADDITONAL COPIES MAY BE PURCHASED FROM:

NATIONAL TECHNICAL INFORMATION SERVICE
5285 PORT ROYAL ROAD
SPRINGFIELD, VIRGINIA 22161

FEDERAL GOVERNMENT AGENCIES AND THEIR CONTRACTORS REGISTERED WITH DEFENSE TECHNICAL INFORMATION CENTER SHOULD DIRECT REQUESTS FOR COPIES OF THIS REPORT TO:

DEFENSE TECHNICAL INFORMATION CENTER
CAMERON STATION
ALEXANDRIA, VIRGINIA 22314

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ESL-TR-81-56	2. GOVT ACCESSION NO. AD-A125153	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Management Impact Assessment of Refuse-Derived Fuel Implementation at Wright-Patterson Air Force Base.		5. TYPE OF REPORT & PERIOD COVERED Final Report 30 Sept 1980 - 11 Mar 1981
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) William J. Huff, P. E. Richard K. McIntosh		8. CONTRACT OR GRANT NUMBER(s) DACA 31-80-D-0020
9. PERFORMING ORGANIZATION NAME AND ADDRESS ULTRASYSTEMS, INC. 10340 Democracy Lane Fairfax, Virginia 22030		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS Program Element: 64708F JON: 20545017
11. CONTROLLING OFFICE NAME AND ADDRESS Air Force Engineering and Services Center HQ AFESC/RDVA Tyndall AFB, Florida 32403		12. REPORT DATE 19 March 1982
		13. NUMBER OF PAGES 53
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office) U. S. Army Facilities Engineering Support Agency FESA-TS Fort Belvoir, Virginia 22060		15. SECURITY CLASS. (of this report) Unclassified
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

Availability of this report is specified on reverse of front cover.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Alternate Solid Fuel	Combustion
Central Heating Plants	Commercial-Industrial Type Activity
CITA	Densified RDF
Coal Fired Plants	DRDF
Co-firing	Energy

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This study has shown that the impact of specifying, procuring, using, and monitoring refuse-derived fuel (RDF) on the organizational structure and the operations and management activities of Wright-Patterson Air Force Base has been generally minimal and essentially absorbed into the various ongoing functional activities. However, the project manager devoted over 75 percent of his time to the program since it started and additional housecleaning

DD FORM 1473, 1 JAN 73 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

19. Management Impact Assessment — RDF
Municipal Solid Waste — Refuse-Derived Fuel

20. (Continued)

personnel were assigned to the operating staff to remove the dust and debris resulting from the RDF. The research and development nature of this particular activity contributes to the necessity of having a project manager with time to keep the program on track and interested persons informed as to its progress. Whether this impact would be reflected in follow-on implementation programs is problematic and dependent upon how the program is viewed locally, the need for further R&D, and the visibility required or desired.

The level of effort dedicated to this project was 5.6 man-years the first year and is expected to be 4.0 man-years the second year. The associated salary costs are $130,500 and $86,500, respectively. This is not to be construed as a cost specifically applied to this project, because most of the people involved were performing their normal tasks. Rather, this should be taken as a level of effort indicator in the planning of follow-on projects and this planning should consider findings of the WPAFB project.

An assessment of the applicability of CITA to the operation of the RDF facility at WPAFB indicates that this and other Air Force central heating plants will be reviewed for possible contract operation in FY 1984. Investigation for this study has identified no critical factors that would preemptively eliminate the WPAFB RDF facility from full review procedures. The probable deciding factor in continuation of governmental operation of the facility will be the results of the comparative cost analysis.

SUMMARY

The objective of this study was to identify and quantitatively assess the management impact of introducing refuse-derived fuel (RDF) pellets as an alternative solid fuel for use with coal in operating a large heating plant and its associated equipment at WPAFB, Ohio. It was found that the overall impact of introducing RDF pellets as an alternate fuel was minimal, with essentially no effect on existing functional activities. However, the designated project officer devoted over 75 percent of his time to the program from its inception and housecleaning personnel were added to the operational staff to remove dust and debris resulting from the RDF. The effort consumed 5.6 man-years in 1980 and 4.0 man-years in 1981, with the associated salary costs of $130,000 and $86,000, respectively. These salary costs reflect both existing normal job activities and RDF implementation. Follow-on projects should indicate the level of effort assessed during the WPAFB study. Implication of commercial-industrial type activity (CITA) at WPAFB and other Air Force central heating plants will be reviewed for possible contract operation in FY 1984. This study identified no critical factors to eliminate the WPAFB RDF facility from full review procedures. The probable deciding factor in continuation of governmental operation of the facility is comparative cost analysis.

(The reverse of this page is blank.)

PREFACE

This report was prepared by Ultrasystems, Inc., Eastern Operations, 10340 Democracy Lane, Fairfax, Virginia 22030. This report was prepared for the U.S. Army Facilities Engineering Support Agency, Fort Belvoir, Virginia 22060, under contract No. USAF ~~MIPR~~ N-80-40 with Air Force Civil Engineering and Services Center, HQ AFESC/RDVA, Tyndall AFB, Florida 32403.

This work was begun in June 1980 and completed in September 1981. The AFESC Project Officer was Stephen A. Hathaway.

This report has been reviewed by the Public Affairs Officer and is releasable to the National Technical Information Service (NTIS). At NTIS it will be available to the general public, including foreign nationals.

This report has been reviewed and is approved for public release.

Paul C Vitucci

PAUL C. VITUCCI, 1Lt, USAF
Alternate Project Officer

John E. Goin

JOHN E. GOIN, LtCol, USAF
Chief, Engineering Research Division

Francis B Crowley III

FRANCIS B. CROWLEY III, Col, USAF
Director, Engineering and
Services Laboratory

(The reverse of this page is blank.)

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

SECTION I

INTRODUCTION

1. GENERAL

The Department of Defense is pursuing a number of efforts designed to reduce the dependence on foreign source energy to satisfy its energy requirements. Of particular concern is the energy consumed in large central heating plants that supply both heating and process energy to large military installations, the majority of which are natural gas- and/or oil-fired. The goal is to convert or replace them with solid fuel units and virtually eliminate oil and natural gas from use as a facility energy in the next 20 years.

Since the shift to coal is rapidly becoming a world wide movement which will place increasing demands on the existing supplies, the development and use of other sources of solid fuel to supplement coal warrant investigation. Such an effort is presently underway by the Air Force in its experimental program of co-firing a mixture of coal and densified refuse-derived fuel (RDF pellets) at Wright-Patterson Air Force Base (WPAFB), Ohio. The tests, which began in September 1979, are being conducted in a large heating plant designed to use coal as the primary fuel. This study examines the various areas of activity involved in planning and conducting these tests.

2. OBJECTIVE

The objective of this study is to identify and quantify the management impact of introducing RDF pellets as an alternate solid fuel for use with coal in operating a large heating plant and its associated equipment at WPAFB, Ohio. The tasks performed by WPAFB personnel in the planning, procurement, coordination, testing, reporting, and other functions are also described as an assist in implementing the use of RDF as an alternate fuel on other Air Force Bases. Additionally the applicability of the RDF Utility being operated under contract with the private sector in accordance with the Commercial-Industrial Type Activity (CITA) program was assessed.

3. SCOPE

To properly address the objective of this study, the data presented pertains only to the manufacture of RDF at the Teledyne National production facility in Cockeysville, Maryland; shipping the material from Maryland to WPAFB, Ohio; and the management of the complete coal/RDF co-firing test program at WPAFB, Ohio. It is necessary to limit the scope of the study to the type of equipment, management structure, procedures, etc., existent and in use at WPAFB. The introduction of RDF as a fuel in base heating facilities fired by any fuel other than coal would introduce a completely different set of problems, procedures and modification requirements.

4. PERSONS CONTACTED

In the course of the investigation, the following persons were interviewed:

HQ, Air Force Logistics Command

Col. G. R. Tate	Director, Operations and Maintenance DCS/Engineering and Services
Lt. Col. Robert Lynch	Chief, Utilities Section, Operations and Maintenance Directorate
Mr. Robert Bishop	Mechanical Engineer, Utilities Section, Operations and Maintenance Directorate
Mr. W. R. Jacobs	Chief, Contracts Branch, Directorate of Manpower and Organization

2750th Air Base Wing

Mr. Dexter Martin	Chief, Base Contracting Branch, Contracting Division
Ms. Toshi Tsukyama	Base Contracting Branch, Contracting Division
Mr. Robert Crooks	Contract Administration Branch, Contracting Division
Ms. Pat Zellanack	Contract Administration Branch, Contracting Division

2750th Civil Engineering Squadron

Col. J. N. Hicks	Commander
Mr. Tom Shoup	Chief, Environmental Planning Section, Engineering and Environmental Branch
Lt. Col. Engelbach	Chief, Operations Branch
Mr. V. Gregory	Deputy Chief, Operations Branch
Mr. B. Jones	Chief Mechanical Section, Operations Branch
Mr. Kermit Allen	Chief, Heating Systems, Mechanical Section
Mr. Harold Edmiston	Chief, Unit A, Heating Systems, Plant 1240C

Mr. Clyde Farris — Chief, Unit B, Heating Systems, Plant 66B and Plant 770B

3025th Management Engineering Squadron

Mr. Richard M. Coffee — Supervisory Management Analyst, Management Engineering Team

Teledyne National, Inc.

Mr. Ken Cramer — RDF Project Manager, Cockeysville, Maryland

Others

Lt. Col. Gary Easton — Office of the Deputy Chief of Staff for Manpower and Personnel, Department of the Air Force

5. CONCLUSIONS

After having reviewed the RDF project at WPAFB and interviewed people in all of the involved organizational elements and functional areas within those elements, it has become apparent that the overall impact of introducing RDF pellets as an alternate solid fuel was minimal and essentially absorbed into the various ongoing functional activities. However, the designated project manager devoted over 75 percent of his time to the program since it started and additional housecleaning personnel were assigned to the operating staff to remove the dust and debris resulting from the RDF.

The level of effort dedicated to this project was 5.6 man-years the first year and is expected to be 4.0 man-years the second year. The associated salary costs are $130,000 and $86,500, respectively. This is not to be construed as a cost specifically applied to this project, because most of the people involved were performing their normal tasks. Rather, this should be taken as a level of effort indicator in the planning of follow-on projects and this planning should be tempered with the lesson learned from the WPAFB project.

An assessment of the applicability of CITA to the operation of the RDF facility at WPAFB indicates that this and other Air Force central heating plants will be reviewed for possible contract operation in FY 1984. Investigation for this study has identified no critical factors that would preemptively eliminate the WPAFB RDF facility from full review procedures. The probable deciding factor in continuation of governmental operation of the facility will be the results of the comparative cost analysis.

SECTION II

FINDINGS

1. APPROACH

The primary objective of this study was to assess the impact that each organizational element experienced as a result of introducing an RDF/coal mixture as a fuel in a large central heating plant at WPAFB. Of particular concern is the impact of planning and preparing for the use of RDF, its procurement, and its eventual use. This impact is assessed from an organizational, management and manpower point of view. The management impact of the program is assessed primarily at the Base level with secondary interest on that experienced within the headquarters of the AFLC. Interviews with Air Force personnel familiar with the co-firing test program, already in progress, led to an early identification of the organizations on WPAFB associated with the program. These interviews also provided initial information regarding the type of management attention, supporting functions and technical problems involved.

Since RDF is the only variant introduced in the operation of the heating plant, knowledge of its production process was deemed necessary. This information was obtained during an onsite inspection of the Teledyne National manufacturing facility of Cockeysville, Maryland. WPAFB was then visited and information obtained on the procurement, shipment, handling, and use of RDF. Lengthy discussions with the project manager provided a description of the background, status, and concerns of the test effort to date. He also identified the organizations, individuals, and functions involved in implementing and conducting the co-firing test. Very informative sessions were then conducted with representatives of all the organizations identified and at all personnel levels. The data obtained resolved itself into the general categories of Organization and Management, Operations, Procurement, and Manpower and Cost.

Data obtained during the visits to Teledyne and WPAFB mentioned above were analyzed and additional information requirements identified. WPAFB was then visited a second time to observe RDF unloading and storage procedures and to discuss specific problems with local personnel.

All of the individuals contacted during the conduct of this study were extremely cooperative and frank in providing any support and information requested.

2. ORGANIZATION AND MANAGEMENT

a. General

This portion of the report assesses the management impact of introducing RDF as an alternate fuel in large scale heating plant operations at WPAFB. This assessment required an examination of the organizational relationship among affected elements of the command, their management role and any problems experienced as a result of supporting the program.

