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THIRD TECHNICAL SESSION

Lawrence E. Tuck, *Vice-President, Presiding*
Boston Edison Company, Boston, Mass.

REFUSE/ENERGY COMMITTEE PROGRAM

Frederick R. Callowhill, *Chairman*
Gilbert/Commonwealth Companies, Quechee, Vt.

GARBAGE IN THE EYES OF THE BEHOLDER: THE UTILITY COMPANY

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ABSTRACT

Monroe County, New York is engaged in a project to recover the maximum amounts of energy, metal, and silicates from solid waste. Raytheon Service Company is the prime contractor for a multi-phase contract that involves the design, construction management, start-up, and operation of a 2000 ton/day resource recovery facility. The facility will process municipal, commercial, and light industrial waste at a rate of approximately 140 tons/hr. Products which will be reclaimed include refuse-derived fuel, iron, glass, aluminum, heavy nonmagnetic metal, sand, and a residual product for disposal.

The refuse-derived fuel (RDF) is adaptable for boiler fuel. Rochester Gas and Electric Corporation, whose franchise territory includes Monroe County, has agreed to purchase as much of the RDF as it can utilize to be burned with coal at Russell Station, the major coal-fired electric generation plant in its system. The Company is cooperating with the County to help make the resource recovery program a success. No profit to the utility nor any cost to its customers and stockholders is expected.

INTRODUCTION

Garbage means many things to many people. To a householder, garbage is what his local government is paid taxes to get rid of. To the government, it is a major headache to be buried wherever the neighbors make the least fuss. To an environmentalist, its burial nearby is something to militantly object to. To the conservationalist, it is a gold mine of untapped resources. In all cases the disposal of garbage is a problem, and the best solution is a bit of each of the above. Although it will probably always cost the taxpayers something, the best solution is to salvage all the possible reusable materials, thus burying as

little as necessary in acceptable landfill areas, and charge the taxpayer a minimum for the service.

The pretreatment of waste material prior to disposal has become essential, due to recent environmental laws regarding landfill, and the ever-increasing hauling distance from metropolitan areas to both politically and environmentally acceptable landfill sites. This pretreatment can range from simple shredding for better transportation and compaction, to volume reduction by incineration. In any case, all that has changed is the shape and texture of the problem. However, if the metals and glass can be recycled during pretreatment, and if the combustibles can be used as an energy source, the bulk to be landfilled can be significantly diminished. In addition, the value of the energy and reusable materials can partially offset disposal costs, lessening a burden on the taxpayer, the government, and the environment.

BACKGROUND

In 1971, the City of Rochester, as well as the surrounding towns and villages in Monroe County, disposed of almost all of its ordinary wastes through municipal or private collection and disposition in a variety of landfills throughout the area. Many of these landfills did not comply with the New York State Sanitary Code. Seven landfills had been exhausted or closed since 1968, due to Code violations. The City's three municipal incinerators had recently been closed, since they could not economically conform to the current air pollution standards.

Recent and reliable figures for the quantities of waste generated in the County were available from previous engineering studies, as were estimates of waste generation through the year 2000. Of major interest to the county government was the ordinary or municipal portion of the waste stream, which was collected and disposed of under the auspices of the various city, town, and village governments. The municipal waste stream by quantity was almost equally divided between the City of Rochester and the towns and villages of the County outside the City. This portion of the waste generation was predicted to be approximately 2000 tons/day by the late 1970's or early 1980's. The decline of available landfill sites within the county, as well as the public dissatisfaction with existing landfill operations and the closure of the City's municipal incinerators, mandated an immediate and innovative alternative solid waste management program for the County.

