INTERN EXPERIENCE AT THE ANDERSONS

An Internship Report

by

BILL MACK NORMAN

Submitted to the College of Engineering
of Texas A&M University
in partial fulfillment of the requirements for the degree of

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May 1981

Major Subject: Agricultural Engineering

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ABSTRACT

Intern Experience at The Andersons. (May 1981)

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This report is a review of the author's year of experience as an intern with The Andersons in Maumee, Ohio. Its purpose is to demonstrate that this experience fulfills the requirements for the Doctor of Engineering internship.

The author's prime responsibility was in the area of energy management for the company. An energy audit of The Andersons' Maumee complex was performed to determine amounts of energy used and how it was used. A recommendations report for a company-wide energy management program was presented to management. The intent of this recommendations report was to develop a company energy policy, determine required manpower and structure for a proposed energy department within the company, and develop a company-wide energy conservation program. In addition, coordination and management of several energy conservation projects was undertaken.

Engineering projects other than energy management were performed. These involved work associated with a survey of waste materials to insure compliance with federal regulations

on hazardous wastes; a study of the grain aeration system at the Champaign elevator to evaluate a possible redesign; and engineering analyses of country elevators being evaluated for lease under the company's Linkage Program. These projects required a close working relationship with engineering, environmental protection, maintenance, purchasing and accounting departments, as well as with operations personnel. Thus, this internship position at The Andersons provided exposure to various segments of the company. This broad exposure to a variety of engineering problem areas provided a valuable educational experience.

ACKNOWLEDGEMENTS

I wish to thank the faculty members in the Department of Agricultural Engineering at Texas A&M who, over the past eight years, have made the university educational experience a most rewarding one. Dr. Calvin B. Parnell, who served first as co-chairman and later as chairman of the author's advisory committee, is especially thanked. Dr. Parnell's guidance and advice in academic and non-academic matters is most appreciated. A special thanks is also expressed to Dr. R.E. Stewart who, prior to his retirement, served as co-chairman of the author's advisory committee and taught me, by his example, the true meaning of professionalism.

Drs. Donald L. Reddell, Otto R. Kunze and Clinton A. Phillips are thanked for serving as advisory committee members and for their valuable advice in the writing of this report.

Special thanks are expressed to Mr. James Appold of The Andersons for serving as internship supervisor. Mr. Appold's help and guidance in all aspects of this internship experience are most appreciated. The personnel at The Andersons who provided assistance to me are too numerous to mention here. However, three people who provided special assistance and advice are Mr. Fred Wolf, Mr. Jack Brunk and Mr. Harlan Sargeant.

I want to express a most special thanks to my wife, Gale. Her love, support and assistance in the writing of this report are more valuable than she will ever know.

I dedicate this report to my parents, Weims and Hope Norman. Their love and support can never be repaid. Their patience and confidence over the years have been most valuable.

Bill Norman

College Station, Texas
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INTRODUCTION

This is the final report of Bill Norman's internship experience at The Andersons in Maumee, Ohio, covering a period from January 8, 1980 through December 31, 1980. The purpose of this report is to establish that the objectives of the Doctor of Engineering internship were met. These objectives were:

1. to enable the student to demonstrate his ability to apply his knowledge and technical training by making an identifiable contribution in an area of practical concern to the organization or industry in which the internship is served; and

2. to enable the student to function in a non-academic environment in a position where he will become aware of the organizational approach to problems in addition to traditional engineering design or analysis. These may include, but are not limited to, problems of management, labor relations, public relations, environmental protection or economics (Texas A&M University, 1976).

Internship Objectives

Prior to entering the internship, a set of specified criteria were prepared to guide in the selection of an appropriate internship position. The first of these criteria was to seek an internship position that would provide for an expansion of technical knowledge in the area of agricultural processing. Second, the internship position should provide an opportunity for additional responsibility that would result in confidence building associated with decisions required of a practicing engineer. Third, the internship position should provide a broad view of the organization, exposing the author to philosophies and actions of people in disciplines other than engineering and teaching him to work effectively with such people. These three criteria were used to determine those organizations which might provide a satisfactory internship position.

The position offered by The Andersons met the above criteria and an agreement was subsequently reached for an internship. During the first few weeks of the internship, several discussions were held to formalize specific work objectives. Out of these discussions came the following objectives:

1. Perform an energy audit of The Andersons Maumee complex to include identifying energy usage, costs and availability;

2. Establish recommendations for a company energy management program to include:
   a. Develop recommended company energy policy,
   b. Determine required manpower and structure of an energy department,
   c. Develop recommendations relative to establishment of an energy committee,
   d. Develop recommendations relative to energy conservation programs, and
   e. Establish recommendations for an energy training and control program;

3. Keep updated on new developments in the energy area;

4. Improve energy efficiency of equipment and processes;

5. Explore alternate sources of energy; and

6. Become familiar with and learn to function within The Andersons organization and corporate structure.

The Andersons Organization

The Andersons was founded in 1947 as a family partnership between Harold Anderson, his wife and six children. The business consisted of a 500,000 bushel grain elevator located in Maumee, Ohio. Because of its strategic location on major water, rail and roadway routes, the company enjoyed a marketing advantage over its competitors and thus realized substantial growth. Today the company has grown to include three major agri-complexes and a river front terminal with combined grain storage capacity of approximately 40 million bushels of grain. It has diversified into other areas including fertilizer manufacture and distribution, feed manufacture, cob milling and retail operations. The ranks of the partnership have grown as well. Approximately 200 Anderson family members and non-family employees make up the limited partnership. Twelve of these partners, including Mr. Anderson's five sons, are designated general partners and make the major decisions concerning management of the company.

Figure 1 shows an organizational outline of the company. Under the general manager, the company is divided into six major groups--three service groups and three operation groups with one operating division reporting directly to the general manager.

The Grain Group has historically provided the company with the bulk of its revenues. It consists of four major

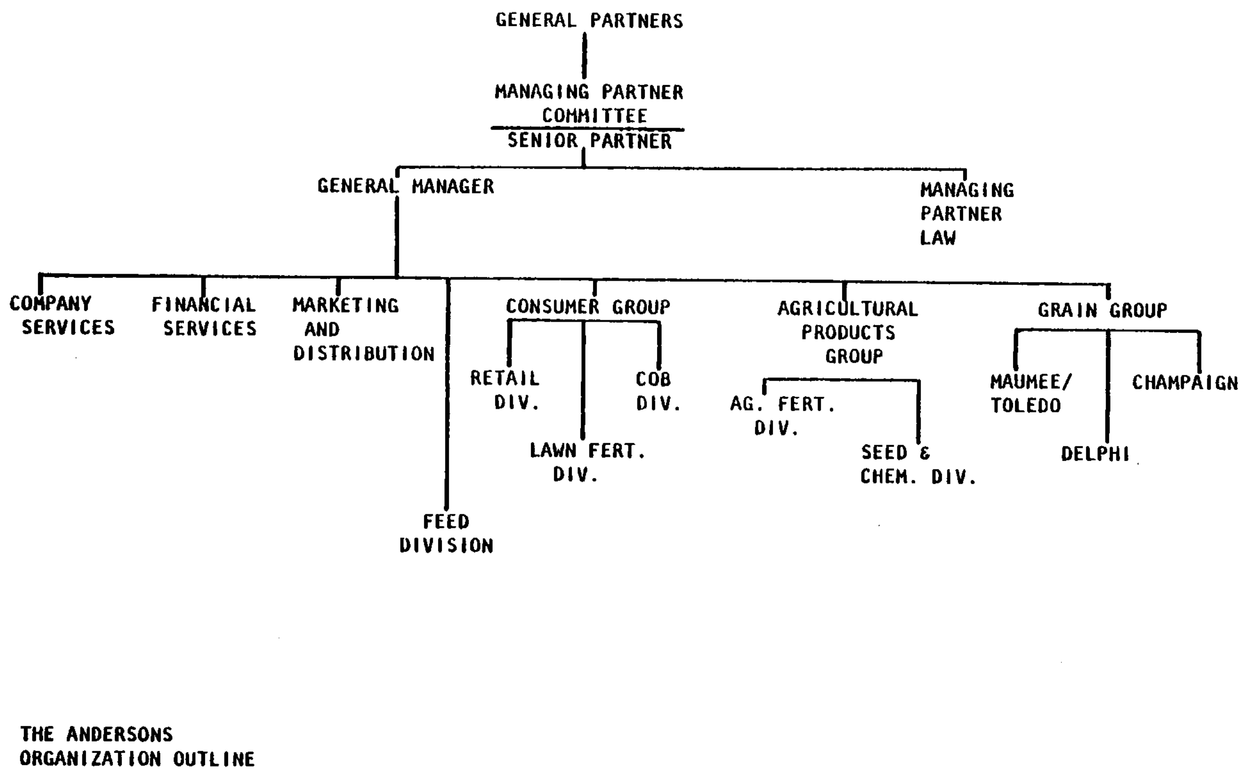


Fig. 1. The Andersons organization outline.

grain terminals located in the Midwest's Corn Belt. The Maumee/Toledo division consists of a 17 million bushel elevator in Maumee and a seven million bushel elevator located on the Maumee River in Toledo. This river front elevator provides a strategic export outlet via the Great Lakes and St. Lawrence Seaway. Other grain divisions consist of a 12 million bushel elevator in Champaign, Illinois, and a four million bushel elevator in Delphi, Indiana. Within the last year the Grain Group has been attempting to expand its market share through the company's Linkage Program. This program has resulted in the leasing of smaller country elevators near Frankfort, Indiana and Albion, Michigan. The Linkage Program will be discussed in greater detail later in this report.

The Agricultural Products Group consists of the Agricultural Fertilizer and the Seed and Chemical Divisions. The Seed and Chemical Division, located at the Maumee complex, provides brand name agricultural chemicals and seeds on a wholesale basis to retailers throughout much of the eastern Midwest. The Agricultural Fertilizer Division consists of two bulk storage and dry blending plants at the Delphi and Maumee complexes. The close approximation of these plants with the adjacent grain facilities has allowed for an innovative and efficient two-way haul unit train concept. These trains carry grain south to Gulf Coast terminals and return with bulk fertilizer components.

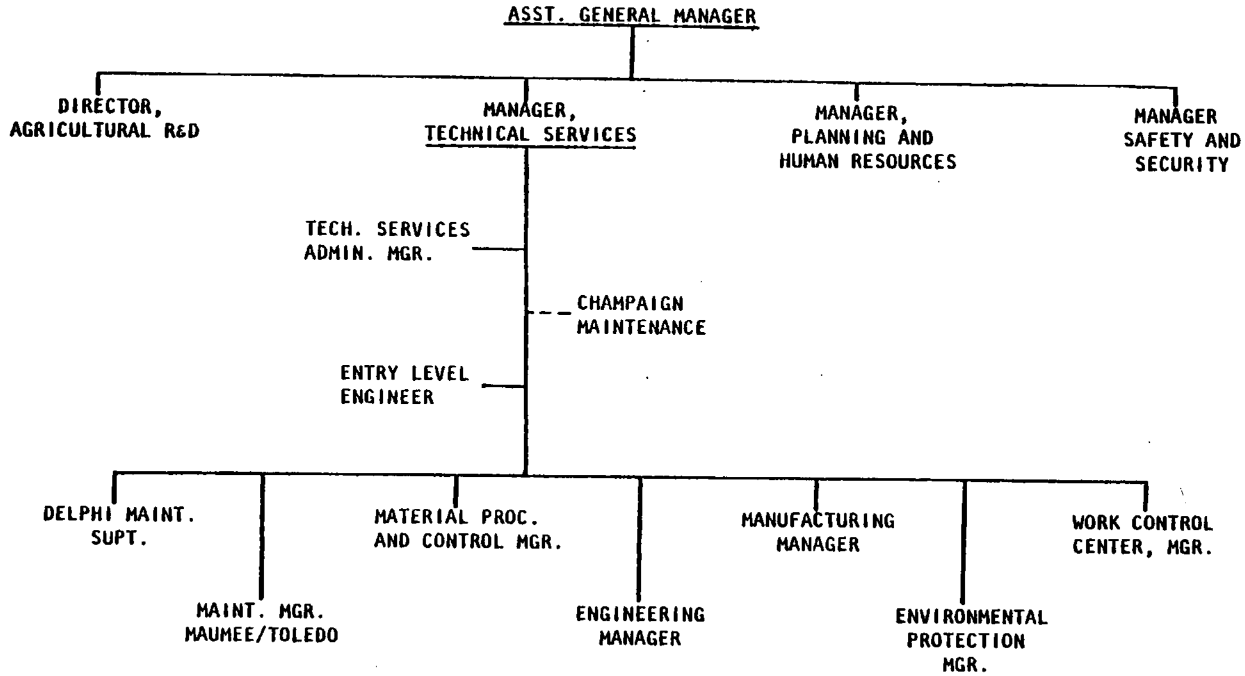
The Consumer Group is the most diverse of the company's operations. The Cob Division consists of two corn cob milling operations located at the Maumee and Delphi complexes. These operations turn a previously unwanted waste material into a valuable product. Whole corn cobs are processed into variously sized materials used as carriers for fertilizer or pesticide and as feedstuffs, abrasives and small animal bedding, among other uses. The Lawn Fertilizer Division, located at the Maumee complex, is an offshoot of the Agricultural Fertilizer operations. This division formulates, packages and markets commercial and residential lawn care products under its own and other labels. The Retail Division is probably the most visible and recognized of the company's operations in the eyes of local consumers. The division consists of three General Stores located adjacent to the major complexes, four Tire Shops in the Toledo area, a Garden Store in Toledo, and a Service Shop and a Farm Sales Division, both located adjacent to the Maumee complex. The largest of these operations is the Maumee General Store which provides brand name and private label merchandise for the farmer, housewife and "do-it-yourselfer". An adjoining Garden Store and nursery provides a wide selection of small plants, shrubs and trees. The nearby Service Shop sells and services brand name lawn and garden equipment.