Only two organizational elements of the AFLC are significantly involved in the RDF program. At the Command Staff level, the focal point of RDF activities is the Office of the Deputy Chief of Staff for Engineering Services (Figure 1). The functional responsibilities of the program are performed by segments of the 2750th Air Base Wing.

b. Headquarters, Air Force Logistics Command (AFLC)

The organization charts shown in Figures 1 and 2 show the relationship among the various elements of the Command participating in this effort. At the HQ, AFLC-level members of the Directorate of Operations and Maintenance, a major segment within the Office of the Deputy Chief of Staff for Engineering and Services, handles all matters pertaining to the RDF test program. Their role consists of providing the planning, monitoring, and assistance required at the AFLC staff level. They are also evaluating the test effort as a part of the command energy conservation program and examining the practicability of using RDF at other AFLC locations.

Colonel G. R. Tate, the Director of Operations and Maintenance, and Lt. Colonel Robert Lynch, the Chief of the Utilities Section, expressed the opinion that the management arrangement existing for the test program is working satisfactorily. Mr. Tom Shoup, assigned to the 2750th Civil Engineering Squadron of the 2750th Air Base Wing, functions as the project manager and keeps the AFLC staff informed on all significant aspects of the test program. From a workload point of view, the AFLC staff participated in the task of preparing the request for proposal (RFP) and getting the contract underway. Even though a staff engineer was quite involved in this effort, his additional support to the test program did not adversely impact his other staff functions. The AFLC staff is interested in the effort and their support is willingly provided. Brig. General C. W. Lamb, the Deputy Chief of Staff for Engineering and Services, is reported to be an enthusiastic supporter of the program. Such support provides stability to the test program.

c. 2750th Air Base Wing

Along with many other vital base functions, the 2750th Air Base Wing is responsible for the operation and maintenance of all housekeeping facilities located on WPAFB, including the heating plants used during the RDF tests. The Air Base Wing Contracting Division at the staff level and the 2750th Civil Engineering Squadron at the unit level (Figure 2) experienced the major impact of initiating the co-firing program. Briefly stated, the Contracting Division is responsible for the procurement of the RDF and the Civil Engineering Squadron provides management for the project and conducts the test operation. Initiating and continuing the program has required a well-coordinated effort by both of these organizations.

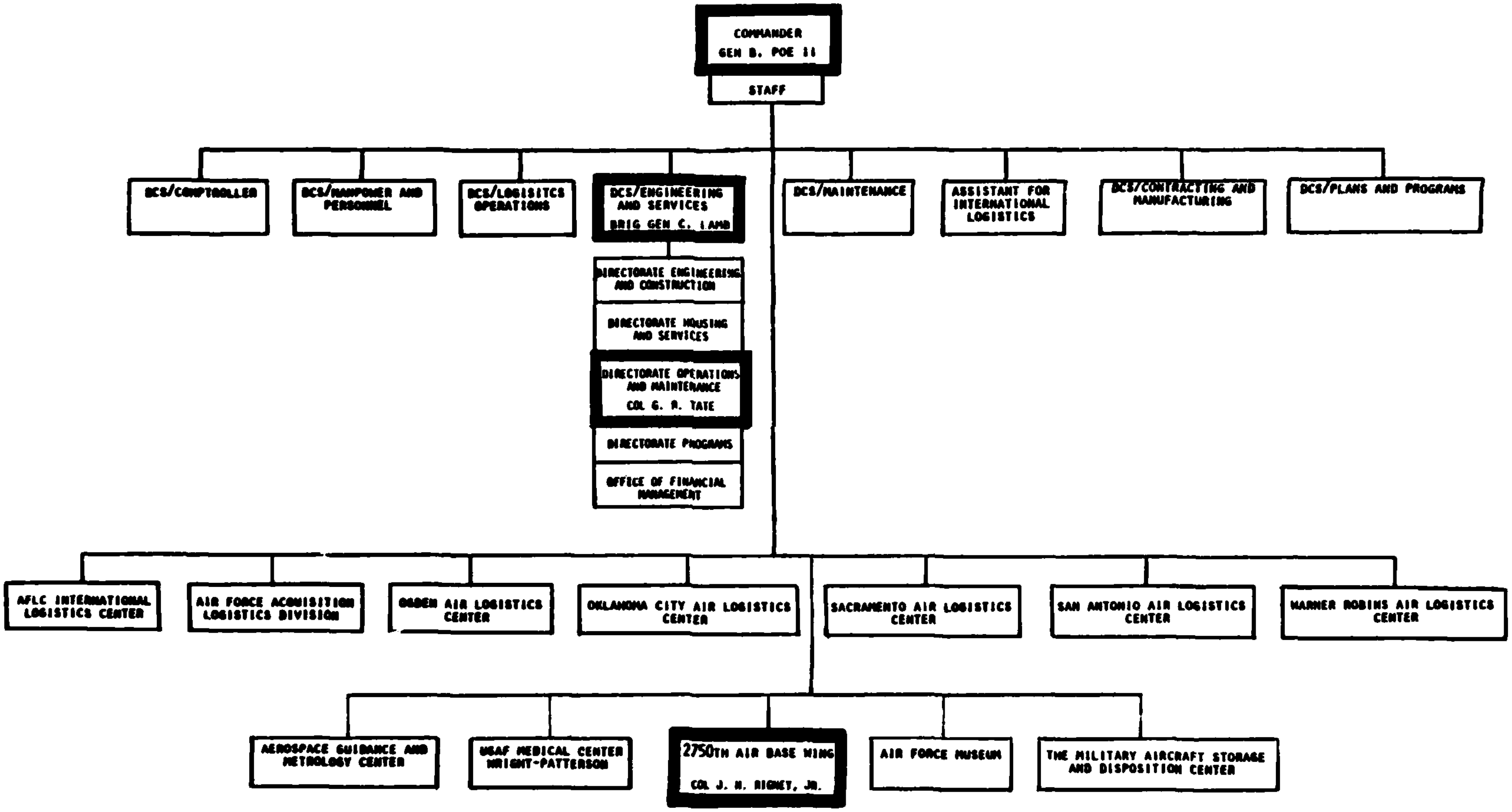


Figure 1. Organization Chart, Air Force Logistics Command.

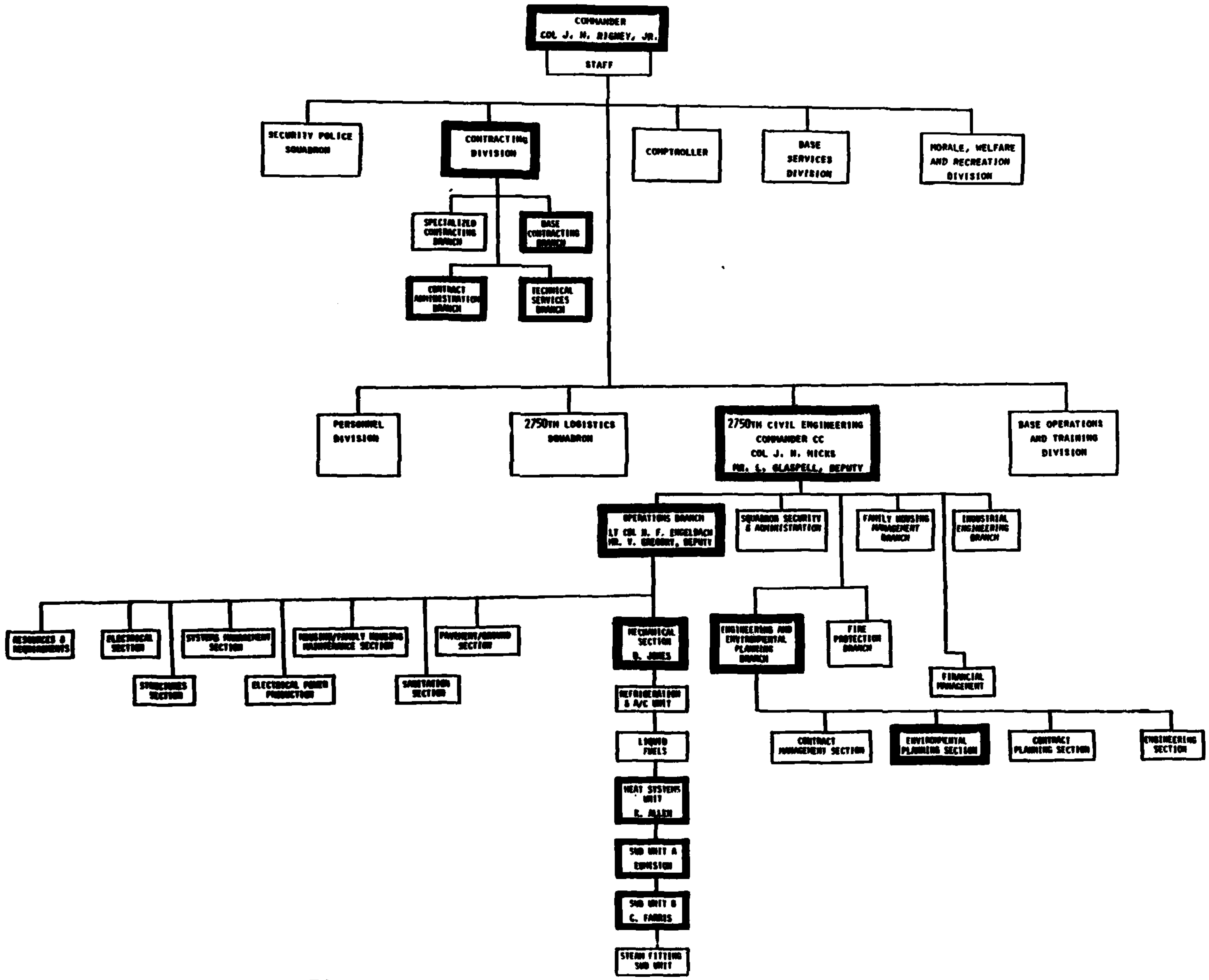


Figure 2. Organization Chart, 2750th Air Base Wing.

(1) Contracting Division

The responsibility of the Contracting Division is somewhat different with respect to the procuring of RDF than it is in the procurement of other fuels such as coal. Usually the Division only administers the contracts. The solicitation of bids and contract award is performed by the Defense Fuel Supply Center. For this particular program, however, the local office was given authority to contract for the fuel. The waiver was granted to enable the buyer, the manufacturer, and the consumer to work closely together in handling the problems that might arise. This action recognized the experimental and developmental nature of the RDF pellets and the need to quickly tailor the fuel specifications to attain compatibility with existing boilers and other heating plant equipment. The arrangement places an additional workload on both organizations, but the close working relationship and immediate control of the contract seems to have resulted in a better managed test program. When shipment by rail was found to degrade the quality of the RDF, it was promptly cancelled and trucks became the primary mode of transportation. Also, during periods of reduced burning, it was possible to quickly arrange for interim storage of fuel at the production site. The decision to place control of the contract at the project management level appears to be a sound one.

Members of the Contracting Division have shown much interest and dedication in their performance of the procurement function. The task of initiating the program was more difficult than anticipated; however, their joint team effort with the project manager, other members of the 2750th Civil Engineering Squadron and representatives of the AFLC staff combined to complete the task in an efficient and timely manner.

(2) 2750th Civil Engineering Squadron

The functions of project management and testing are both performed by personnel assigned to the Civil Engineering Squadron. As can be seen by the organizational chart (Figure 2), the squadron is involved in other activities critical to the maintenance and operation of many major base facilities. Those portions of the organization most active in the RDF program include the Squadron Commander's Office, the Engineering and Environmental Planning Branch, and the Operations Branch.

The manager of the project since its inception has been Mr. Thomas Shoup, Chief of the Environmental Planning Section within the Engineering and Environmental Planning Branch. A review of his responsibilities as project manager indicates that it is essentially a full-time job. Duties include serving as the WPAFB coordinator for all matters, on and off base, that pertain to RDF and the test program. Also included is responsibility for monitoring test activities, being aware of the problems experienced, and expediting their resolution. Periodic status reports, project briefings, talking papers, and information briefings for various key staff members are all provided by Mr. Shoup. Public relations activities and discussions with representatives of industry interested in RDF also require a considerable amount of his time. These responsibilities have been superimposed on his primary responsibility of planning and supervising the activities of his office personnel. He estimates that since mid-1978 approximately 75 percent of his time has been required in managing this project.

Two of the WPAFB heating plants have been involved in the co-firing operations. Operation of these heating plants is the responsibility of the Heat System Unit, which is a part of the Mechanical Section of the Operations Branch (Figure 2). Organizationally, the project manager reports to the Chief of the Engineering and Environmental Planning Branch, which puts him in a different functional portion of the Squadron than the heating plant operators. This potentially cumbersome authority relationship has, from all indications, worked quite well. The positive attitudes displayed by all concerned from the Squadron Commander to the plant supervisor are certainly a major contributing factor to the successful operation. All appear to be strong supporters of the project and fully realize the importance of developing an acceptable alternate fuel. Further, Mr. Billy Jones, Chief of the Mechanical Section, and his Chief of Heat Systems, Mr. Kermit Allen, are in full support of the program and the organizational structure under which it is carried out. For a project such as this to be successful, enthusiastic support at each level is imperative, and from all appearances, such support exists at WPAFB.