Operation Resource

Early in 1971, a member of the Monroe County Legislature, himself an engineer, suggested to the Rochester Engineering Society (RES) [an umbrella-type organization consisting of 700 professional, scientific and technical members, along with 30 other affiliated societies], that it might wish to undertake a comprehensive study of solid waste disposal in the County, and recommend a long-range solution to the increasingly complex dilemma posed by the existing unsatisfactory landfill system. In response to this challenge, the RES assembled a volunteer Task Force for a project called "Operation Resource." Nearly a hundred engineers, scientists, economists, planners, and interested citizens joined the Task Force to define the problems faced by the County, and to attempt a viable and environmentally sound solution.

The RES Task Force issued a three-volume final report early in 1972 that included a short-range (five-year) recommendation for continued sanitary landfill operation on a unified, county-wide basis, and a long-range recommendation to proceed with the development of a major resource recovery program that would return usable materials to the economic mainstream, and ultimately reduce the cost and environmental degradation of the old landfill program.

Four technical design criteria were established by the Task Force for the long-range resource recovery system:

1. Methods of solid waste processing brought into large-scale operation must be sufficiently reliable to assure that solid wastes will be effectively disposed of on a regular basis. Experimental techniques that had not been thoroughly proven should not be used.
2. The systems of disposal or processing should be sufficiently flexible to adapt to future technological changes, changes in the composition of the waste stream, and changes in the markets for recycled materials.
3. Other factors being equal (which they seldom are), the most desirable processing system would be that which provides for disposal of the solid wastes at the lowest cost to the public.
4. The selected system should achieve optimal resource recovery and minimize environmental pollution, so as to preserve natural resources and enhance the quality of the total environment.

A number of solid waste processing techniques were considered by the Task Force as possible solutions to the Monroe County problem. Among them were sanitary landfilling, incineration, fiber recovery, composting, and pyrolysis. The Operation Resource Report recommended:

1. The principal method of disposal, at the outset of the long-range period, should be sanitary landfilling preceded by shredding. Sanitary landfill provides an essential basis upon which to build a long-range resource recovery program.
2. When technological and marketing conditions are favorable, other components should be added to the system. In this manner, the significance of landfilling in the total program can steadily be diminished as resource recovery processes are brought on line.
3. In considering the addition of new components to the system, priority should be given to proven fiber recovery processes.
4. Secondary consideration should be given to composting as an additional major component of the system.
5. Incineration should be added to the system as a primary method of disposal, only if technological and marketing developments render the other alternatives untenable.

The report stressed that the key decision in the establishment of the resource recovery program lay in the manner of processing the combustible portion of the waste stream, since this represented over 50% of the waste stream and its manner of treatment would be irreversible. Glass and metal could be recovered as usable products, irrespective of the manner of processing the combustible element. The construction of a large municipal incinerator was rejected,

largely because its lack of flexibility would tend to foreclose the use of new technologies for economic fiber recovery. Four specific steps were outlined to the Monroe County Legislature for implementing the proposed program:

1. Form a county-wide solid waste management district and hire a county director for the program.
2. Initiate the short-range program immediately as a prelude to the long-range program of resource recovery.
3. Select and retain a firm to establish a dynamic marketing and technical plan for optimal recovery of resources from the solid waste stream.
4. At the earliest possible time, dependent upon the outcome of step three, implement one of the following alternatives:
   a. Execute a contract for a recycling facility.
   b. Construct a composting or incineration system to reduce waste volume prior to landfilling.

County Response to Recommendations

The Monroe County Legislature and its Administration subsequently accepted and is currently implementing the recommendations submitted by the Rochester Engineering Society. A director was hired to coordinate the county-wide solid waste program. Legislation was proposed to give the County title to and control over the solid waste generated within it. The first county-run sanitary landfill operation has since been inaugurated as part of the short-range program.

The firm of Hercules Inc. was retained, following open competition, to perform the detailed market analysis and to design the basic resource recovery system. They determined that sufficient markets were either already available or could be developed to accept all of the anticipated recycled products from a Monroe County facility. Their system design paralleled the recommendations of the RES Study and called for the recovery of ferrous and non-ferrous metals, glass, sand, a clean paper fraction, and a mixed dry, combustible (largely paper) fraction that could have several uses, including use as a supplemental boiler fuel. Subsequently, in a second open competition, the County Legislature contracted with the Raytheon Service Company of Burlington, Massachusetts to design, supervise construction of, and operate for an initial five-year period a resource recovery facility for Monroe County, capable of handling 2000 tons/day of ordinary or municipal solid waste collected there.