The Feed Division completes company operations. The division's feed mill is located at the Maumee complex and formulates various livestock feeds as well as dry pet food. The division markets these products under its own labels as well as those of others.

The three services groups provide support functions for the operation groups. Marketing and Distribution provides traffic, marketing, and employee and public information functions. The Financial Services Group provides accounting, financial and data processing functions. Company Services provides research and development, technical services, planning, personnel, and safety and security support.

The Intern's Position Within the Company

During the internship period, the author served in the capacity of an entry level engineer reporting to the manager, Technical Services Group, within Company Services. An organizational outline for Company Services, in general, and Technical Services, in particular, is shown in Figure 2. Mr. James Appold, manager of Technical Services, served as internship supervisor during the duration of the internship. As can be seen in Figure 2, Mr. Appold was responsible for engineering, maintenance, material purchasing and environmental protection support for the company. By reporting to Mr. Appold, a broad view of company operations was gained and an ability to move laterally within Technical Services was acquired.



THE ANDERSONS
COMPANY SERVICES GROUP
ORGANIZATION OUTLINE

Fig. 2. The Andersons Company Services Group organization outline.

Although broad overall supervision was provided by Mr. Appold, daily supervision came from other sources for obvious reasons. The environmental protection manager, besides having responsibility for environmental concerns, had historical responsibility for energy management within the company. Since the major objectives of this internship dealt with energy, daily supervision for administrative and budgetary purposes was the responsibility of Mr. Fred Wolf, environmental protection manager. During later stages of the internship, engineering projects outside the realm of energy management were undertaken. Supervision for these engineering projects came from Mr. Jack Brunk, engineering manager.

As various projects and studies were undertaken, it was discovered that guidance and assistance available from other departments within Technical Services was invaluable. Informal guidance was regularly obtained from purchasing, maintenance and fabrication departments. Thus, opportunities were afforded to analyze various engineering problems encountered from several points of view.

ENERGY MANAGEMENT RESPONSIBILITIES

Energy Management Recommendations Report

One of the primary objectives of this internship was the development of a recommendations report for a company energy management program. The energy audit of the Maumee plant and other energy-related projects, discussed in later sections, were performed so as to gather data and thus form opinions on recommendations for such a report.

Until the "energy crisis" period of the 1970's, The Andersons, like so many other companies, had not concerned themselves with energy management. The Andersons was not an energy intensive company so that energy costs were not a major factor in previous years. However, energy that was used was critical in order to maintain quality of perishable foodstuffs such as grain.

Natural gas was the primary fuel used in grain drying. Curtailments of natural gas supplies in 1977 and 1978, as well as rising prices, caused management to begin serious thinking about energy conservation. At about this time an energy committee was formed with membership coming from various areas of the company. The energy committee was charged with recommending an energy policy for the company. After a number of months and numerous meetings, they drafted a report outlining actions for the company to take in regard to energy management. However, for whatever reason, the report never left that committee and no results of substance were reported. Energy management took a back seat to more pressing items. With the author joining the company as an intern, the opportunity arose to restudy the energy management problem.

The author was specifically asked to develop an energy policy for the company and to determine the manpower requirements in order to implement such policy. Very little guidance was provided on this project, so as not to bias these efforts with ideas from the previous energy committee. Although possessing very little formal training or experience in the subject of energy management, a combination of engineering and management principles were drawn upon in order to formulate program recommendations. The training and experience possessed by the intern were supplemented by attendance at a four-day energy management seminar held in New York City.

In order to form a basis for recommendations, energy usage data were collected and operations were studied in order to gain some idea of what was to be managed. Energy managers from other companies were contacted and questioned on how their departments were structured. By combining information from the company energy audit with information obtained from the management seminar and from other energy managers, a picture began to form of how a program for The Andersons might take shape.

The full text of the report submitted to company management is contained in Appendix A. Briefly stated, this report outlined the structure of a proposed energy management program. A policy statement by the company on energy was proposed. A full-time energy manager was suggested to oversee implementation of such a policy. Part-time energy coordinators were suggested in each operating division to assist the energy manager. The recommendations report also outlined energy conservation projects and areas for future study. To the author's knowledge, no action has been taken on this report as of this writing.

Energy Audit of the Maumee Complex

The first logical step in any energy management program should be an energy audit. Such an audit is used to determine where and how energy is being used. An audit or survey will usually involve collecting copies of past energy billings, taking meter readings and gathering together the various utility service contracts, where available. The audit of The Andersons Maumee complex was such an audit. The approach taken in accomplishing this audit was first, to collect energy usage data based on past billings, and also collect any utility service contracts that were available and second, to tour Maumee complex facilities and see first-hand how energy resources were being used.

Electricity and natural gas were the two primary energy sources used in Maumee. The major uses for electricity were electric motors, which drive a multitude of equipment including aeration fans, belt conveyors, elevator legs, pellet mills, etc. Natural gas was used primarily for grain drying, cob drying, boiler fuel and space heat. The natural gas supply was supplemented with a backup supply of #2 Fuel Oil. Diesel fuel was used in the company's switch engines and in other stationary engines. Gasoline was used in many of the smaller vehicles in the complex. Electricity and natural gas were each brought to a central metering station at the plant. The complex's internal distribution system supplied either the electricity or the natural gas from the main meter location to locations within the complex. Many of the divisions and departments within the complex were submetered. For instance, natural gas supplied to the feed mill boilers and pet food dryer was submetered. Natural gas to the cob dryer was also submetered. Electricity to each of the areas of the fertilizer plant was submetered, as was the electricity to the feed mill.

However, there were a number of buildings and areas in the complex which were not submetered. These areas depended on a proration from accounting in order to have their natural gas and electricity costs allocated to them on a monthly basis. The accounting proration schemes for both electricity and natural gas were based on prior calculations and estimates of usage in each area.

An example of a natural gas proration is shown in Figure 3. This figure illustrates the method employed by the accounting department in determining the proration. Those areas that were submetered were charged for their usage, which was subtracted from the total meter amount. Remaining usage was prorated among other areas on a percentage basis. The percentage was determined by estimating each area's average usage over the year and dividing by the total estimated average. Electricity was prorated similarly, except estimates of kilowatt-hours used replaced the percentages.

Through the efforts of the environmental protection manager, records of energy usage had been maintained for 1978 and for 1979. These data were collected and recorded by energy type and by company division. Figure 4 is an example of a data sheet used to collect this information. Information was recorded on such forms by the month and was obtained from utility bills or delivery invoices.

Energy usage data combined with appropriate accounting prorations were used to determine total energy consumed by each division. Figure 5 shows aggregate energy consumption for the Maumee plant by year and month. This information was obtained by summing that for each division. For each division, the data, by energy type, were converted to equivalent British thermal unit (Btu) amounts and summed

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Columbia Gas Proration

JE XX-12-04

Total Cost 2" Meter	$		
-Less Charge to Div. 04/05	-	(5%)	40-407-04-850
		(95%)	40-407-05-850
-Less Charge to Dept. 55/58	-	(70%)	60-607-90-155
Balance to Spread	$	(30%)	60-607-90-158

40-407-03-610	3.53%	$
40-407-03-620	1.96%	
40-407-03-625	1.96%	
40-407-03-626	.40%	
40-407-07-720	20.13%	
40-407-10-460	17.70%	
40-407-43-000	4.19%	
40-407-55-000	4.19%	
60-607-90-100	28.07%	
60-607-90-102	3.91%	
60-607-90-155	4.65%	
60-607-90-165	9.31%	
	100.00%	$

Total Cost 4" Meter	$	
-Less Charge to Div. 15	-	40-407-15-850 $
Balance to Maumee Grain	$	40-407-10-460

CR 15-209-00-001 Total Bill

Fig. 3. Existing proration scheme for natural gas at The Andersons Maumee complex.

THE ANDERSONS
19___ ENERGY USAGE

TYPE OF ENERGY ELECTRICITY________ SUPPLIER________ SUPPLIER ACCT. NO.________

DIVISION NO.________ DIVISION NAME________ METER NO.________

ANDERSON ACCT. NO.________ VENDOR NUMBER________

BILLING PERIOD	POWER FACTOR	BILLING DEMAND	RECORDED DEMAND	CONSUMPTION	BILLING AMOUNT	COST PER UNIT	REMARKS
	%	KW	KW	KWH	$	$/KWH	
TOTALS/AVERAGES							

Fig. 4. Example of a data sheet used in recording energy billing information.

MAUMEE PLANT
MONTHLY ENERGY USE

YR. MON.	ELECTRICITY KWH	Btu/KWH	MILLION Btu	NATURAL GAS MCF	Btu/MCF	MILLION Btu	FUEL OIL GALLONS	Btu/GAL	MILLION Btu	DIESEL GALLONS	Btu/GAL.	MILLION Btu	TOTAL Btu	PRODUCTION UNITS ( )	Btu/PROD.
'78 JAN.	1,929,995	3413	6587	24581	1,000,000	24581	24,220	138,500	3341	4697	138,500	651			
FEB.	1,419,477		4844	18508		18508	215		30	7673		1063			
MAR.	1,453,492		4961	16618		16618	160		22	5475		758			
APR.	1,410,767		4815	9847		9847	52		7	4983		690			
MAY.	1,794,035		6123	13030		13030				6098		845			
JUNE	[illegible]		5277	6713		6713				5646		782			
JULY	1,471,835		5023	3798		3798				2521		349			
AUG.	[illegible]		5714	6428		6428	800		111	3639		504			
SEP.	1,421,332		4851	[illegible]		4218				2681		371			
OCT.	[illegible]		6466	14986		14986				2753		381			
NOV.	2,190,383		7476	28550		28550	62		9	5347		741			
DEC.	[illegible]		6617	24603		24603	7000		970	5289		733			
TOTALS	20,144,956		68755	171,880		171,880	32509		4502	56802		7867			
'79 JAN.	1,775,481	3413	6060	11,238	1,000,000	11,238	1263	138,500	175	6694	138,500	927			
FEB.	1,980,904		6071	13,543		13,543	806		112	5707		790			
MAR.	1,849,438		6312	11,028		11,028	486		67	5646		782			
APR.	1,666,23		5687	9971		9971	385		53	5134		711			
MAY	1,678,337		5728	8680		8680				7945		1100			
JUNE	1,522,716		5197	5711		5711	89		12	3085		427			
JULY	1,667,685		5691	4153		4153	192		27	2534		351			
AUG.	1,670,518		5701	11,522		11,522				3588		497			
SEP.	1,298,221		4433	7194		7194				2435		337			
OCT.	1,812,635		6187	15,043		15,043				4240		587			
NOV.	2,142,732		7313	34427		34427	383		53	4805		665			
DEC.	1,943,330		6633	35,626		35,626	496		69	5463		757			
TOTALS	20,969,721		71570	171,136		171,136	4100		568	57,276		7933			

Fig. 5. Equivalent Btu of energy used at The Andersons Maumee complex by year and month.

to obtain total Btu of energy used. This was then divided by appropriate division production data to obtain a ratio of energy consumed per unit of product. For example, ratios such as Btu per ton of livestock feed produced or Btu per bushel of grain received were obtained. The purpose of obtaining these ratios was to eventually be able to compare these actual amounts to some "ideal" ratio for each division. Thus, an "energy budget" could be established. This process was continued for the data being collected during 1980.

As a result of analyzing this information, it was determined that a new proration scheme for natural gas use was needed. The proration scheme that had been previously used was several years old and many changes within the plant had taken place. The scheme utilized only one percentage figure for each department throughout the year and did not take into account departments which may not use natural gas during the summer. For example, several of the maintenance departments used natural gas only in the winter for space heating. However, they were being charged for natural gas throughout the entire year on a percentage based on the rest of the plant's usage.