The introduction of RDF into the heating plants had little impact on the functional responsibilities of the operating crew, as tasks are essentially the same when firing only with coal. The shift to a mixed fuel operations does require the unloading, storing, and handling of RDF in addition to coal, but this has been accomplished without major difficulty. Problems experience are discussed under "Operations" section of this report. The RDF generated some dust during the unloading and handling process which, under some conditions, contributes significantly to the plant cleanliness task. This problem was considered to be an urgent one by plant supervisory personnel and three additional manpower allocations were requested to cope with it.

In discussions with WPAFB personnel at all levels, there was an occasional tendency to refer to RDF as "garbage" and the entire test program as a "garbage disposal operation." Such remarks were usually made in jest, but the situation was not received as lightly by some members of the heating plant crews. Odor and mold occasionally occurred in the plant during periods of high humidity and concern that continued use of RDF might result in a degraded working environment may have been present. There is no evidence that the situation has adversely affected the conduct or results of the program in any way, because the tests have been conducted in the same efficient manner applied to coal operations.

The problems and inconveniences attributed to the first large-scale operation utilizing pelletized RDF are handled competently and the test operations are now continuing in a routine manner. All the crews have contributed significantly to the overall objective of developing satisfactory alternate fuels for facility operations.

3. OPERATIONS

a. General

The Operations portion of this report follows the life cycle of pelletized RDF from its manufacturer in the Teledyne National plant to its consumption in central heating plants at WPAFB. The more significant problems experienced during the different phases of this process are identified and their impact examined.

b. Manufacture of Pelletized Refuse-Derived Fuel (RDF)

(1) RDF Production Plant

The Teledyne National plant at Cockeysville, Maryland, is the location of one of this country's most active efforts to extract energy from the waste material that heretofore has been burned or buried. The original objectives of municipal solid waste (MSW) recovery were to assist in solving the growing shortage of landfill space and also to pursue the development of better resource recovery processes. The manufacture of RDF from MSW by the Cockeysville plant adds the dimension of energy recovery. The plant cost of over $8,000,000 was borne jointly by Baltimore County and the Maryland Environmental Service (Appendix A).

In addition, emphasis is also being placed on energy recovery. Nondensified RDF, or fluff, has been produced for use with coal in existing heating and power plant facilities, but the highly shredded material has major disadvantages. It begins to deteriorate rapidly in storage and is rather difficult to handle. It was found that the process of feeding fluff into a pelletizing machine, subjecting it to pressure, and extruding it through dies produces a pelletized or densified version of the same fuel with vastly improved handling and storage characteristics. WPAFB became the first major customer for RDF pellets, with initial delivery starting in May 1979.

Even though the waste recovery plant is essentially a "garbage" processing plant, no significant difficulty has been experienced in hiring people to work there. The Baltimore County area has a good labor market and employees are required to have no special skills. Personnel are trained on the job and perform very well in the highly automated plant. Initial reluctance to work with garbage soon gives way to interest and enthusiasm, when workers are convinced that they are in the forefront of a national energy recovery program. Consequently, the plant experiences an unusually low rate of turnover for the category of workers employed.

(2) RDF Quality Control

Teledyne National has experienced difficulty in meeting the RDF contractual specifications summarized below:

Energy Content	- 6,500 Btu/Lb (Min) dry
Ash Content	- 15% (Max) dry
Moisture Content	- 20% (Max) as received FOB WPAFB

Bulk Density	- 35 Lb/Cubic Foot (Min) as received FOB WPAFB
Fines	- 5% (Max) as received FOB WPAFB
Pellet Size	- ½ in. x 1 in.

A moisture content in excess of 20% has been experienced periodically. The manufacturing process does not include moisture control; therefore, the moisture content is greatly influenced by damp weather and seasonal influxes of refuse with high moisture content, such as freshly cut grass and green foliage. Further, a high percentage of fines, sometimes over 20%, and a high dust content are often found. These are generally referred to as RDF's most irritating and aggrevating characteristics. A vacuum treatment has been added to the manufacturing process to reduce the percentage of fines. Improvement has been noted, but the problem has not been eliminated. The transportation environment and plant handling procedures also present problems and will be discussed later in this report. It must be noted that the energy content of the pellets, as measured by the National Bureau of Standards, had a mean value of over 10,000 Btu/Lb, far exceeding the specified 6,500 Btu/Lb.

The pellet plant manager, Mr. Ken Kramer, has made a number of modifications to the facility since operation first began in 1976. It is highly automated and efficiently operated by crews of approximately 10 men. In support of the energy recovery program, the plant has played both a research and development and a production role in the attainment of a manufacturing capability for pelletized RDF. Mr. Kramer is quick to emphasize that a new plant would significantly differ from the present facility. Its estimated cost would be approximately $3,000,000, excluding land, and would require a total complement of about 30 people for a 6-day-a-week operation.

c. Transportation and Handling

The program to co-fire coal and RDF has produced extensive information in many areas, none more significant than the data obtained during transportation and handling of the fuel. Both functions affect the integrity of the pelletized material.

Transportation has been cited by both the manufacturer and the consumer as a significant problem area. Because of the lower transportation costs ($23.00 per ton by rail versus $56.00 per ton by truck), rail shipment was initally selected as the primary mode for shipping RDF to WPAFB. Besides requiring up to two weeks transportation time enroute, railcars proved very difficult to unload. The fuel pellets often became compacted during the travel period and were difficult to break up so they would flow out of the car. Railcar unloading operations were extremely costly in man-hours. Although the manufacturer was of the opinion that the fuel was of desired quality when loaded into the railcar, plant personnel at WPAFB found the shipments contained excessive amounts of fines and dust. During the same period, fuel shipped by truck only required two days enroute, was unloaded more easily, and the dust and fine content was found to be less. These observations led to the termination of rail shipments in November 1979.

Comparison of fuel samples before and after shipment indicates that shipping impacts the quality of the fuel; dust and fines content increases with the time enroute and the vibration encountered. The fuel also experiences some degradation due to the many times it is handled. Dropping the pellets from a conveyor belt, a truck, or from a front loader occurs 18 times from the time they are produced until they are burned, five at the manufacturer's plant and thirteen at the WPAFB heating plant facility. Effective planning of future facilities and improved handling processes can reduce this impact significantly.

d. Central Heating Plant Operation

The introduction of pelletized RDF into the fuel stream at WPAFB had little impact on the management of the heating plants or the normal functional activities of operating personnel. Two plants have participated in the test program with similar experience in handling the RDF. The heating plant in Building No. 1240 operated by Heating Sub Unit A was most active in the program during the study period; therefore, comments in this portion are based primarily on observations at that location.

The major complaints lodged against the quality of the RDF product received from Teledyne National related to the high percentage of fines and the accompanying dust. Problems encountered early in the program during the burning of fuel with a high fines content were cause for some concern. An uneven fuel distribution, an increase in ash, and a tendency to develop clinkers were attributed to excessive fines. Recent information from WPAFB indicates that these problems are not currently considered serious; a requirement to modify existing boiler equipment is not anticipated. Excluding housekeeping, the co-firing operations have had no adverse effect on the maintenance workload. Approximately 1,000 tons of RDF have been burned at the Building No. 1240 facility to date and another 1,000 tons were burned in Building No. 770 with little added maintenance effort.

The dust that is associated with RDF has the appearance of a fine lint and is most prominent when the moisture content of the fuel is low. As stated in the Transportation and Handling section of the report, each time the RDF is moved, the percentage of dust and fines is increased. The dust contributes to the plant housekeeping problem and is also a source of mold and odor, particularly during periods of relatively high humidity which caused some workers to register complaints regarding the RDF test program. Teledyne National employees and WPAFB personnel experienced the garbage syndrome, which may have increased their tendency to complain about conditions which were actually similar to those normally experienced when working with coal. This expected reaction should not be a condemnation of employee performance, but an indication of the importance of employees knowing the value of their participation in a special effort. Plant supervisory personnel have requested three additional manpower authorizations for employees to handle the increased housekeeping task.

To date, problems regarding dust and fines constitute the most significant impact to the normal operation of the central heating plant and are most serious when RDF is being unloaded from the trucks and transferred to the silos for storage.

One characteristic of the RDF became apparent as the test program progressed. The best quality fuel received at WPAFB was that which had been recently manufactured and shipped without having been stored. Some pellets were stored for approximately 2 months before being shipped, apparently deteriorated in storage, and almost disintegrated during shipping and handling. Fresh pellets seem to maintain their integrity throughout the handling process and are resistant to the generation of fines and dust. To obtain firsthand knowledge of the situation, a visit to the boiler plant was arranged to coincide with the delivery of two truck loads of RDF pellets.

A crew of five men was trying to unload a railcar of coal which had arrived after being subjected to several days of freezing temperatures. Even though a car shaker/vibrator was used repeatedly, a substantial amount of coal remained frozen in the car. Nine other cars were waiting on the siding to be unloaded, presumably with similar problems.

During the coal car unloading task, two RDF trucks arrived to unload. One truck was driven into place over the receiving hopper adjacent to the area occupied by the coal car and the unloading was accomplished by the two truck drivers. As the RDF fell from the truck, it passed through a heavy metal grate and into the receiving hopper below. Dust and fines were evident as the RDF began to pour from the truck, but became quite heavy as the truck bed was elevated and the RDF flow rate increased (Figure 3). Below the hopper, a belt feeder placed the RDF on the first of four belts used to move the fuel into the storage silo. A heavy concentration of dust and small fines filled the air at this point and settled to form a blanket on the conveyor belt guard rails (Figure 4). As the fuel moved from belt to belt on its trip to the silo, less dust was observed at each transfer point, but enough remained to blanket the tops of the guard rails (Figure 5).

Some locations adjacent to the conveyor belt area had not been cleaned for some time, because the thickness of the blankets observed was more than could have accumulated in the short time since the truck was dumped. At the belt transfer points and other locations along the belt route, accumulations of fines were noted on the solid portions of the floor. Many of the floors, however, are steel grating which allows the material to drop to lower levels and further complicate the housecleaning task. At some locations along the conveyor belt route, large amounts of apparent RDF dust and lint were noted, but further inspection revealed that the pile of material was actually coal dust covered by a thin layer of RDF dust. This was a reminder that coal handling also experiences a problem with dust (Figure 6).

When the RDF fell into the top of the storage silo, it had been handled a total of 12 times since it was manufactured and had been transported approximately 400 miles by truck. It would be handled an additional six times before it was burned. There is little doubt that each handling contributes to the generation of fines and dust along the open belt conveyor route. As the material progresses through the handling system, however, dust decreases (Figures 7 and 8).

Figure 3. Fines and Dust Evident During Unloading.

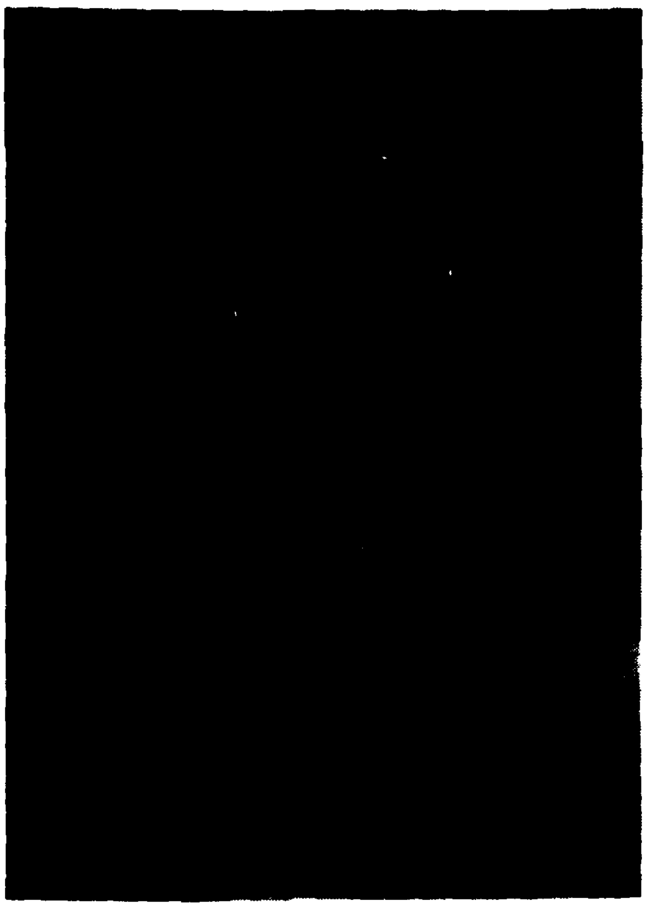


Figure 4. Fines and Dust at Initial Drop to First Belt.