PROJECT SPECIFICS

Raytheon Resource Recovery System

The Monroe County Administration purchased from the Urban Development Corporation a 10.9-acre site for the construction of the resource recovery facility in an industrial park, which was located at the site of a former city dump. The facility is to be owned by the County of Monroe, and the 28-million dollar capital cost will be covered by local bonds and the New York State Environmental Bond Issue on a 50-50 basis. At this time the design portion is complete, and bids were let for the project. Construction commenced on October 15, 1976. Start-up time is currently estimated at 22 months from this date, placing initial operation in late 1978.

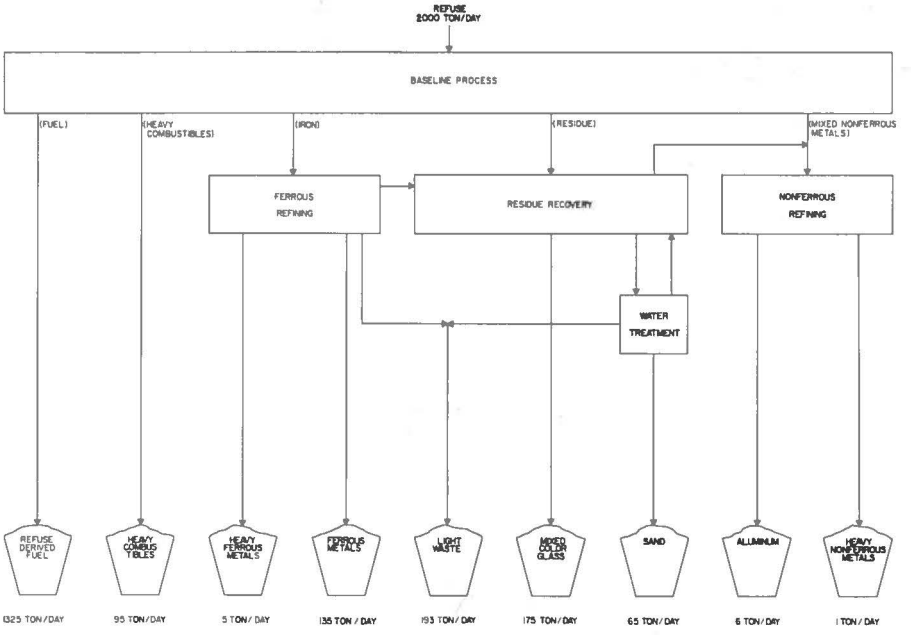

Fig. 1—Process system configuration.

The Raytheon design is based upon many tests made on municipal solid waste processed at the U.S. Bureau of Mines pilot plant at College Park, Maryland over the past several years. The system consists of a base line process to be followed by residue recovery module, as shown in Figs. 1, 2, 3. Based on detailed testing and extensive sampling of actual Monroe County solid waste, Raytheon has predicted the following resource recovery facility output, based on an input of 2000 tons/day:

Recovered Product	Quantity Tons/2000 Tons Refuse
Refuse derived fuel (RDF)	1325
Ferrous metal	135
Aluminum	6
Heavy non-ferrous metals	1
Mixed color glass	175
Clean sand	65
Landfill material	198
Heavy combustibles	95

The product designated as Refuse-Derived Fuel (RDF) is suitable for suspension burning in existing coal-fired boiler systems. It can also be used as raw material for other forms of supplemental fuel, or as the basis for other cellulose fiber-based products. Among these other products are recycled paper and corrugated cardboard, wall board and other construction materials, and pelletized fuel or fuel gas, oil or char from a subsequent pyrolysis process. In other words, this system leaves all possible future options for disposal or

treatment open to the County. Thus, the question of how best to utilize the paper and cellulose fiber fraction of the waste stream can be answered in various ways at various times, as a function both of developing solid waste technology and changing markets.