The author set out to rectify this situation and performed an in-depth audit of each building, in each department, making note of all types of natural gas usage such as space heat, water heating and processing.

Subsequently, an analysis of equipment usage versus time was developed. Btu consumption ratings were taken from equipment and ratings in a particular department were then summed to determine total Btu consumption for that department. A duty factor was then determined for each piece of equipment for the "summer" months and for the "winter" months. These duty factors were then applied to the total Btu rating for the department so that estimated usage for summer and winter were obtained. Summer was defined as the months of April through September and winter was defined as October through March.

The new proration scheme which was adopted is shown in Figure 6. A comparison with the proration shown in Figure 3 indicates that the new scheme was more detailed. This new proration included all actual meter readings available. Once all submetered amounts were subtracted from the main meter reading, the remainder was applied to those areas without meters. This remainder was applied on the basis of calculated percentages just as was done under the old system. However, the new proration includes two sets of percentages--one for "summer" and one for "winter". This feature more accurately reflected natural gas usage throughout the year.

Another result of the energy audit included responsibility for correspondence with utilities concerning energy usage. A specific example of this was the handling of

MAUMEE PLANT - COLUMBIA GAS PRORATION AS OF OCTOBER 1, 1980

					Cost
	Total Columbia 2" Meter	XXX	Mcf		
Div. 05	Less 2" Extruder Dryer Meter	XXX	Mcf	x monthly rate =	$XXXX.XX
		XXX			
				65% to (05) x rate =	
	Less 3" Boiler Meter	XXX	Mcf	35% to (04) x rate =	
		XXX			
				70% to (55) x rate =	
	Less Fab Shop Meter	XXX	Mcf	30% to (58) x rate =	
		XXX			
	Less Cob Mill Meter	XX		x rate =	
	Balance to Be Prorated	XXX	Mcf		

		Winter %	Summer %		
03-620	Fert. Oper. Bldg.	3.3	0.0	x rate =	
03-625	Fert. Plant (Whse. #5)	4.5	0.0	x rate =	
03-626	F-Tank Maint.	1.4	0.0	x rate =	
03-628	Fert. Sales Bldg.	3.7	10.8	x rate =	
04-	Feed Sales Office	1.6	10.8	x rate =	
07-740	Spec. Whses. & Fert. Maint.	7.5	0.0	x rate =	
07-720	Spec. Plant	6.9	10.5	x rate =	
10-460	Grain Oper. Bldg.	3.6	0.0	x rate =	
43-000	Farm Supply	4.6	10.5	x rate =	
55-000	Maumee Whse. #6	1.5	0.0	x rate =	
90-000	TSG Center (entire bldg.)	26.5	44.1	x rate =	
90-005	Safety Bldg.	2.3	0.0	x rate =	
90-040	Maint. & Constr. Bldgs.	23.2	13.4	x rate =	
90-058	Old Paint Shop	2.4	0.0	x rate	
90-065	Tool Room & Elect. Maint.	7.0	0.0	x rate =	
					$XXXX.XX

Total Columbia 4" Meter	XXX	Mcf		
Less Cob Drier Meter	XXX	Mcf	x rate =	$ XXX.XX
Balance to Div. 10 Driers	XXX	Mcf	x rate =	XXXX.XX
				XXXX.XX
Credit 15-209-00-001 Total Bill				$XXXX.XX

Fig. 6. Proposed revision of the proration scheme for natural gas used at The Andersons Maumee complex.

certain requests with Columbia Natural Gas pertaining to the natural gas supply in Maumee. The author was responsible for preparing a revision of Priority 2 natural gas allotments for the company. A copy of this revision request is contained in Appendix B. Formulation of this request required contact with each division in the company requesting that they provide information relative to any process changes or additions that they foresaw which might affect natural gas usage. From these requests, it was determined that the only increase in gas requirements would be for grain drying which was determined to be increased 20 percent over the previous 12-month period. This increase in requested Priority 2 amounts was due to an increase in grain drier capacity.

Additional responsibilities for filling out several energy information forms for state and local agencies were performed. Data obtained during the audit were very helpful in filling out these forms. Most requests were for Btu consumption totals in electricity and natural gas. This information was available from the energy audit.

As a result of the audit, cost projections for energy requirements were made. In the energy recommendations report to management, the energy costs for 1980 were projected. Several times during the internship, management requested data pertaining to energy costs, such as cost of electricity per kilowatt hour or increases in natural gas costs per thousand cubic feet. These data were provided and were used in forming budgets for the next fiscal year. In order to satisfy these requests, contacts were maintained with representatives from each of the utilities and with fuel oil and diesel suppliers, among others.

The energy audit that was performed was by no means an absolute measurement of how energy was being used. However, it provided a picture of what was happening and it was recognized that this should be an on-going process. It was recommended to management that record keeping and data collection be continued in order to keep up-to-date information available for an effective energy management program.

Information assimilated during the audit for each profit center and each division formed the basis for the energy recommendations report. Information from the audit also pointed out areas where improvement in energy conservation were needed.

Retrofit Insulation of the Maumee General Store

Shortly after arriving on the job, a request was made by Retail Division Management for technical assistance in selecting insulation for the Maumee General Store. Management was interested in insulating the exterior walls of the General Store with the most economic insulation available. The one constraint placed on this work was that the interior and exterior appearance of the store remain unchanged. The store was constructed of hollow concrete block. At the time the store was built, some insulation was applied to the roof; however, the walls contained no insulation. The store used #2 Fuel Oil as its heating source and as such, was spending considerable amounts of money for heat during the winter.

On the basis of a heat-transfer analysis, it was determined that the lack of insulation in the store walls resulted in energy losses worth approximately $13,000 every heating season. Prior to this assignment, the Retail Division had already received several bids on performing the retrofit insulation job. One of these bids involved the spraying of a cellulose foam approximately two inches thick on the interior of the store walls. On the surface this appeared to be a very economical approach to the solution of the problem; however, upon further investigation it was determined that the aesthetics of this foam were not acceptable to division managment.

Several other contractors were invited to make proposals for this job and several different types of insulation were suggested. Fiberglass, urethane and polystyrene wall boards installed on the interior walls were proposed, but these were very expensive solutions to the problem. On the other hand, they provided maximum amounts of insulation per thickness of material. After further investigation, the use of an in-the-block foam was considered.

Installation of in-the-block foam involves drilling holes in the concrete block. Foam is pumped into the holes under pressure so that every cavity within the block wall is filled. The holes are subsequently patched and painted to match the existing appearance. After much study and discussion, it was determined that this would be the most feasible way of insulating the General Store walls.

Use of this foam in an eight-inch thick concrete block provides as much insulation as a two-inch thick board of urethane. At the same time the foam costs approximately half as much as applying urethane wall board. A study of the economics indicated that pay-back for the insulation would be less than two years, considering only heat energy savings and excluding any consideration of cooling savings during summer months.

A proposal to use in-the-block foam insulation was well received by division management. Preparations were made to complete negotiations for a foam installation contract when an unforseen development complicated further work.

The foam that was to be used was a urea-formaldehyde (UF) type. Just prior to completing the installation contract, it was discovered that UF foam had been under considerable study by the Consumer Product Safety Commission (CPSC 1980). When improperly installed, the UF foam could release, during its curing period, formaldehyde gas, an extremely harsh irritant to the nasal passages. Studies had indicated formaldehyde as being a possible carcinogen.

Upon learning this information, a personal investigation was made to determine what problems this foam could pose in the General Store. Phone calls were made to the CPSC, the Ohio Department of Health and to the local health department. It was learned that no current ban on UF foam existed in Ohio and that one was not currently being considered by the CPSC. The CPSC was proposing a warning to residential consumers because there was evidence indicating that improper installation could lead to problems. This investigation revealed that almost all complaints resulted from improper installation and that all complaints received involved residences, not commercial or industrial users. Investigation of the proposed installer revealed a flawless record of performance.

Based on these investigations, the decision was made to proceed with the insulation project. A special stipulation was provided in the contract that stated that any adverse health effects that could be traced to the insulation or to the installation of the insulation would be the liability of the contractor and the foam manufacturer.

The author was responsible for insuring that installation proceeded in an orderly manner with a minimum of interference with store activities. Following installation, an inspection with the contractor was performed on the store utilizing an infrared scanning camera. This camera allowed an "X-ray"-like scan of the walls to determine if there were any block cavities that had not been insulated. The results of this scan indicated that the contractor had achieved a 100 percent fill and that the project was completed.

The project was completed just prior to the 1980 heating season. Based on the then present price of #2 Fuel Oil, it was determined that this insulation would save the store approximately $9,000 during the first heating season alone. Total installed cost of the insulation was approximately $12,000.

Energy Control System for the Maumee General Store

In conjunction with the insulation of the General Store, the Retail Division became interested in installing an energy-control system for the General Store to provide control of electrical usage and demand. There were many of these control systems on the market. They came in different sizes with different capabilities. However, all the systems on the market were designed to achieve the same objectives. The primary design objective was to reduce electricity costs by (1) controlling demand, (2) utilizing duty cycling to avoid peak loading, and (3) utilizing a time-of-day schedule to allow for night setback of thermostats.

An analysis of the General Store electricity usage data indicated that peak-loading would occur during the summer months. The primary uses of electricity in the General Store were 11 heating and air conditioning units mounted on the roof. The air conditioning units ranged in size from 25 to 42 connected horsepower. Uncontrolled, these units would cause considerable electrical demand load when started at the same time. There were also 13 oil-fired heaters in the warehouse area that were also candidates for being on an energy-control system.

An investigation of energy control systems applications was requested by the Retail Division to determine feasibility for use in the General Store. Several companies were contacted such as IBM and Honeywell, among others, and proposals for various systems were received. A major consideration in analyzing the proposals was future expansion of the system. Located near the General Store were the Service Shop and the Tire Shop. Across the street was the rest of the Maumee complex. Because future possibility existed for placing the entire complex under some type of energy control, future expansion capabilities of a system for the General Store were seriously considered. Proposals received ranged from a simple microcomputer system costing approximately $8,000 to a minicomputer system, costing approximately $25,000. The author was responsible for analyzing these proposals and determining the most feasible for use in the Maumee General Store.

All proposals received contained systems that had the requested capabilities. The major differences between systems were the amount of memory and software that would be included. Management required a system needing little or no computer programming, little software, and one that could easily be programmed by almost any employee in the General Store.

The system that was recommended and eventually approved was a microprocessor control with capabilities for eight load circuits. Programming of this microprocessor was similar to any hand-held calculator and extremely simple. It provided for demand control, duty cycling and time-of-day control of all units.

The time-of-day control allowed for setback to 45° or 55°F at night with appropriate emergency override thermostats. The time-of-day feature also included an adaptive control that allowed for optimum on-time of equipment each morning. For example, equipment was not set to come on at a specific time every morning. Instead, the adaptive control calculates, on the basis of indoor and outdoor temperature, the time required for the store to recover to 65°F in winter, and allows equipment to come on for that amount of time prior to store opening.

The duty cycling feature of the control system provided for equipment to be off for a specific amount of time during each 30-minute period. This prevented all 11 roof-top units from being on at one time. Instead, units were cycled on and off so there would be a uniform number of units operating throughout the day.

The demand limiting feature of the system prevented electrical demand load of the store from reaching a pre-programmed limit. The system contained three preset limits, one for the winter period, one for the summer period, and one for the mid-season (fall and spring periods). The electrical demand limit for the winter period was set at approximately 375 kilowatts. For the mid-season period, it was set at approximately 420 kilowatts, and for the summer period, it was set at approximately 475 kilowatts. These different limits were chosen because of the electrical usage patterns in the General Store. Very little electricity, other than lighting, was required by the General Store during winter. Electrical requirements for the 11 roof-top heating units were approximately one-half horsepower per unit for fan operation. However, in the summer, with air conditioning load requirements, electrical demand was greatly increased. Thus, a demand limit set during winter would not be sufficient to allow for proper cooling in summer.

The total cost of the system installed was approximately $10,500. Estimated annual savings from this system was over $12,000, resulting in less than a one-year payback. Installation of the system was completed in early December so that no actual results of its operation could be reported.

Water Use Study at the Maumee Feed Mill

An energy audit is an important first step in an energy management program because it can identify how and where energy is being used. The energy audit of the Maumee plant resulted in initiating a study of water usage in the feed mill.

The Maumee feed mill used 400,000 to 500,000 gallons of water monthly. This usage depended upon production for any one month. The City of Maumee charged water and sewage fees to every user on the basis of the amount of water used. For instance, if 100,000 gallons of water were metered at a location, the city charged a water fee and a sewage fee for the 100,000 gallons. At the feed mill, charges were being received for approximately 400,000 gallons of water input and for 400,000 gallons of sewage output. However, the feed mill did not return all water used into the sewer. Much of the water was utilized in processing--some in the form of steam. Water and steam were evaporated during drying. Thus, water and steam used in the process could not be returned to the city sewer. This fact lead to the investigation of ways to avoid sewage charges on this water.