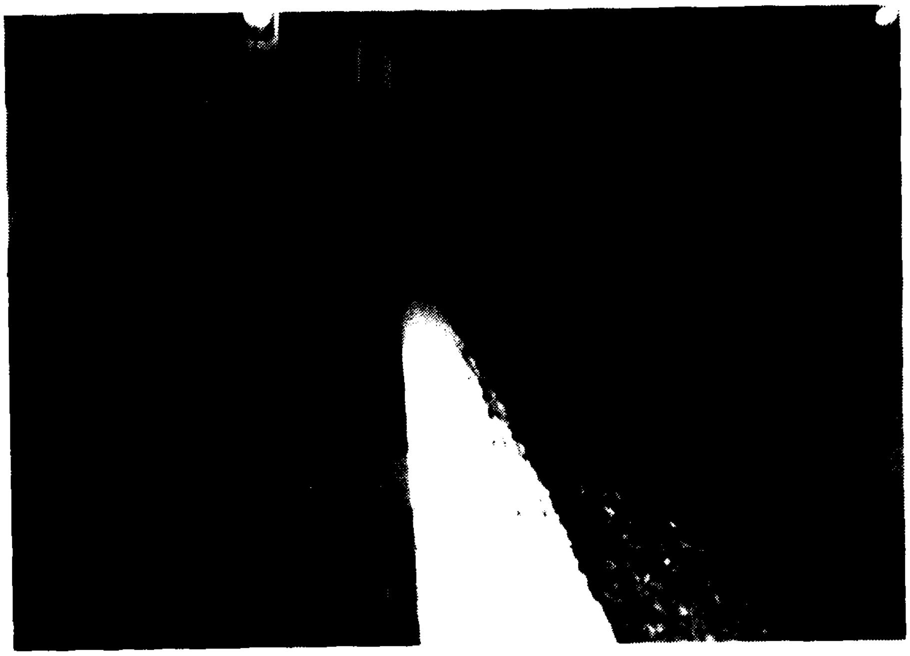


Figure 5. Fines and Dust at Intermediate Belt Transfer Point.

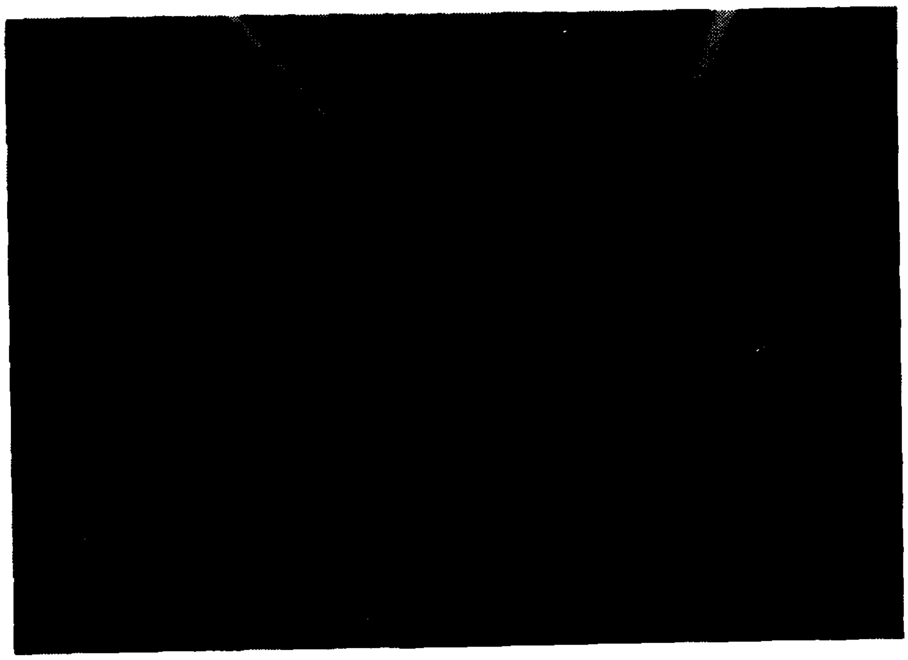


Figure 6. RDF Dust Covering Pile of Coal Dust Below Belt Transfer Point.

Figure 7. Relatively Dust-Free RDF on Intermediate Belt.

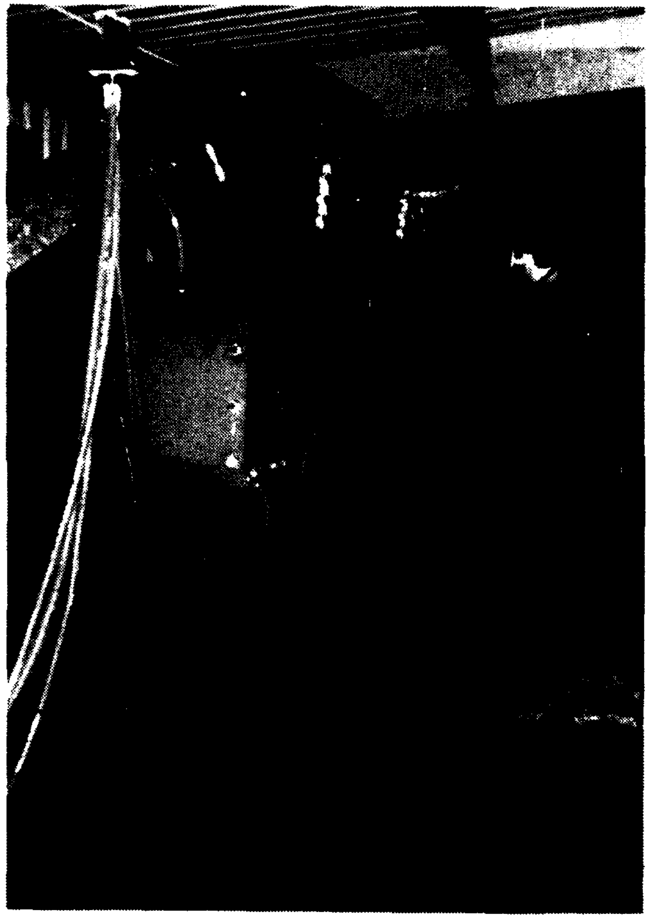


Figure 8. Appearance of RDF at Silo Drop Station.

A visual examination of the RDF was made before it was dumped from the truck and the quality appeared to be good (Figure 9). The quality control checker indicated the pellets were in good condition, but he had observed better shipments.

The second truck load was placed in open storage. The dumping operation created less dust than was expected, no more than experienced when unloading sand or crushed gravel (Figure 10). The unloading of both trucks and the transfer of fuel from the first truck to the top of the silo required approximately 1 hour. At the end of that period, both trucks departed the area. The effort to complete the unloading of the coal car had been temporarily abandoned.

Experience gained during the visit was valuable in understanding the working conditions associated with handling RDF. Dust and lint were very prevalent in the air near the truck unloading operation and at the lower level where the RDF was placed on the conveyor belt, but as the fuel moved toward the silo storage location, conditions improved. Dust and lint were definitely in the air, but to a lesser degree. No discomfort was experienced while witnessing the operation; however, the conditions differed from those experienced by the employees during a large portion of the year. High humidity can lead to the generation of odor and mold in the RDF residue. A hot humid day, light clothing, perspiration and fuel dust can combine to produce uncomfortable working conditions. Face masks, which are required for both coal and RDF dust-laden environments, meet respiratory needs; the remainder of the problem requires a strong housekeeping program. Manufacture of a pellet more resistant to degradation during handling and/or a reduction in the intensity of the handling environment are necessary steps in continued usage of RDF.

The measures in effect to provide the necessary health, safety, and fire protection require no change because of the use of RDF. As mentioned above, face masks are already required, and explosion-proof electrical wiring is required in critical areas because of the coal dust. Although somewhat irritating, the occasional occurrence of mold and odor have not been found to be a health problem. Even though the fuel is derived from a wide variety of refuse, there are no known reports of it having created a problem regarding pest and insect control.

e. Summary

From an operations viewpoint, the introduction of RDF into the boiler fuel system has not caused substantial impact on plant operations or manpower requirements. Difficulties encountered in handling RDF are consistent with those normally experienced in operation of a coal fired heating plant. On the day that Ultrasystems observed the RDF delivery, frozen coal was more of a concern than any of the problems caused by RDF. The dust problem, which could be reduced by less handling and transportation, appears not much greater for RDF than for coal. Utilization of RDF can apparently be integrated in the established operation of the heating plant on a business-as-usual basis.

Figure 9. RDF Quality, as Delivered.

Figure 10. RDF Dust Generated During Open Storage Unloading.

The problems that do exist with RDF would be reduced substantially if the RDF manufacturing plant were reasonably close to the heating plant. This would both reduce pellet degradation during transportation and allow relatively fresh pellets to be delivered and used, thereby further enhancing pellet integrity.

The housecleaning problem caused by the RDF use is also existent with coal use. Although the request for three temporary manpower spaces was accepted as a valid requirement for the purpose of meeting the impact, an across the board manpower survey should be conducted prior to establishing these as permanent spaces based only on RDF utilization.

4. PROCUREMENT

a. General

Initiation of the coal/RDF test firing program did result in an increased workload for members of the Contracting Division of the 2750th Air Base Wing. Preparation of the request for proposal (RFP), writing the contract, evaluation of the proposal, and the subsequent administration of the contract involved an effort of approximately 1 1/2 man-years as shown in the manpower Section of this report.

b. Contract Award and Administration

Procurement of the RDF was not as routine as originally anticipated. This was due primarily to it being the first major procurement of this type fuel by government; specifications for the fuel were nonexistent and had to be developed. Also, some of the contract conditions for a new product were rather difficult to resolve; initial deliveries of RDF were desired by December 1978 and the RFP was not officially released until October 1978. The government requested a 10-year contract with limited deliveries during the first 3 years and large quantities during the remainder of the period. The early delivery requirements left little time to build even small plant production facilities and, further, the wide variation of delivery rates would have resulted in a very slow capital recovery rate on the investment. These two factors undoubtedly contributed significantly to the fact that no proposals were received when the procurement was advertised. After the RFP was revised to reflect different product delivery dates and rates, several proposals were received and a contract awarded to Teledyne National on 2 March 1979.

Although awarding the contract presented an unexpected challenge and workload for the project manager and members of the 2750th Contracting Division, the task was efficiently performed within the framework of normal duties. No major deficiencies in the contract have become apparent and its administration has been relatively simple, requiring only the usual amount of effort.

At least in the short term, procurements of RDF should not be centrally managed as with coal at DFSC. Rather, the procurements of RDF should continue to be the responsibility of the local Contracts Division, because this type fuel is not compatible with routine and repetitive procurement action. Different RDF manufacturing plants will produce fuel with different specifications, because the refuse contents will vary from location to location. Seasonal changes in refuse composition will also cause product contents to vary at different plants. Initial specifications should be developed with a general knowledge of the local plant's refuse content and then refined as burning experience is accrued. The WPAFB RDF study should be considered in similar projects, as well as future RDF contracts at WPAFB.

To date, the Teledyne National RDF facility at Cockeysville, Maryland, appears to have performed satisfactorily and is responsive to the developmental nature of the project. Scheduled delivery dates have been met with variations accommodated as requested by the government. Rail shipments have been virtually discontinued in favor of trucking for reasons described in the Operations Section of this report.

Teledyne National has, however, experienced some difficulty in meeting product specifications, primarily in the acceptable moisture content and percentage of fines areas. Early shipments were particularly off specification and several handling problems were experienced. Followup information about these problems from WPAFB has resulted in improved quality control of Teledyne's recent shipments.

c. Summary

The . iting of the initial specifications for a previously undefined fuel commodity was a formidable task. The initial solicitation process and the subsequent contract awarding also took extraordinary effort. Nevertheless, the monitoring of the contract by the contract administration personnel fell within the functional responsibilities of the Division, their expected workload, and the job description of the persons involved. Accordingly, the impact of this activity was absorbed into the business of the Division.

5. MANPOWER

a. General

In other portions of this report the functions and responsibilities of all organizational elements involved in the RDF program have been discussed. This section quantifies the impact of that involvement and provides an approximation of its direct cost in terms of salaries.

b. Functional Support

An identification by function and organization of the manpower effort actually expended in support of the program is reflected in Table 1. The organizational element is identified, followed by the function or type of support provided, the grade level of the individual on the project during its first year, and an estimate of the man-years provided during the second year.