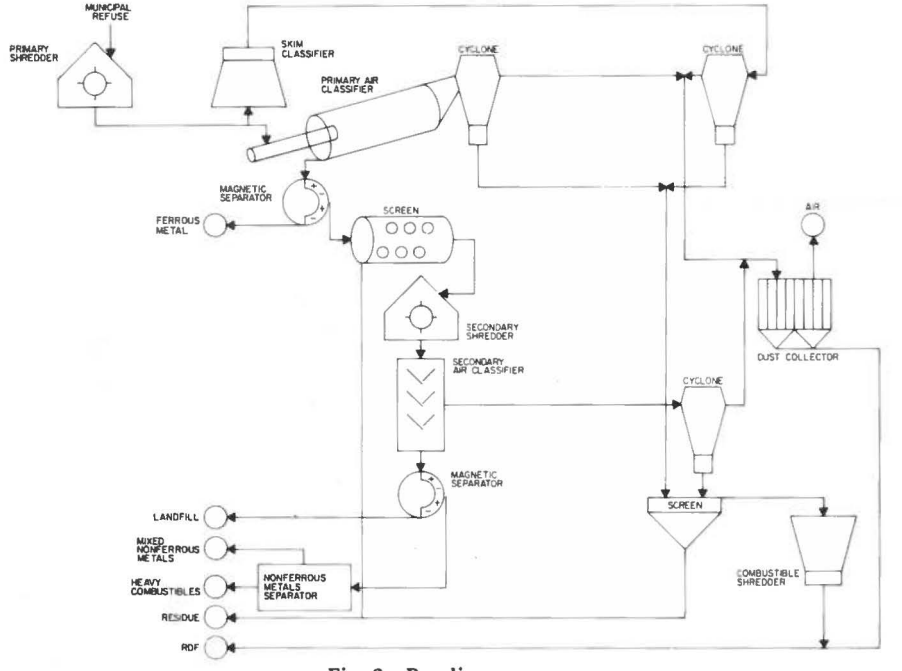

Fig. 2—Baseline process.

Role of Local Power Utility

Rochester Gas and Electric Corporation, a public utility with headquarters in Rochester, New York, provides gas, electric, and steam service for 270,000 customers. The 23,000 square miles of RG&E franchise area includes five counties in Western New York, with the majority of the Company's customers located in Monroe County. The Company has become an important partner in the overall development of the Monroe County Resource Recovery Facility, as well as the major customer of the RDF. RG&E operates Russell Station, a major base-loaded, coal-fired power plant in Monroe County. Russell Station utilizes four Combustion Engineering Inc. tangentially-fired, suspension-type, coal-burning boilers with nominal MW ratings of 42, 62, 62, and 75.

When the County of Monroe approached RG&E as a potential customer for the RDF product, the Company agreed to cooperate in developing a way to use the solid waste as a fuel for the generation of electricity. Present plans call for the building of an RDF receiving facility, and the conversion of two of the four Russell Station boilers to provide capability for burning the RDF as a supplemental fuel, initially at 10% of the total heat input. Assuming successful operation at this level, the burning rate would be increased to 20% of the heat input in gradual steps. After successful tests in these two boilers, the other two boilers will be converted. Fig. 4 shows a plot plan of the proposed receiving facilities.