A more intensive study was undertaken to determine exactly where water was being used in the plant and to determine what internal controls could be taken to avoid unnecessary sewage charges. Results indicated that city water was piped to a process water tank and was heated to approximately 120°F. This water was used in the pet food manufacturing process and then evaporated during drying. A second use of incoming water was for cooling. Approximately 10 to 15 gallons of water per minute was used in oil coolers for two pellet mills and also for cooling in the pet food extruder. This water was returned to the city sewer at approximately 100° to 110°F.

The remainder of water used in the plant was sent through a water conditioning process and a deaerator and then used as boiler feed water. Steam was used in four ways: (1) as space heat, with the condensate returned to the deaerator; (2) as a heat source for liquid ingredient tanks; (3) as a heat source for the process water tank, with the condensate returned to the deaerator; and (4) as a heat source for the pet food extruder, with that condensate being returned separately to the sanitary sewer. Steam was also injected into the product in the two pellet mills and in the pet food extruder. This steam was evaporated during drying.

After determining where water was used in the plant and how it was returned to the city sewers, a meeting was held with city officials to determine what could possibly be done to avoid excessive sewage charges on water not being returned to the city sewer system. Results of these meetings were non-productive. The city was, as could be expected, not very interested in making any allowances on the company's sewage charges. However, this failure was not the end of the study.

An investigation to determine uses for the cooling water that was being returned to the city sewer at approximately 100° to 110°F was conducted. There were two costs determined to be associated with this water. First, there was an energy cost because this water had been heated from 70°F to approximately 110°F and was subsequently released into the city sewer system. Also, there was the cost for handling this water by the city in its sewer system. It was proposed that the cooling water loop be closed by installing a heat exchanger in the boiler room. Cooling water then could be recirculated throughout the plant, therefore eliminating the purchase of additional water from the city.

Heat recovered from plant cooling water could be used to preheat process water. Information obtained from a vendor's proposal for a plate and frame exchanger revealed that, assuming a hot side flow of 10 gallons per minute at 100°F and a cold side flow of 20 gallons per minute at 65°F, 99,000 Btu/hour could be exchanged. This would result in exit temperatures of 80°F on the hot side and 75°F on the cold side. The 99,000 Btu/hour converted to a savings of $120 per month at the then present cost of natural gas used to fire the boilers. The plant would also be saving $240 per month on water and sewer charges. Net savings were determined to be $325 per month after deducting operating costs of a proposed recirculation pump. Cost of the recirculation and heat exchanger system, installed, were estimated to be $3,000. This resulted in a simple pay-back of nine months.

Additional savings were possible by submetering water entering the process water tank. The reading obtained could be used, as suggested by city officials, to reduce the fee being charged for sewage. Although this did not represent all water lost in processing, especially that used as steam, it did represent a significant amount. It was determined that this water amounted to approximately 125,000 gallons per month and that submetering could result in a savings of approximately $85 per month.

The results of this feed mill water study were forwarded to the feed mill's division engineer. He was extremely interested in this information and was to pass the proposals on to the feed mill plant manager for his review and approval for funding.

Fabrication Shop Compressed Air Study

Late in the internship, a request to perform a study of the fabrication shop compressed air requirements was made. The purpose of this study was to determine if the present air compressor designated for shop air use was of sufficient capacity to handle the demand. If not, purchase of a compressor of appropriate capacity was to be proposed.

The fabrication shop had two compressed air systems. One system was designated for shop air, the other system was designated for sand blasting. Shop air requirements were primarily for hand tools such as drills and grinders. The shop air system used a 10 horsepower compressor to supply its air needs. A 150 horsepower compressor was used only one day a week to fulfill needs for sandblasting. However, by bypassing the inadequate 10 horsepower compressor with the 150 horsepower compressor, the shop was requiring the 150 horsepower compressor to operate an additional four days a week. Air demand of the shop was well below the 150 horsepower compressor's capacity.

Prior to moving into its present location, the fabrication shop had been located in another building and utilized a 10 horsepower compressor identical to the one it was presently using. After discussions with the manager of the fabrication shop, it was determined that the previous 10 horsepower compressor met all of the needs of the shop. The manager's contention was that his present 10 horsepower compressor did not have the capacity of his previous compressor which was being used by maintenance. He wanted to switch compressors with the maintenance department. A pump-up test was performed on both 10 horsepower compressors and their capacities were determined to be in the range of

30 to 35 cfm. The manufacturer's rating for both was 40.5 cfm at 100 psig. An analysis of air usage in the fabrication shop determined that present demands required a compressor with a capacity of approximately 80 cfm at 100 psig. The manager's contention that his old compressor would be satisfactory was inaccurate.

It was proposed to the fabrication shop that a new compressor be purchased. This new compressor would be rated at 15 horsepower and would provide approximately 70 cfm at 100 psig. By adding this new 15 horsepower compressor, the fabrication shop would avoid using the 150 horsepower compressor four days out of the week. It was determined that this would save approximately $600 to $700 per month in electrical costs. Cost of a new 15 horsepower compressor was determined to be $6,000 installed. A simple payback on this project was estimated to be less than one year. These proposals were provided to the fabrication shop manager and to the manager of Technical Services. Just before the end of the internship, the fabrication shop began requesting bids on a new compressor.

RESPONSIBILITIES UNRELATED TO ENERGY MANAGEMENT

In addition to his energy management responsibilities, the intern was assigned to other projects by the environmental protection manager and by the engineering manager.

Hazardous Waste Management at The Andersons

A portion of the internship was spent assisting the manager of environmental protection in determining how recent regulations concerning hazardous wastes applied to The Andersons. The Environmental Protection Agency (EPA), through the Resource Conservation and Recovery Act (RCRA), had recently promulgated rules dealing with generating, storing and transporting hazardous wastes (EPA, 1980). The environmental protection manager was responsible for determining if The Andersons were subject to these new regulations.

In order to determine how specific regulations affected The Andersons, the manager for environmental protection initiated a study of all plant wastes. The author was asked to assist in this study by being responsible for analyzing all of the waste materials generated by the Company Services group including plant maintenance, engineering, the company copy center and the fabrication shop.

The results of the study for Company Services indicated that no hazardous wastes, as defined by EPA, were being generated by these areas. Other areas of the company did, however, generate hazardous wastes. The Lawn Fertilizer Division was found to be using materials such as 2,4-D in formulating certain lawn fertilizer materials. 2,4-D is defined by the EPA as an extremely hazardous material.

The final results of this hazardous wastes survey indicated that each plant site of the company generated less than 1,000 kg per month of such wastes. This allowed the company to apply for small generator status. Such status relieved the company of complying with requirements for detailed record keeping. The company was still responsible for the proper disposal of its wastes. The environmental protection manager also intended to set up his own records system to protect the company from any future liability.

Linkage Program

During later stages of the internship, a considerable amount of time was devoted to the company's Linkage Program. This program was designed to be a market expansion tool for the Grain Division. The purpose of the Linkage Program was to lease or build small country elevators of approximately 500,000 bushel capacity with unit train load-out capabilities.

The first of three linkage elevators was one located near Findlay, Ohio, south of Maumee. This was an existing elevator and negotiations were being held for its possible lease. Information was gathered on the electricity supply to the elevator, system capacity, contract costs of supplying electricity, and on the possibility of installing a natural gas pipeline for grain drying. Assistance was also given in evaluating the possibility of extending and expanding the rail spur serving the elevator. Data obtained included transformer capacities and supply voltages available. Discussions with the area's natural gas supplier resulted in determining that a natural gas line would not be feasible for that facility. Such a line would have to cross an interstate highway and be laid underground for approximately four to five miles to reach the facility. The cost of such a line was prohibitive.

By working with a railroad construction company, possibilities in expanding rail spur capacity of the elevator were determined. In its present form, the rail spur was capable of handling 35 cars at a time. The desire was to handle 50 cars, with future expansion to 100 cars. A layout of the possible spur extension was made. This layout, along with the information on natural gas supply and the electric service, was provided to the manager of Technical Services to be included in his analysis. Negotiations for this facility were not successful and the elevator was not leased.

The next facility studied was located near Frankfort, Indiana, which was in the general vicinity of the company's Delphi terminal elevator. Again, information on energy supply, including electricity and natural gas, was obtained. Capacities of transformers available and voltage service available were requested. Since natural gas was unavailable, prices for propane service were obtained from several dealers. Also, prices for diesel fuel were obtained.

In addition to energy information, the condition of certain equipment at the facility was determined. This facility had been out of operation for over a year, and during this time a tornado had damaged one of the grain bins. Information and a quotation on price and installation cost of a new grain bin was obtained.

A hot-spot temperature detection system had been installed in the facility's grain bins. A determination of the type of system installed and its operating condition was requested. However, no information was available from the sales company which installed the system.

Also, a request for information on a probe-a-load sampling system used to sample grain on incoming trucks was made. The salesman who installed the system was contacted, and a short history of the repairs performed on the equipment and the operating condition of the equipment was acquired.

In addition, information was obtained on the operating condition of the truck scales at this elevator. The man who serviced these scales provided the repair and maintenance history and steps needed to bring the scales into operation. A consolidated report was supplied to the manager of technical services who incorporated it into his analysis and recommendations to the Grain Group management. This elevator was subsequently leased and began operating during the internship year.

The third facility under study was a grain elevator to be constructed in Michigan. A similar analysis of electric and natural gas service was made. In addition, information and requirements from Conrail in relation to the construction of a rail spur from their main rail tracks was requested. It was determined that such a rail spur to the facility would have to cross at least one and possibly more gas or oil pipelines. Specifically, it was necessary to determine what requirements the railroad had for construction over such pipelines. Conrail provided a manual outlining all construction specifications. Construction permits for this elevator had to be obtained. Local, county and state officials were contacted regarding construction permits, sewage permits, water permits and environmental permits relating to the construction and operation of the elevator.

Engineering analyses of three elevator layouts were made. The objective was to determine an economical design in terms of energy use, initial construction costs, equipment costs and operating expenses. These data were provided to the manager of Technical Services to be used in his analysis of proposals that had been received from several contractors. Prior to the end of the internship period, a contract was approved for the construction of a facility plus the leasing of two nearby elevators.

Champaign Aeration Study

During the last month of the internship, the manager of engineering requested an analysis of the aeration system at the Champaign grain terminal. The Champaign facility consisted of 24 round steel bins. Each of these bins had a capacity of 500,000 bushels.

An important aspect of grain storage is the aeration of grain to prevent hot spots and spoilage. Each bin at the Champaign elevator was equipped with four aeration fans. Each fan served two ducts which extended radially toward the center of the bin. These eight ducts had an approximate length of 40 feet. They ran below the bin floor and were connected to air cells which extended vertically from the floor. Each duct was connected to four cells, thus there were 32 cells per grain bin. These cells were constructed of perforated metal to allow for air flow. The physical shape of each cell was that of a cylinder two feet in diameter and eight feet in height.

The objectives of this study were: (1) to determine if the number of cells could be reduced to eight, or possibly four, from the present 32 per bin, and (2) to determine if the existing fan system would have the proper static pressure and air flow capacities to handle an eight-cell or four-cell system. Similar bins at Maumee and Delphi, Indiana, utilized only four air cells with dimensions of roughly 5 feet 9 inches in diameter and 10 feet in height.

Static pressure loss for the air flow requirement in each duct was calculated. It was determined that the fans in place were capable of providing the required air flow at the system pressure resulting from either a four-cell or eight-cell arrangement. Information from this study was given to the company's structural engineer who was responsible for structural design of air cells for either the eight- or four-cell configuration. A cost estimate was to be prepared by him and sent to Champaign management. This estimate was to be compared with one already received for complete retrofit of the existing 32-cell system.

SUMMARY AND CONCLUSIONS

The purpose of this report was to establish that objectives of the Doctor of Engineering internship had been met. It recaps activities related to objectives specified by the internship supervisor at The Andersons.

An energy audit of the Maumee complex was performed and a recommendations report was submitted to company management concerning an energy management program. The results of the energy audit initiated several energy conservation projects, such as the study of water usage in the Maumee feed mill. Coordination of an insulation project and of an energy control system project, both in the Maumee General Store, were other responsibilities. A study of compressed air needs in the Maumee fabrication shop was also performed. These energy projects resulted in substantial cost saving potential for the company and provided the opportunity for broad exposure to company operations.

Responsibilities in projects not related to energy management were also undertaken. Assistance was provided in a study of hazardous wastes generated by the company to determine if limits proposed by the United States EPA were being exceeded. The study was the first step in formulating a hazardous waste management plan. Engineering duties were also performed in association with the company's

Linkage Program and in relation to a proposed revision in the grain aeration system at the Champaign elevator.