Impact has been relatively small. The total effort expended during the first year of the program was 5.6 man-years. This figure dropped to 4.0 for

TABLE 1. MANPOWER IMPACT OF RDF TESTING AT WPAFB

Organization	Function	Grade Level	Manpower Impact 1st Year Man Yrs.	1st Year Cost($)	2nd Year Man Yrs.	2nd Year Cost($)
HQ, AFLC	Staff Engineer	GS-13	.25	9,000		
2750th Air Base Wing	Contracting (Buyer)	GS-11	1.0	26,000		
Contracting Division	Contract Admin. (Pricing)	GS-11	0.25	6,500	0.25	6,500
		GS-12	0.25	7,000		
2750th Civil Engineering Squadron	Financial Management	GS-9	0.10	2,000		
	Project Manager	GS-13	0.75	27,000	0.75	27,000
	Laborer (Housekeeper)	WG-3	3.00	53,000	3.00	53,000
TOTAL			5.60	130,500	4.00	86,500

the second year, because the effort to award the RDF contract (staff engineer, pricing, and buyer) was no longer necessary. For purposes of this analysis, the program is considered to have started with the activity required to award the contract for RDF pellets -- August 1976.

At the conclusion of the test, if a decision is made to include RDF as a co-fired fuel with coal on a regular basis, the only permanent manpower impact would be the three Wage Grade positions to handle the increased housekeeping task. To date, permanent manpower increases have not been approved and the work is being performed by temporary employees. The requirement for the project manager would terminate with the conclusion of the test program and the function of contract administration would be easily absorbed by existing personnel.

Care should be exercised in applying these manpower data as a measure for estimating the impact that might be experienced at another Air Force Station. The WPAFB has, to date, been primarily concerned with a test program, not just the implementation of RDF in the central heating fuel supply. The initial contracting for RDF was also a challenging task that should be performed in the future with little difficulty. The type of equipment in facility heating plants can vary widely between Air Force Bases.

c. Cost

Other than procurement and transportation of the pellets, very little cost is associated with the RDF test program at WPAFB. Possible unidentified individual efforts and expenditures have not been noted during the study, but they are believed to be small.

The cost of the manpower support described in Table 1 for the first years' operation is estimated at just over $130,000. This figure is based on the assumption that each individual was being paid at approximately the mid-point in his grade level. Wages of three WG-3 housekeeping employees require about 40 percent of the above total.

Except for the three housekeeping employees, no additional personnel were hired to perform the tasks outlined in Table 1. The inherent elasticity of the personnel system, particularly in the Contracting Division and the 2750th Civil Engineering Squadron Staff, can absorb the additional and/or redirected workload. At the staff level, new programs are continually developing and managing these is frequently a matter of ordering priorities and redirecting effort.

No RDF specialized equipment or facility modification costs have been addressed in this report, because none of significance were identified. Both boiler plants (Building Nos. 770 and 1240) have undergone extensive upgrading which has contributed to the successful use of RDF, but these costs cannot be attributed to the RDF program. Additionally, if long term use of RDF is contemplated, modifications to the existing system would be appropriate, but they have not been considered in this study.

SECTION III

COMMERCIAL-INDUSTRIAL TYPE ACTIVITY (CITA) APPLICATION

1. GENERAL

The Office of Management and Budget (OMB) Circular No. A-76 establishes the policies and procedures used to determine if government needed commercial or industrial type work should be performed by contract with the private sector or in-house using government facilities and personnel. Attachment A to the Circular lists examples of the commercial or industrial type activities that should be reviewed. Under the heading of "Other Services" the attachment identifies "Operations of Utility Systems (Power, Gas, Water, Steam, and Sewage)" as activities for review.

This portion of the report is concerned with the examination of OMB Circular A-76 and an assessment of whether the RDF utility at WPAFB lends itself for consideration as a Commercial-Industrial Type Activity (CITA) as described in the Circular. Management considerations unique to the possible operation of the RDF utilities by contract personnel are also discussed.

2. THE OMB CIRCULAR NO. A-76 EVALUATION PROCESS

Before examining the specifics of the WPAFB facility, the review process required by OMB Circular No. A-76 should be discussed.

The Circular requires that each governmental agency designate an official at the Assistant Secretary or equivalent level, and officials at the major component level to have the overall responsibility for its implementation. These focal points are now established and the bulk of the activity required to administer the policy is performed by designated staff elements. Department of Defense Instructions (DODI) 4100.33, "Operation of Commercial and Industrial Type Activity," and 4100.15, "CITA," are both implementing documents for OMB Circular A-76.

Although there are some small variations in the way each military component performs its tasks, the process followed is generally the same. Since the heating facilities are in the category of "Existing Government Activity," only the procedures pertaining to that type activity will be discussed.

At designated levels within the component, an inventory is compiled of all activities subject to Circular No. A-76. The functions of each is recorded, along with the historical information related to it being performed in-house. The complete list of data on the functions is transmitted to the component headquarters staff, where it is often used in the decision-making process regarding manpower and resource utilization. A continuous review cycle is established which provides for each activity being examined once every 5 years.

Figure 11 shows the general sequence of events from development of the list of governmental functions to the final decision to continue the in-house governmental activity or award a contract to the private sector. The sequence discussed below is applicable to a government-operated activity like the WPAFB central heating plant facility.

The purpose of the first step is to determine if government performance of the activity is in accord with the policy expressed in Circular No. A-76. If the answer is yes, it will remain an in-house activity. If it is no and the annual cost is more than $100,000, the activity will be added to the inventory schedule for review and possible cost analysis. The item is then closely examined for the role it plays in national defense; if it is not considered critical, a determination is made regarding the availability of a satisfactory source for the required service or product in the private sector. A cost analysis is then conducted as specified in the "Cost Comparison Handbook, Supplement 1 to OMB Circular No. A-76." The cost experienced by the government is compared with that involved in contracting with a private source. The Circular states that an existing in-house activity will not be converted to contract performance on the basis of economy alone, unless it will result in savings of at least 10 percent of the estimated government personnel costs for the period of the comparative analysis.

If the annual cost of an existing government activity is determined to be less than $100,000 (Figure 11), Circular No. A-76 states that agencies should not incur the expense and delay of conducting a cost comparison study, but should contract for the activities, unless national defense is impacted or a suitable commercial source is not available. However, even if a commercial source is available, if it is believed that inadequate competition or other factors are causing commercial prices to be unreasonable, a cost study still may be conducted.

3. APPLICABILITY OF OMB CIRCULAR NO. A-76 TO WPAFB CENTRAL HEATING PLANT

This portion of the study involved discussions with individuals familiar with all aspects of the Circular, the comparative cost analysis, the evaluations made regarding military readiness, and the availability of private contractors to provide the required services and products. Such reviews are conducted in a thorough manner and several former government activities have been moved to the private sector. The operation of utility systems, which will undoubtedly include the central heating systems at WPAFB, will be reviewed by the Air Force Management Engineering Agency at Randolph AFB, Texas, during 1984. Comparative cost analyses will be performed on the selected activities approximately two years later.

From Ultrasystems' cursory review of the WPAFB facility, it appears that the results of a comparative cost analysis would probably be the deciding factor in continuation of in-house governmental operation of the facility. In-house performance of this heating operation does not appear to be mandatory in support of national defense. The Air Force hospital is probably the most critical function that would be affected if the operation of the heating plant were interrupted. The hospital has a standby heating capability for the surgical area; however, the capacity is insufficient for indefinite operation

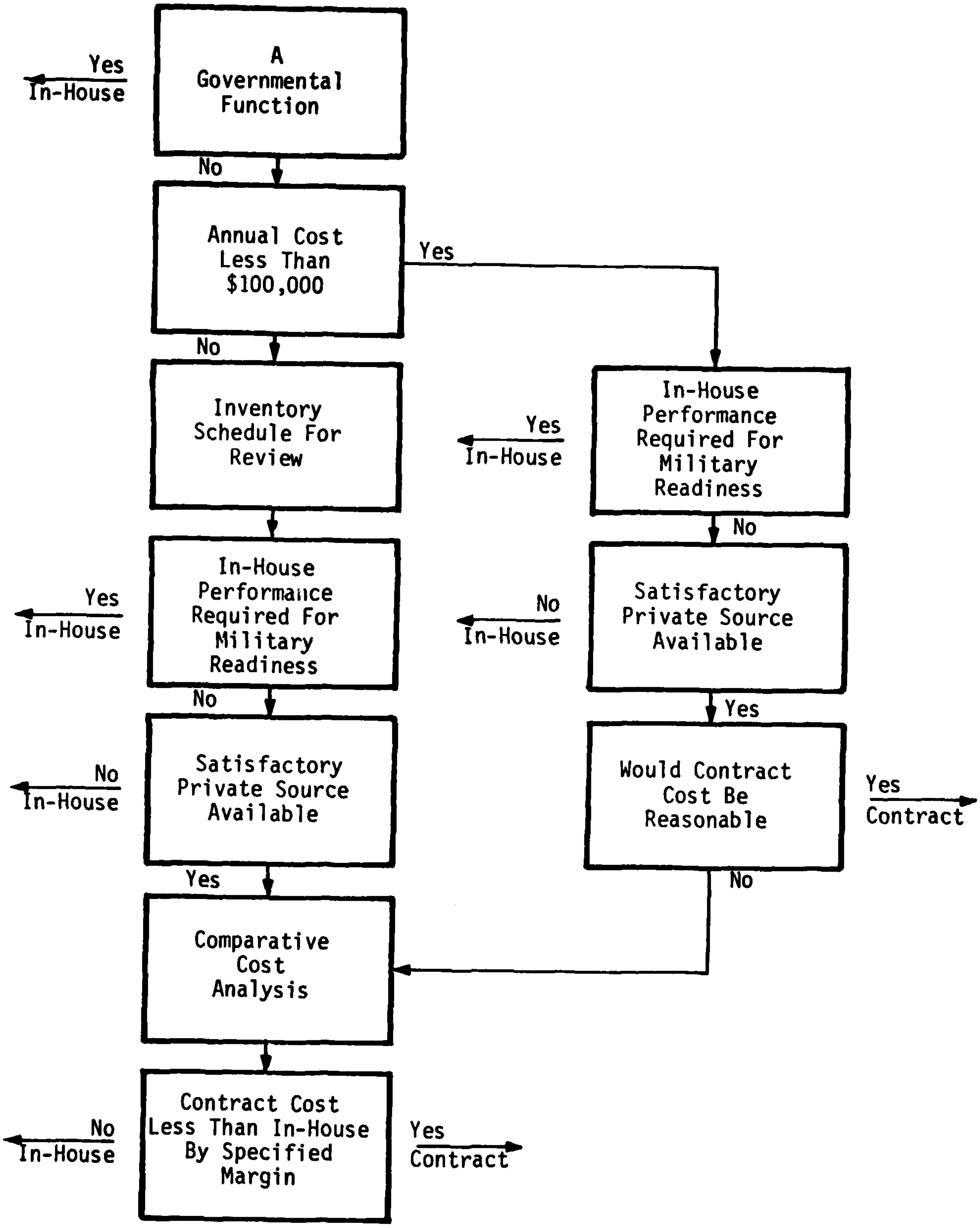


Figure 11. Flow Chart: OMB Circular No. A-76 Evaluation of Existing Government Activity.

in cold weather. If a strike were experienced, there would probably be sufficient warning to form local emergency crews and operate the plant without great difficulty. In times of national emergency, the impact of strike action would not seriously limit the capability of the base. Maintenance areas and offices would be without heat, as would some homes, but others are served by individual heating facilities and critical operations could be consolidated in them. It would be inconvenient, but the installation could continue to operate until normalcy could be restored.

Regarding the availability of commercial sources to operate the heating plants, there is little doubt that several such companies exist in the Dayton, Ohio area. Many large buildings in the vicinity are heated with steam from centralized heating facilities, which are quite possibly operated under contract.

If a decision is made to continue co-firing operations with RDF on a permanent basis, it should have no effect on the outcome of a review of this facility. RDF use introduces no technical complexities or difficult techniques into the operation of the systems. The findings of a comparative cost analysis would probably affect the outcome of a review more than any other factor.

4. MANAGEMENT CONSIDERATIONS

Replacement of the government in-house capability to operate the central heating plants at WPAFB with contract operation does involve management actions unique to transfer of functions and responsibility, but no major difficulty is foreseen.

Circular No. A-76 requires that contracts awarded as a result of the reviews shall contain all applicable clauses and provisions related to equal employment opportunities, veteran's preference, minimal wages, and fringe benefits. They shall also include a provision that the contractor give Federal employees, displaced as a result of the conversion to contract performance, the right of first refusal for employment openings on the contract in positions for which they are qualified.

Other management issues and questions related to a government-owned, contractor-operated (GOCO) type operation are associated with contract provisions, contract administration, and assurance of compliance with the contract. These management concerns must be dealt with on an individual basis; however, at this time it appears the WPAFB heating facilities can be operated by either the government or by contract without major difficulty.