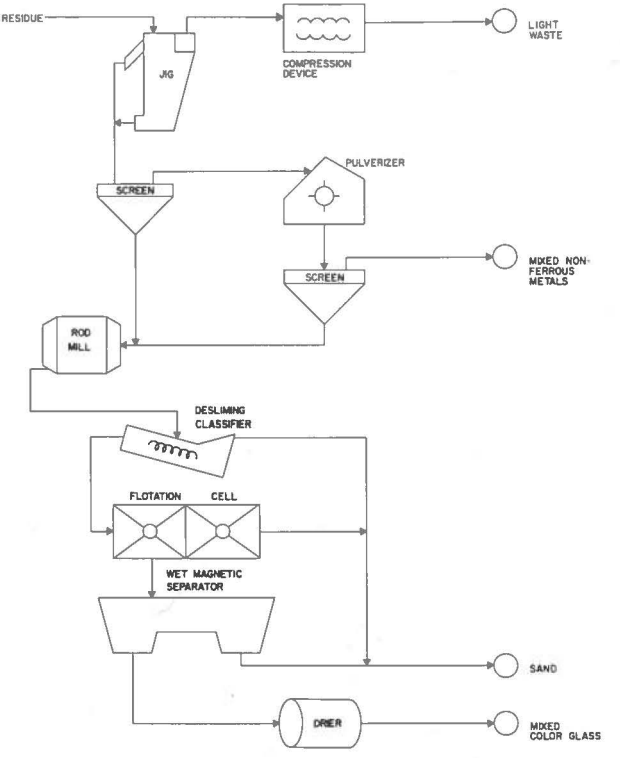

Fig. 3—Residue recovery system.

There were several requirements placed by the utility on this use of its power plant:

1. The burning of RDF cannot affect the plant's availability and/or reliability.
2. The plant must continue to be operated within environmental constraints.
3. Any additions to the plant facilities for the handling of RDF must be environmentally compatible regarding noise, odor, and air and water quality. All additional operating and maintenance costs relating to burning RDF must be reimbursed to the utility.

The resulting contract between RG&E and Monroe County reflected the above criteria. It was successfully negotiated, and signed by both parties on October 26, 1976. It might be of interest to know that this contract was signed 2-1/2 years after a letter of intent was sent to the County Manager from the Chairman of the Board of RG&E, pledging the utility's cooperation "in developing a use for solid waste as a fuel for the generation of electricity." The terms of the contract depict what was felt by RG&E to be the role of a private power utility in a municipality mixed resource recovery system: that of a cooperative partner in the utilization of available energy released or made available from the facility, in a manner that does not result in a cost or profit to the investor or customers of the utility. By coincidence, the Public Service Commission (PSC) of New York also stated this precise view in a policy paper dated February 14, 1974.

RG&E agreed to accept all the RDF that it is capable of burning within the restraints previously mentioned. Actual testing obviously could modify this amount.

Based on operating curves for a typical summer and winter week and an estimate of 6000 Btu/lb for RDF, it was predicted that the four boilers could burn a total of 710 tons/day during the winter and 620 tons/day during the summer, on a seven-day per week basis. The summer rate is based on all four units burning refuse for an average of 9.7 hours at 20% of the heat input from maximum operating load to 75% of MCR (maximum continuous rating), and an average of 7.6 hours at 10% maximum load heat input from 75 to 50% MCR. In the winter, the 20% and 10% average time factors are 13 and 6.4 hours, respectively. The boiler manufacturer recommended that initial refuse burning be restricted to 10% of the gross heat input, from maximum load down to 75% of MCR, and 5% from 75 to 50% of MCR until an evaluation of erosion and corrosion wastage has been made. Since this represents only about half of the RDF produced by the County's plant, other customers for fuel or the cellulose fiber product will need to be developed.

Specifications for the RDF were developed by the County and RG&E staff jointly, and appeared in the County's "Request for Proposal" for the recycling facility issued in April 1974. Those specifications are included in the Appendix as "Schedule A."