Internship duties required contact with people throughout the company's organization. As a result, the importance of the organizational approach to problem solving was learned and appreciated. Several of these projects required a close working relationship with accounting, engineering, maintenance, purchasing and the legal department.

The projects encountered allowed the demonstration of the author's ability to apply knowledge and training so as to make an identifiable contribution to the organization. The ability to function in a non-academic environment was also demonstrated. Awareness of the organizational approach to problem solving was attained. Thus, the two prime objectives of the Doctor of Engineering internship were met. The internship was a valuable educational experience and has provided essential engineering training.

REFERENCES

1. Texas A&M University, College of Engineering. "Guidelines for Doctor of Engineering Internship Report," College Station, September, 1976.

2. U.S. Consumer Product Safety Commission, Proposed Rule. "Urea-Formaldehyde Foam Insulation; Proposed Notice to Purchasers," Federal Register, 45, no. 113, June 10, 1980, 39434-44.

3. U.S. Environmental Protection Agency, Final Rule. "Hazardous Waste Management System," Federal Register, 45, no. 98, May 19, 1980, 33063-285.

APPENDIX A

Recommendations for an Energy Management Program at The Andersons

Recommendations for an Energy Management Program

at

The Andersons

Prepared by

Bill Norman

November 14, 1980

ABSTRACT

This report reviews the current energy usage situation at The Andersons and outlines recommendations for a company energy management program. The full-time position of Company Energy Manager is proposed that would be responsible for carrying out management policies on energy as outlined in a Company Energy Policy Statement. The Energy Manager, working with each operating division through its Division Energy Coordinator, will be responsible for keeping management updated on energy use data and will suggest means to reduce overall energy use and costs. The Divisions' Energy Coordinators will be existing personnel who have been assigned this added duty by the Division Manager.

Specific recommendations are made for areas and projects that should be handled by the Energy Manager. These recommendations include establishing a practical and effective usage data gathering and reporting scheme, developing energy use standards for equipment and processes which can be used as goals in energy reduction, investigating heat recovery from boilers, driers, and waste materials, and involving employees and partners in energy saving through an information and awareness program.

RECOMMENDATIONS FOR AN ENERGY PROGRAM AT THE ANDERSONS

REVIEW OF CURRENT ENERGY STATUS

The 1973 oil embargo by the Organization of Petroleum Exporting Countries (OPEC) has been credited as the beginning of an energy crisis in this country. Although much hoopla was made at that time, an "energy crisis" was not seriously recognized until the winter of 1977-78. The severity of the winter weather and a lack of sufficient energy stores brought curtailments to industry and business in many parts of the country. During this period many businesses and industries began organizing energy management programs to cope with shortages and price increases. The appearance of gasoline lines in the spring of 1979 brought the energy problem to the consumer and the idea of an energy crisis was again fashionable.

At present, no "crisis" now exists with regard to energy. However, an energy "problem" is still at hand. Our country's increasing energy appetite has resulted in the importation of over 40 percent of our crude oil needs from OPEC nations at prices ranging from $28 a barrel upward. Additional natural gas demands have resulted in the shipment of liquified natural gas from Algeria. Because of our present situation, energy costs have come to the forefront where in years past energy expenditures were taken for granted.

Figures 1 through 4 illustrate how energy costs have increased over the past years at The Andersons. Figure 1 illustrates energy costs company-wide. Total 1979 expenditures were approximately $3.1 million, which was up over 18 percent from 1978. It is estimated that 1980 costs will be near $3.7 million, an increase of 19 percent over 1979, and an 802 percent increase over 1971 estimated costs.

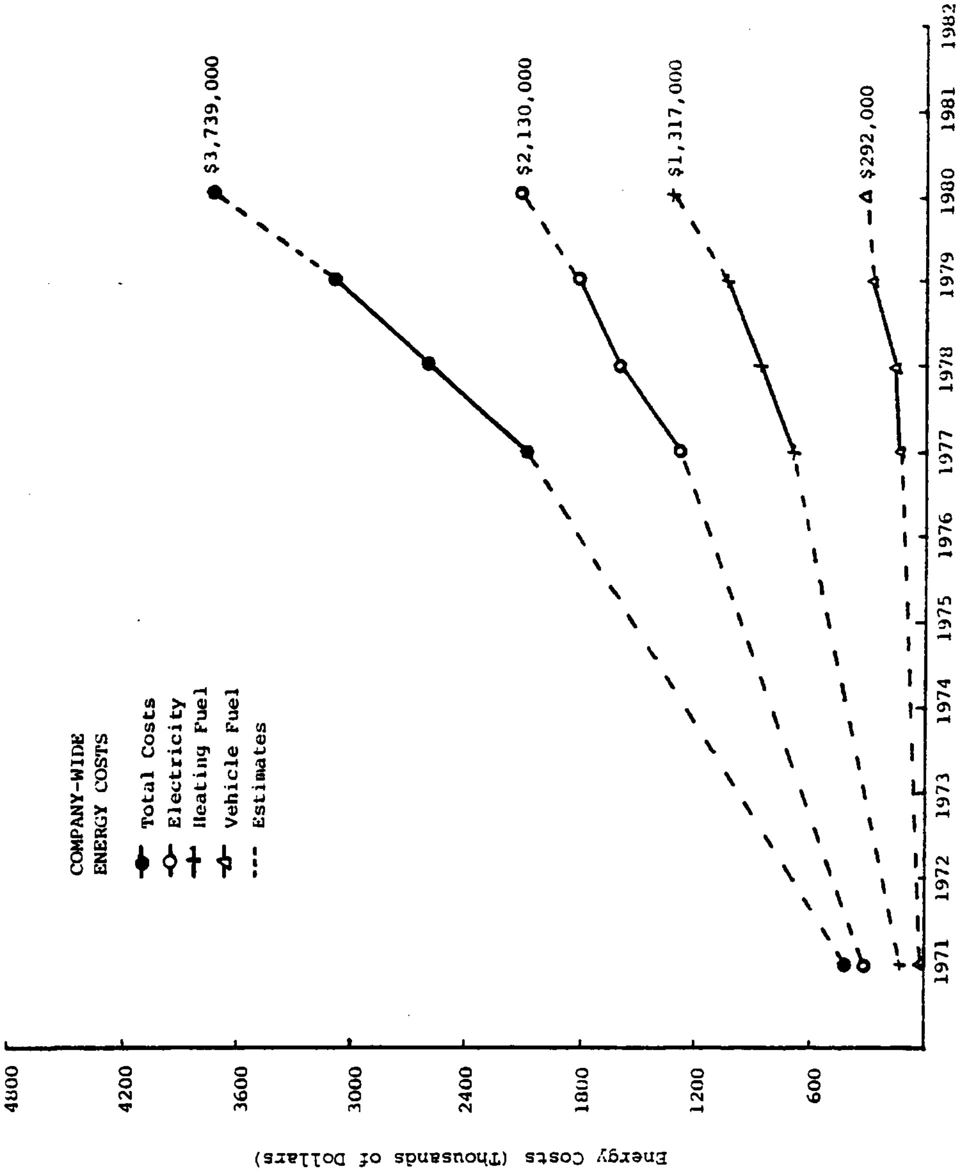

COMPANY-WIDE
ENERGY COSTS
Total Costs
Electricity
Heating Fuel
Vehicle Fuel
Estimates
$3,739,000
$2,130,000
$1,317,000
$292,000
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
4800
4200
3600
3000
2400
1800
1200
600
Energy Costs (Thousands of Dollars)

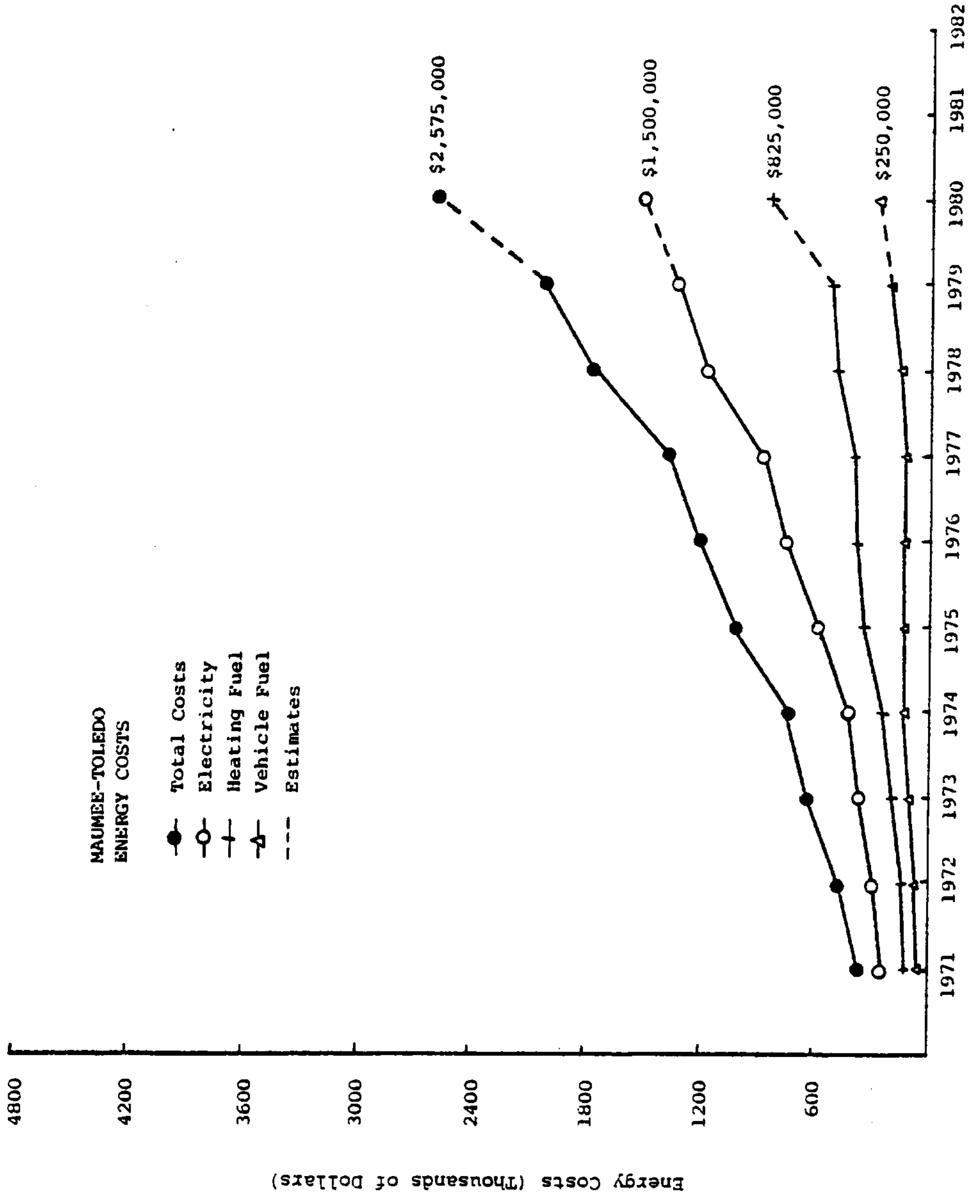
Figure 1

Figures 2 through 4 illustrate energy cost data for the Maumee-Toledo, Delphi, and Champaign complexes respectively. Data for the Maumee-Toledo area is the most complete. These data give the best illustration of how costs have been rising. From 1971 through 1979 energy costs have increased at an annual compounded rate of 24 percent. Similar increases can be seen for Delphi and Champaign. Some of these increases are a result of expansion and increased consumption. However, most of the energy cost increases over the past few years are due to price increases rather than increased consumption.

There is little that can be done about energy prices short of changing energy sources. This was done in 1979 at the Delphi complex when natural gas was substituted for #2 fuel oil. From Figure 3 it can be seen that there is a dramatic decrease in the heating fuel portion of the Delphi energy cost forecast for 1980 due to this change. This cost will begin to increase again as natural gas prices rise, but natural gas prices are far from the levels of those for equivalent amounts of #2 fuel oil. Therefore, the company will continue to realize savings from this change. Seeking alternate energy sources that are cost effective is one method of reducing total energy costs.

Another way to reduce costs is through conservation. While little control can be exerted over energy prices, considerable control options exist for energy consumption. These options range from the shut-down of unused equipment to heat recovery from existing processes, and to the replacement of existing equipment with more energy efficient equipment.