SECTION IV

SUMMARY AND CONCLUSIONS

1. GENERAL

The impact of specifying, procuring, using, and monitoring the use of refuse-derived fuel (RDF) on the organizational structure, and the operations and management activities of Wright-Patterson Air Force Base has been discussed. This section provides a summary of this discussion and makes a statement as to the overall impact of the RDF program. An assessment of the applicability of CITA to the operation of the RDF utility at WPAFB is also discussed.

2. IMPACT OF THE REFUSE DERIVED FUEL PROGRAM

a. Organization and Management

The organizational structure of the Air Force Logistics Command and the 2750th Air Base Wing was clearly able to assimilate the impact of the RDF program. The management of the program followed well established lines of authority with the operational responsibility resting on the commander of the 2750th Civil Engineering Squadron. Supportive staff action was provided at all necessary levels.

b. Operations

In the area of operations there were some growing pains associated with doing something for the first time. Materials handling systems were initially inadequate to receive and store the RDF product. However, once early problems were solved and the project moved to the Building No. 1240 plant, operations smoothed out considerably. The latter environment is assessed here.

From an operational aspect the one impact area that was identified is the additional housecleaning requirement brought about because of the dust and fines in the RDF product. Though identified and highlighted here, this condition can be reduced by decreasing the hauling distance, improving handling procedures, and providing dust removal equipment in the material receiving area. The immediate solution supported here is to increase the housecleaning duties of the operating personnel.

c. Procurement

The greatest challenge to the successful operation of this project was in the procurement area. Major problems were solved before the first RDF pellet arrived. The "first time" syndrome applied here as in other aspects of the project; nevertheless, the people involved were professionally capable and functionally responsible for performing the various tasks included in the procurement of the RDF product and did so within the framework of expected activities. Although several people in the Contracting Division were involved in this task from time to time, this program did not constitute an extraordinary impact.

d. Manpower and Cost

Included in this area is a tabulation of dedicated time and resulting salaries of persons who participated in this program. To say that these figures constitute program costs is misleading. Except for the three wage grade employees hired to perform housekeeping chores in the heating plant, no one worked outside of his defined functional responsibilities nor neglected normal tasks. The man-hour and salary figures do serve, however, to describe the level of effort required at WPAFB to conduct the RDF program. Accordingly, these figures can be used by others to assess the impact that might be expected if a similar program were carried out at another base. It must be realized, however, that much can be gained from the work performed by the WPAFB personnel.

e. Project Manager

The one functional aspect of the RDF project that deviates from the normal activity of the WPAFB personnel involved the project manager. The exploratory and dynamic nature of the project, combined with the high level interest and long range implications of the effort, required an individual on virtually a full time basis. Should it be decided to introduce RDF at other Air Force installations with coal-fired central heating or power facilities, availability of the lessons learned at WPAFB could reduce or possibly eliminate the requirement for a full-time project manager.

3. ASSESSMENT OF THE APPLICABILITY OF CITA TO THE OPERATION OF THE RDF UTILITY AT WPAFB

The Office of Management and Budget (OMB) Circular No. A-76 is clear in its identification of utility systems as example of the type of activity that must be reviewed for contractor operation. Review of Air Force procedures and a cursory assessment of conditions at WPAFB indicates that no critical circumstances would preemptively eliminate the heating plants from full review procedures. The probable deciding factor in continuation of in-house governmental operation of the facility will be the result of a comparative cost analysis. Central heating systems, in general, are scheduled for review in FY 84-87.

4. CONCLUSIONS

This study has shown that the impact of specifying, procuring, using, and monitoring refuse-derived fuel (RDF) on the organizational structure and the operations and management activities of Wright-Patterson Air Force Base has been generally minimal and essentially absorbed into the various ongoing functional activities. However, the project manager devoted over 75 percent of his time to the program since it started and additional housecleaning personnel were assigned to the operating staff to remove the dust and debris resulting from the RDF. The research and development nature of this particular activity contributes to the necessity of having a project manager

SECTION IV

SUMMARY AND CONCLUSIONS

1. GENERAL

The impact of specifying, procuring, using, and monitoring the use of refuse-derived fuel (RDF) on the organizational structure, and the operations and management activities of Wright-Patterson Air Force Base has been discussed. This section provides a summary of this discussion and makes a statement as to the overall impact of the RDF program. An assessment of the applicability of CITA to the operation of the RDF utility at WPAFB is also discussed.

2. IMPACT OF THE REFUSE DERIVED FUEL PROGRAM

a. Organization and Management

The organizational structure of the Air Force Logistics Command and the 2750th Air Base Wing was clearly able to assimilate the impact of the RDF program. The management of the program followed well established lines of authority with the operational responsibility resting on the commander of the 2750th Civil Engineering Squadron. Supportive staff action was provided at all necessary levels.

b. Operations

In the area of operations there were some growing pains associated with doing something for the first time. Materials handling systems were initially inadequate to receive and store the RDF product. However, once early problems were solved and the project moved to the Building No. 1240 plant, operations smoothed out considerably. The latter environment is assessed here.

From an operational aspect the one impact area that was identified is the additional housecleaning requirement brought about because of the dust and fines in the RDF product. Though identified and highlighted here, this condition can be reduced by decreasing the hauling distance, improving handling procedures, and providing dust removal equipment in the material receiving area. The immediate solution supported here is to increase the housecleaning duties of the operating personnel.

c. Procurement

The greatest challenge to the successful operation of this project was in the procurement area. Major problems were solved before the first RDF pellet arrived. The "first time" syndrome applied here as in other aspects of the project; nevertheless, the people involved were professionally capable and functionally responsible for performing the various tasks included in the procurement of the RDF product and did so within the framework of expected activities. Although several people in the Contracting Division were involved in this task from time to time, this program did not constitute an extraordinary impact.

d. Manpower and Cost

Included in this area is a tabulation of dedicated time and resulting salaries of persons who participated in this program. To say that these figures constitute program costs is misleading. Except for the three wage grade employees hired to perform housekeeping chores in the heating plant, no one worked outside of his defined functional responsibilities nor neglected normal tasks. The man-hour and salary figures do serve, however, to describe the level of effort required at WPAFB to conduct the RDF program. Accordingly, these figures can be used by others to assess the impact that might be expected if a similar program were carried out at another base. It must be realized, however, that much can be gained from the work performed by the WPAFB personnel.

e. Project Manager

The one functional aspect of the RDF project that deviates from the normal activity of the WPAFB personnel involved the project manager. The exploratory and dynamic nature of the project, combined with the high level interest and long range implications of the effort, required an individual on virtually a full time basis. Should it be decided to introduce RDF at other Air Force installations with coal-fired central heating or power facilities, availability of the lessons learned at WPAFB could reduce or possibly eliminate the requirement for a full-time project manager.

3. ASSESSMENT OF THE APPLICABILITY OF CITA TO THE OPERATION OF THE RDF UTILITY AT WPAFB

The Office of Management and Budget (OMB) Circular No. A-76 is clear in its identification of utility systems as an example of the type of activity that must be reviewed for contractor operation. Review of Air Force procedures and a cursory assessment of conditions at WPAFB indicates that no critical circumstances would preemptively eliminate the heating plants from full review procedures. The probable deciding factor in continuation of in-house governmental operation of the facility will be the result of a comparative cost analysis. Central heating systems, in general, are scheduled for review in FY 84-87.

4. CONCLUSIONS

This study has shown that the impact of specifying, procuring, using, and monitoring refuse-derived fuel (RDF) on the organizational structure and the operations and management activities of Wright-Patterson Air Force Base has been generally minimal and essentially absorbed into the various ongoing functional activities. However, the project manager devoted over 75 percent of his time to the program since it started and additional housecleaning personnel were assigned to the operating staff to remove the dust and debris resulting from the RDF. The research and development nature of this particular activity contributes to the necessity of having a project manager with time to keep the program on track and interested persons informed as to its progress. Whether this impact would be reflected in follow-on implementation programs is problematic and dependent upon how the program is viewed locally, the need for further R&D, and the visibility required or desired.

The level of effort dedicated to this project was 5.6 man-years the first year and is expected to be 4.0 man-years the second year. The associated salary costs are $130,000 and $86,500, respectively. This is not to be construed as a cost specifically applied to this project, because most of the people involved were performing their normal tasks. Rather, this should be taken as a level of effort indicator in the planning of follow-on projects and this planning should consider findings of the WPAFB project.

An assessment of the applicability of CITA to the operation of the RDF facility at WPAFB indicates that this and other Air Force central heating plants will be reviewed for possible contract operation in FY 1984. Investigation for this study has identified no critical factors that would preemptively eliminate the WPAFB RDF facility from full review procedures. The probable deciding factor in continuation of governmental operation of the facility will be the results of the comparative cost analysis.

REFERENCES

1. "Baltimore Tries Squeezing Out RDF Profits," Waste Age, Washington, D.C., May 1980.

2. Bounicore, A. J., and Waltz, J. P. District Heating with Refuse-Derived Fuel at Wright-Patterson Air Force Base, Dayton, Ohio, Sept. 1975.

3. Hathaway, S. A. Air Force Research in Solid Waste Resource Recovery, HQ, Air Force Engineering and Services Center, Tyndall Air Force Base, Fl., Washington, D.C.: ASME 9th Biennial Waste Processing Conference, 12 March 1980.

4. Hathaway, S. A., et al., Densified Biomass as an Alternative Army Heating and Power Plant Fuel, TR E-158. Champaign, Il.: Construction Engineering Laboratory, March 1980.

5. Kirklin, D. R., et al., Test Procedures for the Determination of the Gross Calorific Value of Refuse and Refuse-Derived-Fuels by Oxygen Bomb Calorimetry: Summary of the 1977 Fiscal Year Results, National Bureau of Standards, NBSIR 78-1494, Washington, D.C., December 1978.

6. Kirklin, D. R., et al., Determination of the Calorific Value of Refuse-Derived-Fuels by Large-Bomb Calorimetry Summary of 1978 Fiscal Year Results, National Bureau of Standards, NBSIR 80-1968. Washington, D.C., January 1980.

APPENDIX A

WASTE AGE ARTICLE ABOUT THE TELEDYNE NATIONAL PLANT

(May 1980, p.10; reprinted with permission)

Baltimore Tries Squeezing Out RDF Profits

Conventional wisdom has it that you don't change horses in midstream. But that's exactly what Baltimore County, Md. did with its resource recovery facility.

Nearly a decade ago, Baltimore County public works officials realized they had a problem—an impending landfill shortage. In order to stretch landfill space to its maximum, the county, with the help of Maryland Environmental Service (MES) decided to construct a prelandfill shredder/transfer facility. And they decided that the facility also would have potential for demonstrating resource recovery processes.

"At that time," recalls Michael Long, Chief of Administrative Services for MES, "we believed resource recovery would mean primarily an effort to reclaim solid materials. Of course, that changed after the Arab oil embargo in 1973. The emphasis shifted to recovering energy."

And so, the county and MES awarded a contract to Teledyne National to design, construct, and operate the facility, which was built at the base of the Texas Landfill in Cockeysville. The plant cost $8.4 million to construct, a sum which was evenly split between the county and MES.

In January 1976, the first trucks laden with solid waste drove up to the beige and blue corrugated steel buildings to deposit their cargo for shredding and steel can recovery. In the next four years, the plant would become a laboratory devoted to finding ways of using refuse-derived fuel.

Baltimore County, which does not include the city of Baltimore, has a population of approximately 700,000 people located in an area of 610 square miles. The county generates about 2,000 tons of garbage each day, approximately 800 of which are processed at the resource recovery facility. However, when a county landfill was closed down last summer during a labor dispute, the facility processed more than 1,200 tpd without a hitch. And Teledyne officials say it could process up to 1,500 tpd in the future.

Refuse is trucked in by private haulers who have been contracted by the county. Most of these private trucks are 20-yard Leach Packers, although a number of vehicles by Heil, Garwood, and Truxmore also are in use. Nearly 300 tpd arrive via the county-owned Southwestern Transfer Station, some 24 miles away. There, refuse is compacted into Heil 65 cubic yard trailers owned by the state and transported to Cockeysville. The use of the transfer station guarantees reductions in road traffic, fuel consumption, and vehicle maintenance, as well as providing increased time for the local collectors to service their routes.

The trucks enter the plant site at Cockeysville on a one-way road which encircles the buildings. First stop is the weighing station where two automated scales and a computer keep daily records of the amount of incoming waste. The county charges no tipping fee for disposal of residential garbage.

The trucks proceed to one of seven bays where they back over either a stationary bridge or one of two movable bridges which lead to the edge of the four receiving pits. The trucks empty their contents into these "push pits," or if all are filled, there is a large storage pit in front which can hold approximately 350 tons of refuse at a time. An overhead traveling crane can move the length of the storage pit and transfer garbage into the push pits with a five-cubic-yard grapple.

Two control pods look down over the receiving area. From these pods, operators direct the movement of the bridges and the trucks by speaking to floor workers below through two-way radios. By moving the two bridges laterally, the operators determine into which pit the refuse will be unloaded.