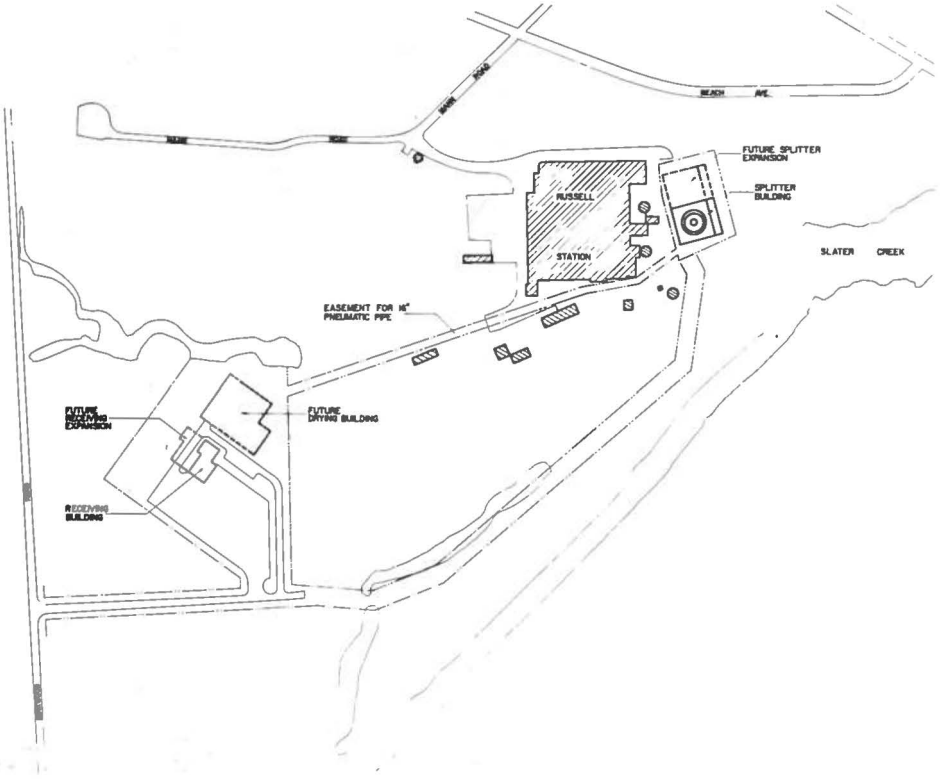

Fig. 4—Site plan.

FINANCIAL AGREEMENTS

The contract between RG&E and Monroe County states that the installed cost of the RDF delivery facilities, storage facilities, and conveying equipment located at the Russell Plant site will be borne by the County. At this time, the total cost of these facilities is estimated to be between six and eight million dollars. The cost of the boiler conversions and the RDF piping inside the plant will be the financial responsibility of Rochester Gas and Electric Corporation. The boiler conversion cost, however, will be amortized over 20 years, and this cost will be included in the RDF payment formula (Schedule B). Although the County is financially responsible for the receiving facilities at Russell Station, RG&E is responsible for the design and preparation of the bid packages. RG&E chose Raytheon Service Company to design its facility so that there would be maximum continuity between the County's Recovery and Receiving Facilities. Raytheon bills RG&E for its services, which in turn are billed to the County for payment.

The contract also states that the Rochester Gas and Electric Corporation will agree to a long-term lease to the County, of the land required on its property for the delivery and storage equipment for the fuel, with suitable recapture provisions if the contract is terminated for any reason. All systems installed at the power plant site shall be approved by RG&E, and shall be designed for a fuel delivery to the station at a 30% ratio of RDF to coal by heating value. It is also understood that RG&E will maintain and operate all RDF facilities on its property. Transportation of the RDF to the boiler plant will be the responsibility of the County.

During the initial testing period, the fuel will be delivered to the testing site at no cost to Rochester Gas and Electric Corporation, and will be delivered in quantities compatible with the testing program. If at any time during this program the bottom ash becomes contaminated with foreign material to an objectionable extent, the County will be responsible for the disposition of this bottom ash in a sanitary landfill.