Conservation and alternative energy sources are two major facets of most energy management programs in industry today. Although these programs take different shapes and emphasize different aspects of energy, depending on the industry, they all share a common goal of reducing overall energy costs. Typical



MAUMEE-TOLEDO
ENERGY COSTS
Total Costs
Electricity
Heating Fuel
Vehicle Fuel
Estimates
$2,575,000
$1,500,000
$825,000
$250,000
Energy Costs (Thousands of Dollars)
4800
4200
3600
3000
2400
1800
1200
600
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982

Figure 2

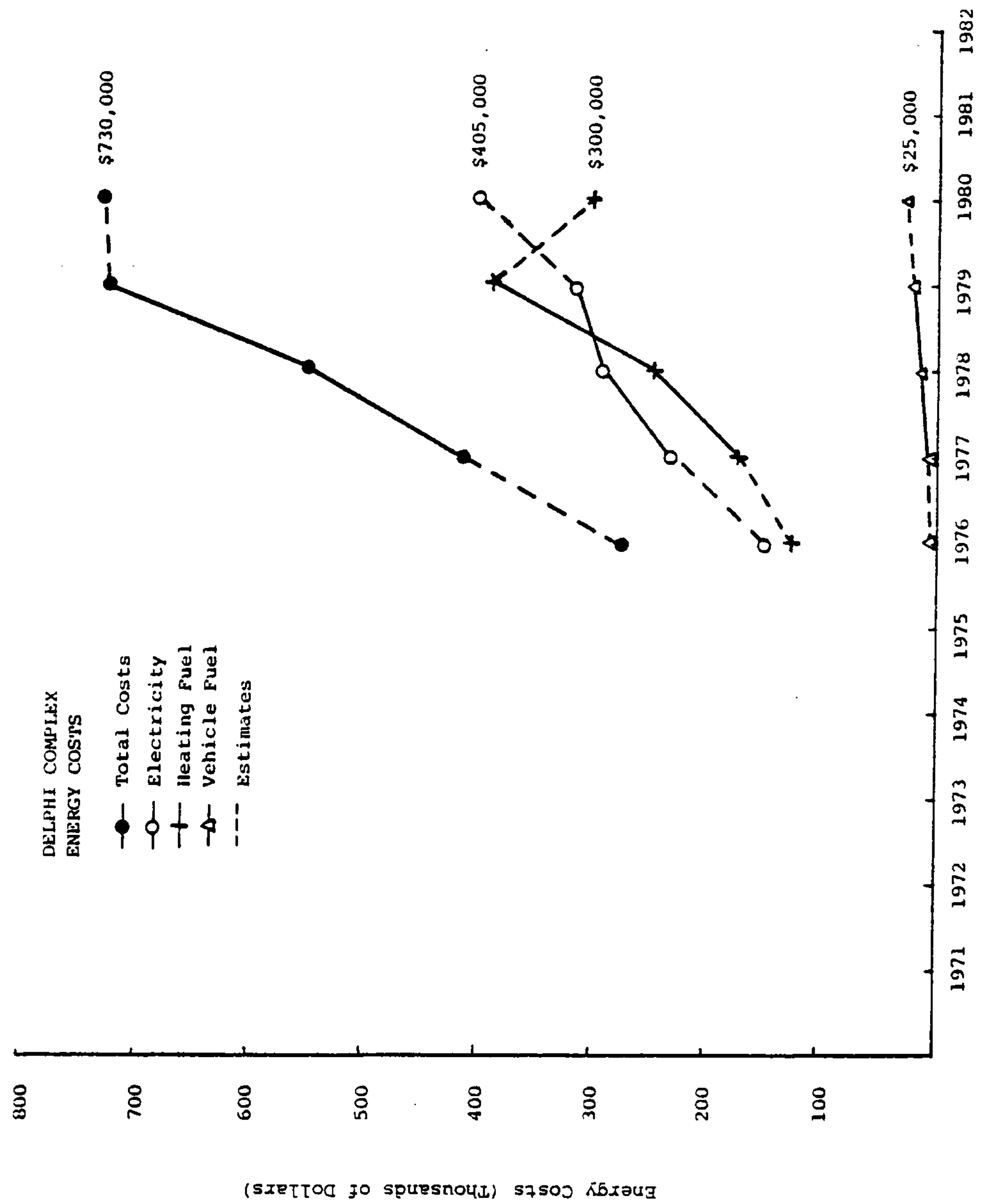

DELPHI COMPLEX
ENERGY COSTS
Total Costs
Electricity
Heating Fuel
Vehicle Fuel
Estimates
$730,000
$405,000
$300,000
$25,000
800
700
600
500
400
300
200
100
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
Energy Costs (Thousands of Dollars)

Figure 3

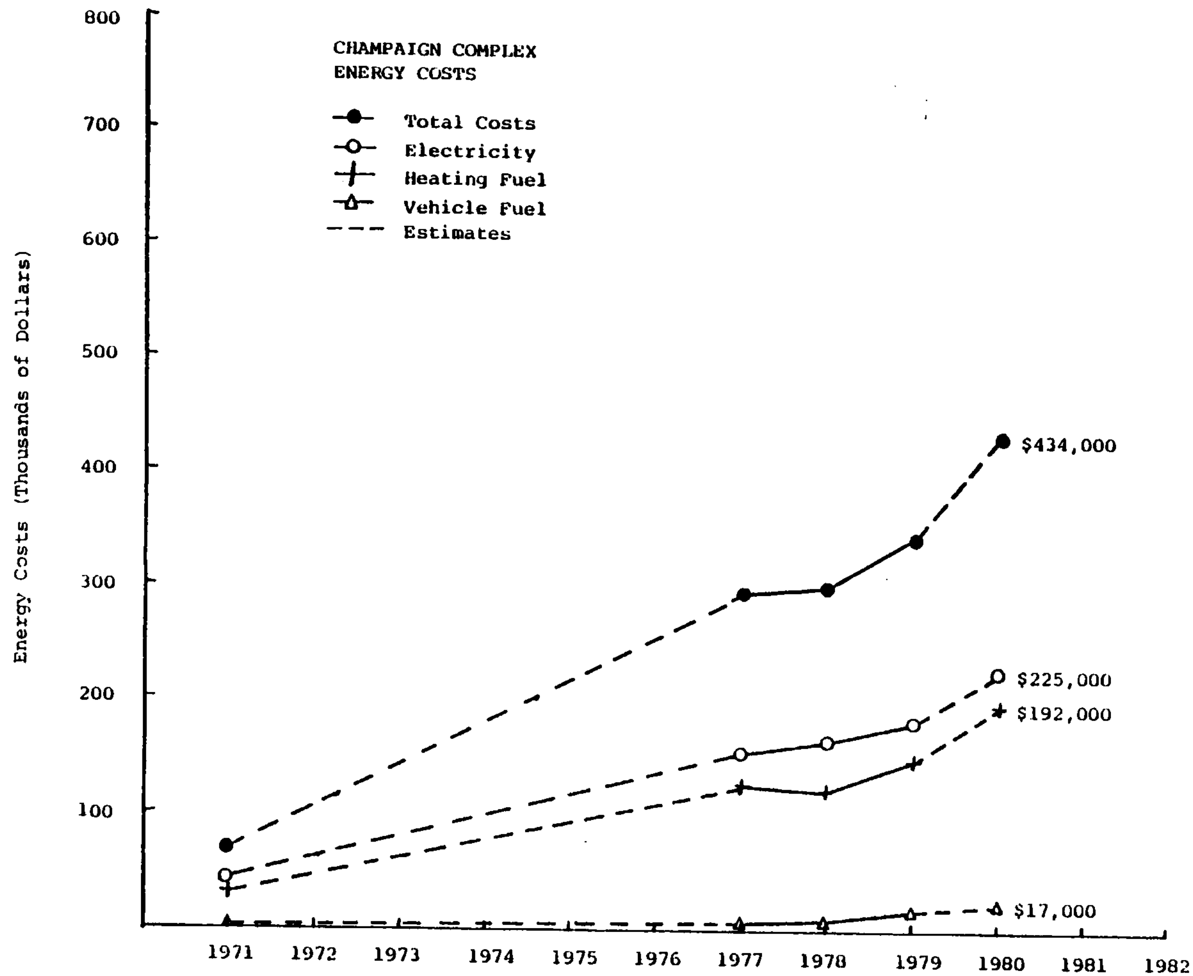

CHAMPAIGN COMPLEX
ENERGY COSTS
Total Costs
Electricity
Heating Fuel
Vehicle Fuel
Estimates
Energy Costs (Thousands of Dollars)
800
700
600
500
400
300
200
100
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
$434,000
$225,000
$192,000
$17,000

Figure 4

programs in existence today have reportedly saved 10 to 25 percent of their company's overall energy costs in their first year alone. In the case of The Andersons, this could mean a potential savings of one-half of a million dollars in the first year alone if a company-wide program were started in 1980.

ENERGY PROGRAM REQUIREMENTS

The first prerequisite of a viable energy management program is no different from that for any other beginning program in an organization. Top management must be committed to, and supportive of, the program if it is to have any success. The need for such commitment has been stated in many sources by numerous people. It is mentioned again in this report to emphasize the importance of such commitment. No program, whether it be employee safety, preventive maintenance, or energy management, can make a viable contribution to the organization without top level support.

The second prerequisite of an energy management program is to involve the employees, especially the line personnel. The employees are the people that make operations function. They are the ones that ultimately determine the effectiveness of an energy program. The energy program should be structured and managed so that the line workers are aware of what their contributions toward saving energy are worth. The workers should be able to see how their contribution is used and what results from their efforts. Ideally this would mean placing meters in locations so that employees can see the amounts of energy they are using. Of course, this is not always practical, but a good energy program must make some effort toward informing employees, as well as managers, of our energy status.

In order to show its commitment and give some direction to an energy program, top management should issue an Energy Policy Statement. This statement should be a broad overview of what the company's objectives are in formulating an energy program. The following areas should be addressed in the policy statement.

1. Conservation--The need for conservation in all areas should be stressed. Employee conservation on the job as well as at home should be emphasized. Major capital expenditures for energy conservation projects should be encouraged where deemed economically feasible.
2. Security of Supply--Steps to insure the availability of energy supply should be encouraged. Alternative sources should be arranged for in the event of curtailment of any major sources. Additional storage of fuels should be considered where alternatives are lacking. The ability to generate energy internally through plant wastes and by-products should not be ignored.
3. Project Evaluation--A consistent, equitable method of economic analysis for energy capital expenditure projects should be developed. Energy projects should be able to compete with other projects for capital funds on a sound financial basis.
4. Industrial and Government Interchange--An effective energy program should allow the company to anticipate any change in government energy policy rather than react to it. Adequate communications with industrial groups and with government are necessary in order to remain on top of the energy situation.

A draft policy statement is included in the appendix of this report.

REVIEW OF EXISTING ENERGY PROGRAMS

Almost every corporation now has some type of energy management program in existence. Most of these programs were set in place following the 1973 OPEC oil embargo. However, some large, energy-intensive companies have had programs organized for many years. In order to propose development of a program at The Andersons, information was collected on programs at several companies of various sizes. The following discussion will review what other companies are doing about energy management.

There seem to be as many different types of energy management programs as there are companies that have organized them. The complexity of the corporation and its energy-use pattern determine the organization and complexity of its energy program. In some companies energy responsibility rests in corporate engineering; in some it rests in corporate purchasing; and in others the responsibility is divided among several areas. However, there seems to be a general trend in how the programs are structured and in how they function.

Generally, there exists a managerial position at the corporate level in which most of the energy management responsibilities lie. This position usually appears either in the purchasing or in the engineering area and is responsible for corporate policy on energy supplies, on energy conservation, and on the monitoring of energy legislation and regulation. Depending on the size of the company, this position will be supported by as few as one person to as many as six full-time personnel with assistance from outside consultants.

At the plant level, there is usually a plant energy coordinator. The plant coordinator works with the plant manager and the plant engineer, and is responsible for energy management for the plant. The plant coordinator is normally a full-time position coordinating all energy conservation projects and reporting results and usage data to the corporate energy manager. In some large corporations, there is an intermediate division coordinator. The division coordinator is in many cases a part-time responsibility and normally serves as a communications link between the corporate energy manager and the several plant coordinators for which he is responsible.

Large corporations such as General Motors, Owens-Corning, Owens-Illinois, Uniroyal, Ralston Purina, and others have adopted successful energy management programs which are organized as outlined above. This type of organization is well suited to such complex corporations that have diverse plant locations and diverse products. Smaller companies would need to modify such a program structure to fit their needs. However, there are two main concepts in this type of energy program structure which are necessary in any size program. There must be some central clearinghouse for collecting data, issuing reports, securing energy supplies, and responding to government regulations. The structure must also be broad enough to reach the employees of the company and motivate them to save energy at their work places. These two functions are crucial in insuring a successful energy management program.

PROPOSED PROGRAM ORGANIZATION

With overall energy expenditures expected to reach above $3.7 million for 1980, an energy management program for The Andersons begins to make good economic sense. As the company continues to grow, the need for formal, centralized control of energy usage will become even more necessary. The earlier such control is started, the easier it will be to maintain effective control and management in the future. However, The Andersons is not a company on the scale of General Motors or Owens-Illinois in terms of size or diversity. Thus, an energy management program would not need to be as complex for The Andersons as compared to some of the larger companies previously mentioned.