Through a control console, the pod operators set the hydraulic rams inside the push pits in motion. These rams move the refuse onto the two hinged, variable-speed conveyors for transport to the shredders. They also control a small grapple crane which can remove items from the conveyors that could damage the system, such as engine blocks or potential explosives. In addition, most of the processing line is under the watchful eye of closed-circuit TV cameras, thus allowing the operators to monitor the system via video screens.

The system consists of two separate shredder lines which can be run simultaneously, depending on the refuse load. Garbage is transported by conveyor from the push pits to the two Tracor Marksman 1000 horsepower horizontal shaft hammermills where it is pulverized at a rate of up to 65 tons per hour. (Baltimore County was the first plant in the U.S. to employ Tracor Marksman shredders). Ninety-five percent of the waste emerges from the shredders in particles four inches or smaller.

Each of the shredders is equipped with a Fenwal explosion suppression system. When sensors inside the shredders detect a pressure build-up (which occurs just prior to an explosion), the Fenwal system releases a cloud of Halon gas to extinguish the potential explosion at this stage.

Unfortunately, residents of the county occasionally dump into the trash those wonderful objects that can't be detected by explosion prevention systems. In January 1977, someone apparently dumped a crate of aerosol cans into the trash. When it went through a shredder it detonated, spreading fire along the shredded refuse which was moving along a conveyor. While no structural damage to the building resulted, some sheet metal was blown off

Sophisticated electronics monitor all facets of the plant's operation.

the roof and side walls and damage was sustained to the conveyor dust covers and rubber belting. The plant was down for all of four days to undergo repairs. Incidentally, those four days are the only days of downtime the complete facility has experienced in four years of operation.

After that explosion, the shredders were modified to further ensure that explosions would be channeled upwards, thus minimizing damage to the plant. Subsequent explosions have proven the modifications successful.

After shredding, the garbage moves up an inclined conveyor to the ferrous tower inside the main building. Here, two Dings "hockey stick" magnets (one on each line) clang merrily away as they pull out steel cans, wire and practically everything else made of iron or steel. In fact, Baltimore County reports that they are separating 95% of the ferrous component. The scrap is deposited on another conveyor after separation and dropped off into Steco 65-cubic-yard open top transfer trucks. When a truck is filled with ferrous, the shredding line is shut off, the truck pulls out, and is then replaced by an empty one.

The iron and steel is taken to United Iron and Metal Company, a local scrap dealer, for baling, and the bales are hauled to Bethlehem Steel's nearby Sparrows Point plant, where they are used as feedstock in the manufacturing of new steel in open hearth furnaces. Nearly 25 tpd of ferrous scrap are being recovered and sold. Jim Ferrigan of Bethlehem's purchasing department reports that the scrap has performed well despite the fact that it is not detinned before remelting.

The refuse, now ferrous-free, is transferred to the RDF building via conveyor, where it will either be compacted into trucks to be transported to the Parkton Sanitary Landfill, or, if RDF is to be produced, it will go through air classification. "Our original air classifier did not yield a good split between lights and heavies," notes Ken Cramer, Associate Program Manager for Teledyne. "So our engineers designed their own, which has given us the split we need."

The heavy fraction, mostly glass and non-ferrous metals, passes through a secondary separation and recovery (SSR) trommel which was also adapted for the plant by Teledyne engineers. The trommel is ten feet in diameter with one-inch holes at the front to allow glass particles to fall through, while the aluminum particles move to the trommel rear and fall through four-inch holes.

The glass "unders" fall through onto a Triple/S air table where they are separated from any stones or remaining organics on the basis of specific gravity and shape. The air table is perforated with small holes and as it vibrates, compressed air is blown up through the holes, causing the material to separate. The heavier glass particles move to one end of the table and the lighter residue goes to the other. Then each segment falls into a separate chute and is collected below.

In February 1980, the Maryland Environmental Service announced that Teledyne National had secured a contract for the Texas facility's recovered glass. The customer is Owens-Corning Fiberglas

Project manager Bob Kramer in front of the RDF extruder.

Corporation, and the company has agreed to purchase up to 15,000 tons per year at $18.75 per ton, FOB Cockeysville. Shipments of the glass cullet, which will be used in the production of fiberglass for thermal insulation, began in April.

An additional benefit of the sale of recovered glass is that it will now be economical to operate the eddy current separator to reclaim aluminum. "Our aluminum has already been tested by a number of companies, and they've shown strong interest in purchasing it," says Cramer.

Meanwhile, the "lights" that come out of air classification are refined by passing them through a 12-foot diameter trommel built by Triple/S Dynamics. Fines and residues less than 1½ inch fall through the holes, improving the quality of the RDF which continues on through. But the fuelmaking process isn't over yet.

The fuel is further reduced in size by running it through a Williams shredder, which handles 25 tons per hour. This secondary shredding yields a finely shredded material, 95% of which is less than one inch in particle size. The result is non-densified RDF, or fluff. If fluff is what the customer wants, then the product is transported in compactor trucks. But the folks at Baltimore County have added an additional step in order to open up some new markets: pelletization.

Studies performed at the National Center for Resource Recovery's Washington, D.C. test plant found that RDF pellets offered several important advantages over fluff. First, pellets will store for a much longer period of time. "If you store fluff for longer than ten days, you wind up with a compost heap," notes Cramer. Baltimore County had not been able to locate a steady fuel customer in the neighborhood, so they began to look elsewhere. Therefore, RDF pelletization seemed a logical route to take, since it is easier to handle than fluff, increases storage life, and greatly enhances transportation capabilities.

And in late 1979, a customer was located. It was none other than the United States Air Force, which began buying about 25 tpd of pellets to be burned with coal at the Wright-Peterson base near Dayton, Ohio. The Air Force pays $27/ton FOB Cockeysville.

The manufacturing of the pellets is quite a unique process. Fluff is fed into either of two pelletizing machines, the front of which looks like flattened bathospheres. Inside, the fluff is heated to a temperature of 300-350 degrees F. and then extruded through hundreds of cylindrical dies. The internal heat of the machines sterilizes the pellets and increases their storage capabilities by eliminating the likelihood of mildew. Densified RDF pellets emerge through a chute onto a conveyor and are carried off to a bin. One of the machines is made by California Pellet Mill, the other by Sprout-Waldron. At this time, they are performing equally well.

The pellets are stored in a nearby warehouse and are shipped as required by Wright-Peterson. The stoker-fed boilers in which they are co-fired with coal provide steam to heat the buildings on the base.

The pellets have a minimum heating value of 6,000 btu's per pound, nearly one-half of the btu value of eastern coal. Ash content runs at about 10-12%, with moisture content ranging from 10-20%, depending on the season.

In the quest to find markets for RDF, the county, MES and Teledyne have experimented with the product in a number of different test situations. Consider these for starters:

- The fluff has been used as an organic component in a fiber mulch used for land seeding, with some success.
- In cooperation with the Department of Agriculture, RDF is being mixed with sewage sludge to form a compost at a testing station in Beltsville, Maryland. The use of RDF reduces the concentration of heavy metals in the compost.
- An oil company is interested in testing RDF as a feed stock for the production of ethanol, which can be used to produce gasohol.
- RDF pellets have been test-burned at the Maryland Correctional Institution with coal on a traveling grate. The tests found that the use of the pellets actually increased the combustion efficiency of the coal in the mixture.

A Dings magnetic separator pulls ferrous metals—primarily tin cans—from the waste stream.

■ RDF pellets were supplied to the Department of Energy (DOE) for a test program that was conducted in Erie, Pa. in a stoker-fed boiler at the General Electric facility.

But here are the two most promising developments:

A 22-day test burn using Baltimore County's fluff was conducted in late 1979 at the Lehigh Portland Cement plant. During the tests, fluff replaced 30% of the coal burned in a cement kiln. Thomas D. McKewen, director of the Maryland Environmental Service notes, "Cement kilns are an ideal way to burn RDF because the residual ash of the fuel becomes part of the cement." Discussions are now in progress to consider whether the cement plant can use the fuel on a regular basis, and if so, in what quantities.

But what may eventually lead to a bigger breakthrough came in early 1980 when the EPA granted Baltimore Gas & Electric Co. preliminary approval to test burn coal and RDF for a four-month period which will begin sometime in the spring. The utility intends to burn the RDF fluff at its Crane power plant in eastern Baltimore County. The Crane plant currently burns oil to generate electricity. But the utility expects to receive an order from the Department of Energy in the near future to convert from oil to coal. It was originally designed to burn coal, but was converted to oil in the early 1970s to reduce air pollution.

With the imminent switchover to coal, RDF becomes a potentially important factor in the effort to limit air pollution. Most of the coal that the utility will burn will be eastern coal, which has a high sulfur content. RDF has a lower sulfur content (.2 percent vs. 1.5 - 2.5 percent) and will be useful in reducing sulfur emissions.

According to a Baltimore Gas & Electric engineer, the utility hopes to eventually mix 65 tons of coal with 7 tons of RDF per hour of operation. However, at the start of the test burn, coal will be mixed with RDF at a ratio of 98-to-2. Gradually, the amount of RDF will be increased, with a 90-to-10 ratio as the desired goal.

If that goal is attained, the utility would be using most of the RDF now produced at the Baltimore County plant. Ken Cramer is quick to point out that the plant could produce a lot more of the fuel, if and when the demand occurs. In fact, the plant could install a third shredder line if necessary.

At the current time, however, about 90% of the incoming waste is landfilled after shredding and ferrous recovery. Charles Farley, Baltimore County's chief of the Bureau of Sanitation, points out that this is exactly what the system was designed to do. "By shredding much of the county's refuse, we're significantly increasing the lives of our landfills," he says. Teledyne officials estimate that the plant has resulted in a 20% reduction in the use of landfill space.

Meanwhile, the county and MES are going ahead with plans to develop a possible second resource recovery facility in the eastern section of the county. This plant, if constructed, would either generate electricity from the burning of RDF in on-site dedicated boilers which would power turbines; or it would sell the RDF directly to Baltimore Gas & Electric for use in its own boilers (which depend on the success of this spring's test burn).

But that's at least a few years away. As for finding additional markets for RDF produced at the existing Baltimore County plant, Ken Cramer remains optimistic. "Four years ago, nobody would talk to us. Now we have a lot of people calling us to ask questions about our fuel. Because of the oil price increases, I think that the demand for RDF will increase in the near future." One thing is apparent. If there is a new way to use RDF, it may likely be discovered at the Baltimore County facility. □

(The reverse of this page is blank.)

APPENDIX B

PRESENTATION, SUBJECT: "AIR FORCE RESEARCH IN SOLID WASTE RESOURCE RECOVERY," S. A. HATHAWAY

AIR FORCE RESEARCH IN SOLID WASTE RESOURCE RECOVERY *

Stephen A. Hathaway **

Introduction

Air Force research, development, test and evaluation (RDT&E) in solid waste resource recovery is inextricably linked to facility energy goals. The long-term Air Force energy objective is to be independent of foreign energy sources, and this will be reached by pursuing a vigorous energy conservation program, reliance on domestic energy sources, and development of renewable energy technology.[1] Specific measures to be taken include implementation and enhancement of:

- Energy Supply Assurance to ensure operation during periods of unforeseen utility interruptions or cutbacks;
- Alternate Fuel Conversion to decrease dependence on petroleum and natural gas as sources of facility energy as fast as economically possible;
- Advanced Energy Technology emphasizing use of renewable energy sources where practical and economically feasible;
- Energy System Optimization in existing and new structures and facilities to conserve energy and reduce peak usage;
- Joint Energy Initiatives with DOE to test, evaluate, demonstrate and implement state-of-art energy technologies which will assist the Air Force (and DOD) in meeting its energy goals;
- Energy Awareness to provide a greater understanding Air Force-wide of the need to conserve defense energy.

Our solid waste energy recovery RDT&E places particular emphasis on using raw and processed material in combustion systems, and our efforts fall into many of the measures categorized above. This paper provides a context and a philosophy rather than a program definition of our work. Specific RDT&E projects are mentioned to illustrate our more salient user-oriented viewpoints

---

* - The views of the author do not purport to reflect the position of the Department of the Air Force or the Department of Defense.

** - Project Officer in Facility Energy Research and Development, Headquarters Air Force Engineering and Services Center, Tyndall Air Force Base, FL 32403.

and to demonstrate our perception both of the Air Force waste-derived fuels (WDF) "market" and RDT&E needs in solid waste processing.