Over the past few years there has been some provision made for energy management through the Environmental Protection Department. Through the efforts of Fred Wolf, energy usage data has been maintained back to 1977 in some detail. Although this information provides a good starting point in energy management, record keeping alone will not yield the results expected from a well-organized management plan.

The draft policy statement for an energy management program gives a suggested general outline for the shape of a program for the company. However, words and paper don't get the job done, people do. For this reason it is being proposed that the position of Company Energy Manager be created. This position would be responsible for implementing company energy policy and coordinating energy saving projects and energy usage among the various divisions. It is also suggested that each Operating Division manager assign the responsibility of Division Energy Coordinator to someone of responsibility on his staff. One division has already made this commitment and savings from its efforts will begin to be seen during the upcoming winter.

THE ENERGY MANAGER

This position will be patterned after similar positions at larger companies. The position will be responsible for planning for adequate energy supplies at all Andersons locations. The position will also be responsible for collecting and analyzing energy use data and for communicating this information to the company managers. The incumbent will work closely with each operating division manager or his Energy Coordinator to determine what engineering or management steps can

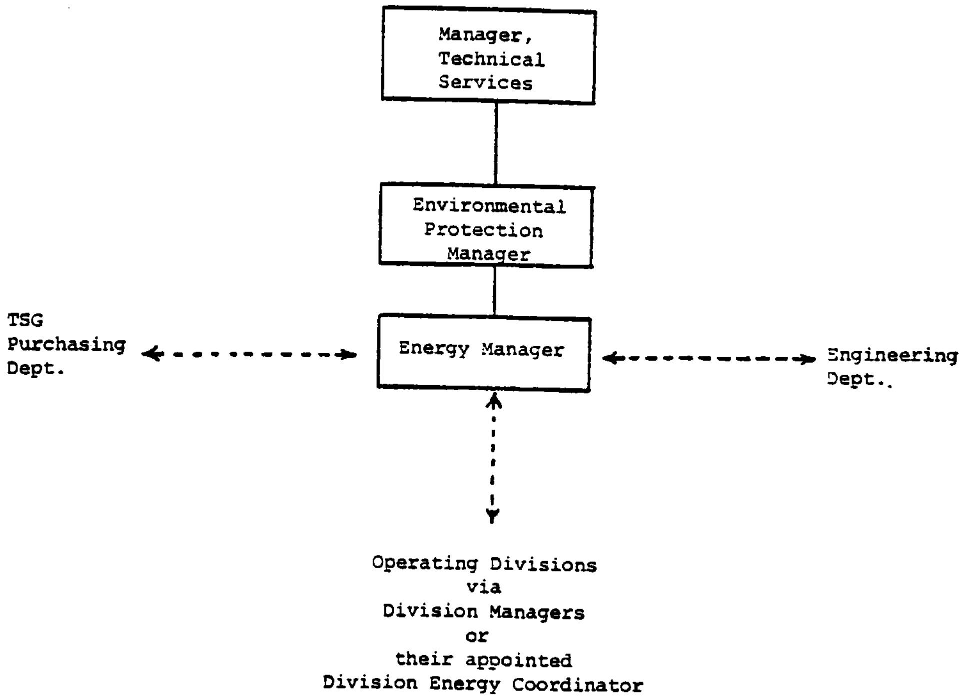


Figure 5. Schematic of proposed Energy Management Program organization.

be taken to effectively reduce energy costs in that division. This position will be responsible for setting up a communications program that will reach all employees of the company and will encourage an energy awareness at work and at home. The Manager will also be responsible for serving as the Energy Coordinator for the Technical Services Group to include Maintenance, Fabrication Shop, and other energy usage within that group.

Because of the nature of the job, the Energy Manager will work closely with the Engineering and Purchasing Departments of Technical Services. Thus, an initial thought was to have the Energy Manager report to the Manager of Technical Services. This would provide the position with the needed company-wide exposure, as well as allowing easy access to the Engineering, Purchasing, and Maintenance Departments. However, it would not be practical to put what would initially be a one-man department under the TSG Manager. It is recommended that the Energy Manager position be placed in the Environmental Protection Department initially. The function of energy management exists there now and there is no reason for the function to be anywhere else for the time being. As time passes and the position evolves, it may become appropriate to move the position into Engineering, Purchasing, or possibly somewhere else within Technical Services.

The incumbent shall possess, at a minimum, a bachelor's degree in engineering with a background in thermodynamics and other energy areas. It would be advantageous for the incumbent to possess an advanced degree in engineering or business administration. Since the position will be covering somewhat untrodden ground, the incumbent should be a self-motivator and capable of working with minimal supervision. The salary for this position shall be commensurate with that of engineering and management positions with similar responsibilities within the company and shall also depend on the incumbent's qualifications.

Specific job accountabilities will include the following:

1. Collect and analyze energy use and cost data and communicate this information to management through an energy newsletter as needed.
2. Develop and implement a communications program with all employees to provide them with energy related information necessary for their participation in a company energy program and that will be helpful to them in their homes.
3. Work with each Division Manager or his appointed Energy Coordinator to develop management practices or new process techniques that will result in energy savings for the division and the company.
4. Assure adequate energy supplies at reasonable prices for all operating locations. Maintain appropriate back-up supplies and alternatives in the event of a major energy curtailment.
5. Remain abreast of all new energy technologies that could be applicable to The Andersons. Investigate the use of process wastes or by-products as alternative energy sources. Keep updated on any legislation or regulation that would affect energy costs or supply.

This position will require some clerical support in order to properly collect and file data and issue required internal and external correspondence. However, at least initially, this workload probably can be handled by existing personnel.

THE DIVISION ENERGY COORDINATORS

An inherent problem with many energy programs in existence today is that the energy manager has no direct line authority to carry through with any programs or ideas. In order to circumvent this problem, it is suggested that each operating division manager assign someone on his staff the responsibility of Division Energy Coordinator. Not every division will have the need of this position, but as energy prices continue to rise, hopefully all division managers will be able to justify such a position.

The Retail Division has gone in this direction already and appointed not only a Division Coordinator, but also designated Energy Coordinators at each profit center. The Coordinators were assigned this responsibility in addition to their existing operation responsibilities. Through the efforts of the Division Coordinator and with assistance from Technical Services, the Retail Division, by the end of this calendar year, will have insulated the walls of the General Store, converted the Service Shop from fuel oil to natural gas heat, and installed a computerized energy load management system in the General Store. Total annual savings on these three projects is estimated to be approximately $22,000 based on present fuel costs and all three projects have simple paybacks of less than two and one-half years. Possibly more important than the savings from these three projects is the fact that division management realizes the importance of energy management and has made a commitment toward achieving it.

Savings on such projects as those mentioned above might have been achieved without the presence of a Division Energy Coordinator. Efforts from a Company Energy Manager alone might have yielded similar results. However, the key to having Division Coordinators is the fact that they will have closer contact on a day-to-day basis with division management and employees than will a Company Energy Manager. Thus, when the Energy Manager sees an area in a division that could yield savings through some change, he can work through the Division Coordinator much more easily than he could work without him. On the other hand, because he is a part of the division structure, the Coordinator may see something that could be changed, because he is in that division daily, that the Energy Manager might not be aware of. In this case, the Coordinator could work with the Energy Manager to effect whatever changes seemed necessary.

A Division Energy Coordinator is not necessarily required for this process or information exchange to take place between the Energy Manager and division management. However, by assigning the responsibility to someone on his staff, the Division Manager is assuring himself that someone will be monitoring energy in his division at all times. In selecting the Division Coordinator, the Division Manager should look to someone on his staff with line authority who is capable of handling this added role along with his other normal responsibilities. The idea of having someone with line authority is not so that the Coordinator will be iron-fisted with his subordinates on energy matters. On the contrary, experience indicates that employees better respond to the ideas of someone they work with and respect than they do to those ideas of someone who is outside their working area and is not familiar to them. With a full-time Energy Manager working with each division, through the Division Coordinators, a strong energy saving program can take shape at The Andersons.

THE ENERGY MANAGER: SPECIFIC AREAS OF INVESTIGATION

Earlier sections of this report have mentioned in general terms what an Energy Manager should do in terms of running an energy management program. This section of the report will attempt to give more specifics concerning his responsibilities and areas of investigation.

Before beginning improvements in energy usage, the Energy Manager will need to establish what present and past usage patterns are and have been. The Manager must also become familiar with all processes that his work may have an effect on. It is rather useless to begin actions in energy reduction unless it is known why the energy is being used and what it is being used for. At present, a good data base of energy usage is available. Most energy contracts and rate structures are on file and bills and accounting prorations are available back through 1977 for the Maumee-Toledo installations. This is not to say some refinements, such as additional metering, are not needed but most necessary information for every profit center in the company is available.

In addition to energy use data, corresponding production data should be collected for production areas. By combining these data, an efficiency ratio can be determined. For example, in 1979 the Agricultural Fertilizer Division used a total amount of electricity, natural gas, etc., equivalent to 10,841,340,000 BTU's while producing 524,284 tons of finished product. Thus for the year, the division averaged 20,680 BTU's per ton of feed. This type of number can give one indication of how energy was used and can be compared to past years or months, or can be compared with information from other companies producing similar products. With in-depth study, standards can be developed for each process or plant and used as guides in comparing actual usage data. This kind of information is not an absolute, but can serve as one of a number of indicators on energy use. These indicators can then be communicated to management.

As the Energy Manager begins his collection of usage data, he should also begin observing plant operations in general. He should be looking for obvious wastes in energy such as lack of insulation, poor weather stripping, steam leaks and compressed air leaks, among others. He should also be observing the processes themselves, looking for waste due to bad management or operation technique. The Energy Manager must become familiar with the processes his work will affect. Walk through tours of the various departments in the company and discussions with the respective department managers should allow the Energy Manager to begin to formulate a list of projects for indepth investigation. The following discussion gives examples of such projects. Some of the projects mentioned have recently been completed. Others are examples of areas for future savings.

In 1979 the grain driers in Delphi were converted from #2 fuel oil to natural gas. Total cost of this conversion was approximately $17,300 which included pipeline installation and burner conversion. Through October this fuel conversion reduced costs by $94,000 in 1980 alone. The Maumee Service Shop has recently converted its heating system from fuel oil to natural gas. This just completed job cost $6,900 but should produce annual savings, based on today's prices, of near $3,200.

In 1978 ceiling fans and an "Energy Master" system were installed in the Fabrication Shop to reduce heating costs. The fans were designed to bring warm air near the roof down to work level while the "Energy Master" was designed to shut off building heat at night and on weekends except to maintain a minimum temperature of 45°F. Total cost of these installations was $4,550. First year savings for this project was over $3,500.

Two projects have recently been undertaken at the Maumee General Store that will reduce heating and electrical costs. Foam insulation has been pumped into the exterior block walls of the store at a cost of $12,700. This insulation will reduce heat loss and thus save an estimated $6,600 per year. An energy control system is now being installed in the General Store at a cost of $10,300. This unit is user programmable and will monitor electrical demand in the store. To keep demand at a minimum, it will cycle large electric loads such as air conditioners on and off. It will also allow for night setback of thermostats to a preset minimum. Annual savings expected from this system is estimated to be over $12,000.

Two projects have been under study at the Feed Mill dealing with energy savings. The first involves the installation of a heat exchanger to preheat boiler feed and process water. At present water from the city is used to cool the pellet mills and the pet food extruder in the Feed Mill. This water enters these machines at approximately 65°F, is heated to 100°/110°F by the machines, and is then dumped into the city sewer. It has been proposed that a heat exchanger be installed that would allow this cooling water to be recirculated thus avoiding city water charges of $2,600 per year. The heat collected by this 100°+ water would be used to preheat incoming boiler and process water from 65°F to 75°F while the cooling water is reduced from 100°+ to 80°F. Savings resulting from this preheating would be near $1,500 per year. Thus, total savings would be near $4,100 per year while the installed cost is estimated to be only $3,200. The other Feed Mill project also deals with water. At present process water is added to the pet food products and is then evaporated after extrusion in the drying process. However, we are being charged by the city of Maumee for sewage services on this water. With the city's permission, it could be possible to install a meter on the process water line so as to avoid sewer charges on this water. Estimated annual savings are near $600 with cost estimated to be less than $1,000.

Several possibilities exist for electricity savings in Maumee. An ongoing problem at the Maumee plant and at the General Store is low power factor. Although power factor has no direct impact on energy use, it can have an impact on cost. Depending on the utility's rate structure a low power factor (below 85%) can result in a penalty while a high power factor (above 90%) can result in discounts. The power factor for the Maumee plant is presently running near 88%. Correction of this power factor to 95% by the addition of capacitors where necessary would result in annual savings of $24,000. The cost of this correction is not yet known. During the summer months, the General Store power factor falls to near 87% due to the air conditioning compressor motors. If this were corrected to yield a 95% power factor the annual savings would be $1,650. The cost of this correction is unknown at present.

Another possibility for electrical cost savings involves a change in the service voltage at the Maumee plant. At present the plant has 12,470 volt service. A 69,000 volt line runs to near the southwest corner of the General Store. If the service voltage at the Maumee plant were switched to 69,000 volts, a reduction in rates would occur resulting in an annual estimated savings of $40,000. This savings is based on the assumption that the General Store, Service Shop and Tire Shop would be on this new service also. In order to enjoy these savings a new master transformer station would have to be constructed to handle the 69,000 volt service. Cost of this transformer station plus installation of required feeder lines is estimated to be $300,000 to $400,000.

Another possibility for electrical savings involves controlling electrical demand. All commercial and industrial electric bills are based not only on kilowatt-hour usage, but also on kilowatt demand. The demand portion of the total Maumee plant electric bill can be as high as 30% or $30,000 per month.

This demand charge is not based on average demand over the month, but rather on the peak demand occurring in any thirty minute period. Peaks in demand will normally occur in any business, normally at the time of daily start-up or some other period when many electric loads are turned on at almost the same time. Demand control, also called peak shaving or load management, involves management methods set up to avoid such peaks. Computerized equipment can also be purchased to automatically manage loads according to a desired limit. There are indications that peaks do occur at the Maumee plant. At present, each incremental kilowatt of demand costs $6.55 and recent demand levels have been near 5,000 kw. Because of the diversity of the operations, managing the demand will require some indepth study.

A review of specific electrical loads, such as motors or lighting could turn up significant savings possibilities. New high efficiency motor designs and new lighting sources are being marketed every day.

A review of compressed air requirements could also lead to significant savings opportunities. An example of the possibilities exists at the Fabrication Shop. At present a 150 horsepower compressor, originally to be used only for sandblasting, is being used for shop air requirements because the 10 horsepower compressor designated for those needs is not large enough to keep up with demand. This extra use of the large compressor is costing the Shop as much as $700 per month. In all probability the small compressor will need to be replaced with a larger one, possibly 15 or 20 horsepower. However, the elimination of air leaks in lines and equipment could be enough of reduction in load to allow use of the existing compressor alone. The elimination of air leaks and the replacement of several small compressors by one large unit could result in substantial savings in energy and maintenance throughout the company.

The use of alternative energy sources could provide considerable savings and merit closer study. With natural gas prices presently at $3.00 per thousand cubic feet and rising to $4.00 by 1982 the economics of alternative fuels begins to look atrractive. Possible fuel sources could include marginal cob products, by-husks, waste paper and cardboard, broken pallets, waste engine oil, and old tires. All of these materials could be burned in a fluidized bed combustor or reduced by pyrolysis to produce low BTU gas or heat for crop drying or for steam production. However, such equipment would be of high capital expense and the economics involved would require considerable study.

The projects mentioned above are examples of the type of work the Energy Manager should try to initiate and coordinate. Building insulation, redesign of HVAC systems, heat recovery from drier and boiler exhaust, and other similar projects are also areas that the Energy Manager should investigate. The Energy Manager should not be a project engineer and design every phase of a project. Rather he should initiate energy cost saving projects within each division. Once a study or project is approved he should coordinate between engineering, purchasing, maintenance, and division mangement to insure optimum energy savings.

One of the most valuable functions of the Energy Manager should be his efforts toward employee/partner energy awareness. A quarterly energy newsletter to management containing current costs and projections could be a valuable planning and budgeting tool. Through the use of posters, mailings, and announcements, the Manager should strive to inform all individuals in the company on energy issues. By supplying hints and tips on energy savings methods, a saving attitude should begin to be developed. If people can develop conservation habits at work that carry over to their homes or vice versa, we are all better off. Conservation in industry and commerce will only occur when the line personnel that operate the equipment begin to take an interest. It is imperative that these personnel be included in any savings efforts.

In summary, The Andersons has a great opportunity to realize significant savings by implementing an energy management program. Top level commitment to such a program is essential and should be asserted through the issuance of a strong Energy Policy Statement. In order to carry out the policies of management, an Energy Manager should be appointed. The Energy Manager will be responsible for collecting information on company energy usage for use in management decision making, investigating new opportunities for energy savings through equipment or process changes, assuring appropriate supplies of energy at available prices, and involving all employees in the conservation effort. Each operating division is urged to assign someone the added responsibility of Division Energy Coordinator similar to the example of the Retail Division. This action will aid both the Energy Manager and the division concerned in reducing costs and realizing energy use goals.

Proper management of energy use both now and in the future will play an important role in company profitability. The sooner an effective, comprehensive program is initiated the sooner proper management of precious resources can begin.

APPENDIX

THE ANDERSONS

Draft Statement of Energy Policy

The Andersons recognizes that the era of boundless energy resources has passed and that proper management of remaining resources is vital to the welfare of our society. Energy is essential to our way of life and is required in every phase of commerce and trade that we know today. However, it is realized that, in order to meet our responsibilities to our customers and our community, The Andersons must become more effective in utilizing its energy sources.

Recognizing the benefits of sound energy management to itself, its customers, and the community, The Andersons establishes and endorses an energy management program that will be responsible for the following.

Conservation--All equipment and processes are to be installed and maintained to provide optimum energy utilization. Constant vigil must be maintained for new products and equipment that will increase overall energy efficiency provided they are economically practical. All employees and partners are to minimize energy usage in their work areas and are encouraged to do the same in their homes.

Security of Supply--Adequate alternative energy sources are to be maintained to minimize the effects of any curtailment of a major energy source. Product wastes and by-products are to be investigated for energy content and their feasibility as an energy resource. Long-range energy requirements are to be defined so that appropriate future energy sources can be located and utilized in an orderly and well planned manner.

Draft Statement of Energy Policy

Project Evaluation--A consistent, equitable method of economic analysis for energy capital improvements is to be developed. This method is to be consistent with existing company economic analysis methods, thus insuring the fair competition for capital within the company.

Industrial and Governmental Interchange--In order to allow for adequate business planning and to assure equitable government policies, an effective energy program will have an interface with government agencies and industrial groups. Such an interface will allow for adequate updating in new equipment and processes and will allow for appropriate response to proposed government regulations affecting energy supplies. The public welfare is best served when inputs from various sectors form the basis of government policy on national issues such as the energy issue.

APPENDIX B

Revision Request in Priority 2
Natural Gas Volumes for The Andersons Maumee Complex

AUG 4 1980

The Andersons P.O. Box 119 Maumee, Ohio 43537 • 419/893/5050 • TWX 810/449/2692

August 4, 1980

Mr. Robert L. Duket
Senior Industrial Engineer
Columbia Gas of Ohio, Inc.
701 Jefferson Avenue
Toledo, Ohio 43653

Dear Mr. Duket:

I am returning the revision request concerning Priority 2 natural gas volumes for The Andersons' Maumee Plant. We are requesting an increase totaling 21,402 MCF over our previous curtailment volumes based on an increased grain drier capacity of 20%. Attached to the request, please find a statement explaining how the 21,402 MCF volume was obtained.

If you require any further information, please contact Fred Wolf or myself.

Sincerely,

THIS COPY FOR

THE ANDERSONS

Bill Norman

Bill Norman
Engineer

BN:cb

Attachments

cc: Tom Anderson
Jim Appold
Art Henderlong
Duane Leedy
Jim Maas
Ron Meier
Tom Weidner
Fred Wolf

Revision of Natural Gas Volumes Classified as Essential Agricultural Requirements

Name THE ANDERSONS

Address 527 ILLINOIS AVE
MAUMEE, OHIO 43537

SIC No. 2753

Acct. No. 341 10 1100 03800 04

We hereby request Columbia to replace those volumes listed in Column 3 and classified as essential agricultural requirements with the revised volumes listed in Column 6.

(Column 1) Month	(Column 2) Actual Deliveries Mcf	(Column 3) Volumes Presently Classified EAR* Mcf	(Column 4) Month	(Column 5) Actual Deliveries Mcf	(Column 6) Revised Volumes** To Be Classified EAR* Mcf
May 1978	13,030	11,786	May 1979	8680	11,799
June 1978	6,713	8,901	June 1979	5711	8,915
July 1978	3,798	5,476	July 1979	4153	5,506
Aug. 1978	6,428	5,265	Aug. 1979	11522	6,626
Sept. 1978	4,218	4,535	Sept. 1979	7194	5,204
Oct. 1978	14,986	16,652	Oct. 1979	18043	19,181
Nov. 1978	28,550	41,255	Nov. 1979	34427	45,819
Dec. 1978	24,603	38,867	Dec. 1979	35626	43,924
Jan. 1979	11,238	36,472	Jan. 1980	21343	40,588
Feb. 1979	13,543	37,268	Feb. 1980	14142	37,594
March 1979	11,028	24,950	March 1980	23919	27,002
April 1979	9,971	18,644	April 1980	13048	19,314
TOTAL	148,106	250,071	TOTAL	207808	271,472

*Essential Agricultural Requirements as defined by the U.S. Department of Agriculture in 7 CFR Section 2900.

**The volumes listed in Column 6 may include increases due to essential agricultural growth, additions or reductions for an abnormal processing season etc., but may not include gas volumes over 300 Mcf on a peak day where the ability to use an alternate fuel (coal or residual oil) existed on August 29, 1979, and in fact such alternate fuel was used at any time since 1973, or volumes of gas for a new boiler that has a capacity in excess of 300 Mcf per day and is first put into service after August 29, 1979, except diesel engine or turbine designed to use distillate fuels.

I hereby certify and affirm that the information submitted herewith is in accord with Federal Energy Regulatory Commission Order 29, which was issued May 6, 1979, and also in accordance with the Federal Energy Regulatory Commission Order 55, which was issued October 26, 1979, and is true and correct to the best of my knowledge and belief.

Subscribed and Sworn to Before Me

This 4th day of AUGUST 1980.

My Commission Expires 10/30/84

Charles J. LaFountaine
Notary Public

CHARLES J. LaFOUNTAINE, Lucas County
Notary Public, State of Ohio
My Commission Expires Oct. 30, 1984

Signed Thomas E. Weidner

Typed Name Thomas E. Weidner

Title General Partner

CALCULATIONS FOR ADJUSTMENTS TO NATURAL GAS VOLUMES

The following table summarizes calculations used to determine revised volumes requested to be determined as Essential Agricultural Requirements. Since the last twelve (12) month period shown on the revision document, grain drier capacity has been increased by approximately 20%. Thus we are requesting an increased allotment based on this increased capacity as follows:

Month	Grain Drier Usage (MCF)	20% of Column 2 (MCF)	Present EAR Volume (MCF)	Requested EAR Volumes (MCF)
May 1979	66	13	11,786	11,799
June 1979	69	14	8,901	8,915
July 1979	149	30	5,476	5,506
Aug. 1979	6,806	1,361	5,265	6,626
Sept. 1979	3,346	669	4,535	5,204
Oct. 1979	12,645	2,529	16,652	19,181
Nov. 1979	22,821	4,564	41,255	45,819
Dec. 1979	25,287	5,057	38,867	43,924
Jan. 1980	20,581	4,116	36,472	40,588
Feb. 1980	1,631	326	37,268	37,594
March 1980	10,262	2,052	24,950	27,002
April 1980	3,348	670	18,644	19,314
Total	107,011	21,402	250,071	271,472

THE ANDERSONS

Thomas E. Weidner

Thomas E. Weidner
General Partner

VITA

Name:	Bill Mack Norman
Born:	November 26, 1954 - Temple, Texas
Parents:	Weims L. Norman and Hope Norman
Marital Status:	Married
Wife's Name:	Cynthia Gale (Kauffman) Norman
Permanent Address:	818 Mesquite, Floydada, Texas 79235
University:	Texas A&M University, College Station, Texas: Bachelor of Science, Agricultural Engineering (May 1977); Master of Engineering, Agricultural Engineering (May 1979); Doctor of Engineering (May 1981)
Work Experience:	Engineer, The Andersons, Maumee, Ohio (January 1980 through December 1980)
Member:	American Society of Agricultural Engineers; National Society of Professional Engineers; Tau Beta Pi, National Engineering Honor Society; Alpha Zeta, The Honor Society of Agriculture; The Honor Society of Phi Kappa Phi; Alpha Epsilon, The Honor Society of Agricultural Engineering
Honors:	Phi Eta Sigma, Freshman Honor Society; Outstanding Senior, College of Agriculture; Texas A&M University Undergraduate Fellow; Ralston Purina Scholarship; Student Honor Award, American Society of Agricultural Engineers

The typist for this report was Dorothy Holtkamp.