Program Motivation

The driving force behind our WDF RDT&E program and interests is primarily a combination of the need to decrease facility use of oil and gas plus the opportunity to use energy-efficient, environmentally compatible and cost-effective alternate fuels. Technology-based materials recovery systems are not high priority in our resource-constrained program because of low forecasted payoff; the average base generates only 25 tons/day solid waste during peacetime, and none more than 110 tons/day. Also because of economics, it is improbable that the average base will produce a WDF (such as RDF), but instead will purchase from others an alternate fuel for use as a supplement or substitite in its own central heating and/or power boilers, which range up to 200 MBtuh input capacity.[2]

Pursuant to Air Force facility energy goals, most of these boilers will be converted to coal or replaced by coal-fired units over the next 2-12 years. Now, facilities energy accounts for 20% of Air Force energy consumption, with motor vehicles (2%) and aircraft operations (68%) making up the remainder of the approximately 190,000,000 MBtu energy consumed annually. Electricity comprises 54% of annual facility energy consumption, natural gas 21%, fuel oil about 19%, and coal only 6%.[3] Air Force energy goals include obtaining a minimum of 10% of annual base energy from coal, coal-derived gas, solid waste, RDF and biomass by 1985.

Within 20 years it is hoped to virtually eliminate oil and gas from the facility energy picture. A major objective of this effort is to ensure a supply of energy sufficient to meet essential training requirements in peacetime and sustainability requirements in wartime.[4] A lion's share of our mobile equipment operates on petroleum and petroleum-based fuels, and will continue to do so over the next two decades. Reducing facility use of these fuels will make proportionally more available for equipment essential to the defense mission.

Considerable potential exists for using solid fuels other than coal to meet facility energy needs. Solid waste, RDF and biomass could be compatible with new and converted coal-burning equipment, and opportunistic use of these virtually sulfur-free fuels could permit avoidance of the high first and annually recurring costs of flue gas desulfurization. If our future coal systems have the technical flexibility to use these fuels, then we will have greater freedom to take advantage of one or more of them as they become cost-effective on the market. This will give us more useful energy for the fuel dollar.

Alternate Fuels Interests

The research community is in an excellent position today to act productively to create a flexible multiple fuel-capable military-scale central boiler, which also may be easily converted to electrical power generation. Much experience has accumulated with coal, solid waste, RDF, wood and other biomass, and it could be brought to bear upon the character of the fuel burning equipment we will field in the future to back off oil and gas. Our most basic thrust in researching solid waste energy conversion systems is to develop the data and information needed to create such a boiler, along with its appropriate and essential total plant infrastructure, which is capable of meeting future military-specific performance requirements as we now can foresee them.

This basic thrust is evident in past, current and planned RDT&E efforts in WDF. Over the past 2-1/2 years, we have sponsored exploratory, advanced and engineering development of military-scale RDF systems. Early laboratory analyses in combustion mechanisms, the static and dynamic character of stored material, biodegradation, etc. have led to current test and evaluation of RDF at Wright-Patterson Air Force Base (WPAFB), OH. Here, we are not so much interested in the performance of the fuel in a coal-designed boiler as we are in how this performance, and the reasons for it, can lead to better future designs for new and converted equipment. Our interests in small incinerators has been guided partly by our need to know more about the unique characteristics of base solid waste, especially with respect to minimizing costly preprocessing needs to produce a workable RDF. Next year, we will examine some specific aspects of small cogeneration systems in order to set more bricks on our path to the "boiler of the future" we wish to evolve.

We have not neglected those numerous oil- and gas-fired boilers which, in the near term, will not be converted to or replaced by coal units for a variety of technical and economic reasons. This year and next, we are investigating cofiring a variety of alternate solid fuels with oil, hoping to demonstrate that we can mix one or more of the fuels with oil in order to save some of the increasingly costly "liquid gold." Simultaneously, we are looking at close-coupled gasifiers working on biomass, with the hope that these can soon be recommended to conserve natural gas in many of our gas-fired boilers.

Throughout these efforts we have invariably recognized that "none of us is as smart as all of us." Accordingly, we have maintained close working liaison with researchers of the other services, EPA, the Bureau of Mines, and many other Government agencies, including DOE. Forums such as this Conference give us the welcome opportunity to exchange ideas with industry on common ground as engineers and scientists. And, in the past 4 months we have fielded Research and Technology Liaison Officers (RTLO's) at DOE's Albuquerque Operations Office and Solar Energy Research Institute (Denver). The RTLO's will interface our small facility energy RDT&E programs with the more comprehensive national program, will enhance two-way technology transfer, and will accelerate accomplishment of our RDT&E milestones in a way that will make maximum use of the Air Force research dollar.

A significant problem we see in accomplishing our energy goals involves resource and commitment. It is debatable whether immediate "windfall" funding to convert all bases to coal would be tenable, especially over the long term. There would most certainly be an impact on the programming and budgeting process, an unprecedented swamping of qualified Architect/Engineers, a perturbation of traditional fuel supply patterns, and perhaps some stress on iron and steel manufacture. Importantly, there would be an alarming sudden need for plentiful and skilled manpower on these many bases, and there is bountiful puzzlement about how such an immediate large-scale staffing might occur. Finally, this conversion strategy could effectively block future technological advance in military-scale boilers, as there would be virtually no incentive to think about such RDT&E until the new equipment approached the end of its functional life -- 25-35 years! A commitment to well-planned and orderly conversion, coupled with firm resolve to push the art steadily forward and maintain innovative technical capability among human resources, simply makes good sense. We are taking some steps in this direction at WPAFB.

Cofiring RDF at WPAFB

About a year ago, personnel at WPAFB began contracting actions for a 30-month supply of pelletized RDF to cofire in a 1:1 volumetric mix with bituminous coal in two 90,000 lbh boilers equipped with mechanical spreader stokers and traveling grates. Teledyne Corporation of Cockeysville, MD was awarded the contract, and more than 800 tons of RDF have been consumed to date. Problem areas encountered so far include accumulation of glassy slag on front and rear wall refractory, excessive clinkering on the grate, smoke generation, difficult reclamation from storage, and dust generation at transition points in the conveying system. Current moves to change from truck to rail delivery will cut the delivered cost of RDF by 40% and make it cost-competitive with coal. The pooled resources of boiler plant operators, engineers from the Base and Air Force Logistics Command, and RDT&E personnel will solve the other problems before long.

Using RDF was a Base and Command initiative which had an unforeseen benefit: acceleration of the RDT&E product. Without this initiative, the RDT&E plan called for initiating a long-term field evaluation in 1982-3. Now, we are fully two years ahead of schedule, and plan to have results in time to impact designs early in the Air Force's massive coal conversion program. We hope to continue our evaluation for a number of years in order to bring a constant influx of refinements and innovations into our designs.

In our evaluation, we are departing markedly from the "product testing" approach which has characterized the two dozen or so short-term, small-scale RDF tests over the past decade. As researchers, we are trying to be open-minded, hypothetical, scientific and future-oriented. A positive balance is struck when this vision is combined with the often difficult day-to-day operation with the alternate fuel at the Base. Some of the important questions shared about RDF are: Are there long-term affects which will compromise maximum performance of the boiler in time of critical energy need? What are the characteristics and properties of a workable RDF, and how do they affect design of a multifuel boiler meeting military performance requirements? How do we specify and procure RDF, maintaining control over the quality of the delivered and fired product? What sort of RDF can we expect in 10 years or 20 years that we should be thinking about in today's new designs? What other future alternate fuels should we be preparing for? Is RDF institutionally workable within the civil engineering management structure and mode of operation one finds on military bases?

Criteria

Answers to questions such as these must be sought not only at WPAFB, but also at forums such as this. Many of us often have wondered why questions such as these persist if RDF is "commercialized." Some of the criteria by which we judge a technology for base deployment are technical reliability, practicability, conservation (or extent of resource consumption), environmental compatability, experience, economics and survivability.[5, 6] A survey of RDF facts reveals a paucity of good quantitative information on all of these criteria, and dissuades many decision-makers from entering into long-term RDF purchase agreements which we have been allowed since 1978.[7] This is an area where both the "commercializers" and attendees at this Conference are encouraged to generate and publish valuable data and information.

The question of survivability is quite broad, but, simply stated, it refers to retention of operational capability under different threat scenarios. These threats include tactical nuclear and conventional weaponry, sabotage, vandalism, and natural disaster. A survivable system has high availability, or assurance of performance. Where present and future alternate fuels are concerned, this question bears directly upon the extent to which a base would depend on an outside alternate fuel supply.

Energy Supply Assurance

Ensuring a supply of energy sufficient to meet essential training requirements in peacetime and sustainability requirements in wartime has been cited as the "most basic policy in Defense energy." [8] The criteria uncertainties mentioned above must be reconciled before there can be a significant, dependable, long-term defense "market" for alternate fuels. On-going RDT&E in RDF and other forms of WDF will contribute toward this reconciliation insofar as converting purchased alternate fuel to base energy is concerned. Of course, if the research is performed correctly, it will uncover at least an equal number of questions and opportunities.

But what of the fuel supply itself? Two limiting problems in the current state of the art of RDF production and use are unforeseen plant outage and infeasibility of long-term storage. The former problem leads to inevitable supply interruption, and the latter to the need for nearly continuous supply to sustain boiler operation. Add to these very real problems the fact that current alternate fuel production facilities are, broadly, more vulnerable to many threats than on-base heating and power plants, and it must be concluded that total dependence on an off-base alternate fuel supply is indeed risky business at the present time. The consequences of fuel supply interruption could be severe in time of critical need.

The fall-back position, of course, is coal. Provided that the technical capability exists to use a multiplicity of fuels, there appears to be few, if any, intractable problems preventing use of commercially available alternate fuels by a given base when and where they are cost-effecive. A large quantity of coal easily could be stockpiled for backup in event of alternate fuel supply disruption. Under this arrangement, a variety of joint ventures remain possible, and the concept of the base as a self-reliant and secure "island" remains unthreatened.

A Challenge

The inescapable conclusion from the above discussion is that there is an increasing need for a fuel-flexible boiler system which meets the general criteria written in this paper, and which is capable of performing according to specific future requirements as we now are able to identify them. Development of such a system is a fundamental objective of Air Force RDT&E in solid waste energy conversion, RDF and biomass. The sharing of accumulated knowledge at this Conference allows yet another step to be taken in this direction. But time is getting short.

What more appropriate province than ASME to step up pursuit of this concept? The aims and objectives of the ASME include producing creative solutions for the technical/government/society interface, encompassing reliable performance, economical cost and performance, safety procedures and standards, environmentally sound practices, and energy and resource conservation. ASME develops and disseminates technical information to its members, industry and society at large. The purpose of ASME's active Solid Waste Processing Division is to advance the science of solid waste processing. Our basic RDT&E objectives in WDF find much common ground here.

In view of this, the following two-fold challenge is proffered to the Society and, in particular, to the Division.

First, the science, not the art, of waste processing should be reexamined. Do we really need costly high-technology separation and waste fuel preparation systems? Should we continue to adapt and modify equipment, including coal-designed boilers, to meet what we have long perceived as legitimate waste processing needs? Or, does the current collective of waste processing and fuels knowledge lead us reasonably to conclude that we must seek fundamentally new technology for fuel preparation and handling, combustion and pollution abatement? We must, of course, continue to deal effectively with present problems. But we would be remiss not to have a vision far into the future and a corresponding perspective on today's technological dynamism.

Second, it is evident that the objectives, goals and purposes of the Society and the Division permit them to play a preeminent role in accelerated development of future waste processing and alternate fuel systems for the benefit of industry, Government and society. The military boiler described briefly herein is but one example of what could be evolved. This is not only an unprecedented challenge, but also a vast opportunity. In substance, it matters not whether this role would be played by existing or new committee, so long as the developmental work is carried out with the same rigorous dispatch, immutable debate and unmatched competence which have set the Division apart since the days of the old Incinerator Committee.

References

1. Air Force Facility Energy Plan FY76-85. Headquarters Air Force Engineering and Services Center, Tyndall AFB, FL, July, 1979.

2. The terms "heating" and "power" are used here in accordance with definitions by the ASME (Boiler and Pressure Vessel Code). Few Air Force bases generate their own electricity.

3. Op cit., Note 1.

4. Keynote Address of Hon. George Marienthal on Joint DOD-DOE Energy Technology Initiatives for the DOD-DOE Energy Technology Workshop at National Bureau of Standards. Office of Deputy Assistant Secretary of Defense (Energy, Environment and Safety), Washington, DC, 10 March 80.

5. Hathaway, S. A., "Evaluation of Small Scale Waste-To-Energy Systems," in Rolsten, R. and Sweeney, P., eds., Proceedings of Third International Conference on Environmental Problems of the Extractive Industries, Dayton, OH, 1977.

6. Survivability of Remote Site Alternate Energy Systems. Engineering and Services Laboratory Report ESL-TR-79-21, Headquarters Air Force Engineering and Services Center, Tyndall AFB, FL, 1979.

7. Military Construction Authorization FY1978, Report 95-125, Senate Armed Services Committee, Washington, DC, 1978.

8. Op cit., Note 4.