Upon completion of testing and successful demonstration of the commercial and economic feasibility, to the satisfaction of RG&E, the Company will enter into negotiations with the County or its agent for a long-term contract concerning the quantity of fuel to be delivered, and the cost of the fuel to RG&E. The cost will be computed annually, based upon the current cost of coal, less all of the additional costs connected with the operation and maintenance of the conveying equipment and the burning of the fuel. These costs shall also include the cost of accelerated write-off of any equipment necessary for the conversion that was purchased and installed by the Company, as shown in the RDF payment formula, Schedule B.

STATUS OF PROJECT

The County's Resource Recovery Facility is now under construction, and should be completed in early 1979. The conceptual design for the receiving facility at Russell Station has been completed, and final design is scheduled to be completed in early 1978. The present construction schedule for the receiving facility depicts an 11-month gap between the completion of the

two facilities; thus, some sort of "fast tracking" (means of shortening the normal construction time by preordering long delivery items, or taking other similar shortcuts during construction) will be required to close this gap.

The initial concept was designed to accommodate rail delivery, and to handle the RDF in 40 x 8 x 8 ft cargo boxes for transportation and storage. However, the cost of this receiving facility was estimated to be twice that budgeted. Some options had to be eliminated (rail delivery being one of these) to lower the project cost. But, the system's ultimate cost, whatever it may be, must include two essential factors:

1. The system must be maintainable, and achieve utility standards where it can affect plant reliability and availability.
2. It must be environmentally compatible with the present station and its neighborhood.

CONCLUSION

Although initial operation of the Monroe County Resource Recovery Facility is still almost two years away, studies are in progress to determine the next steps in what is to be an evolutionary process of solid waste management in this region. Of major concern in the immediate future will be the selection of additional processing equipment to handle the uncommitted portion of the RDF, in order to prepare it for viable markets. Under consideration at the present time are a variety of fuel preparation steps ranging from pyrolysis to pelletizing, as well as a variety of construction material manufacturing processes that use the RDF as a primary raw material. One promising possibility is a 100% RDF-fired boiler which would supply steam for RG&E's downtown steam network. If this concept becomes a reality, it would replace steam now supplied from oil-fired boilers.

In the final analysis, technical developments in solid waste processing and the development of new markets will determine the path to be followed by Monroe County in the future. In any event, this program is a great step forward in the utilization of the resources in refuse, to save our natural resources and to decrease the cost of refuse disposition to the taxpayers of Monroe County.

(Grateful appreciation is acknowledged to my friend, Dr. David B. Spencer, with Raytheon Service Company, for his contribution to this paper.)

APPENDIX

SCHEDULE A
Specifications of RDF

1. *Maximum size of the particles* of RDF shall be such that 90% of them by weight will pass through 3/4 sq in. mesh, and 100% by weight through one-in. sq mesh.
2. *Gross calorific value* of RDF delivered at receiving facility shall not be less than 5000 Btu/lb, as determined by the bomb calorimeter on an as-received basis.

3. *Maximum sulfur content* of RDF delivered at receiving station shall not exceed 0.4% by weight on an as-received basis.
4. *Maximum chlorine content* of RDF delivered at receiving facility shall not exceed 0.5% by weight on an as-received basis, including water-soluble chlorides and organically-bound chlorine.
5. *Maximum moisture content* of RDF delivered at receiving station shall not exceed 25%* by weight, unless approved after tests by RG&E.
6. *Maximum ash content* of RDF delivered at receiving station shall, by laboratory analysis, not exceed 17%* by weight on an as-received basis.

**It is mutually understood that these are maximum values. The quantity of RDF consumed at Russell Station is dependent upon the moisture content, heating value, and quantity of ash remaining after in-site combustion in the boilers for the material supplied. Moisture and ash content are intended to be maximum values beyond which RG&E shall have the right to reject shipment.*

County and RG&E may mutually make such modifications to the foregoing RDF specifications, as performance and operation may prove to be necessary or desirable in accordance with Article VI (19).

SCHEDULE B

RDF Payment Formula

RDF_1 = Coal Cost - $(C + M + 0 + A + P_e + P_c)$

RDF_1 = Price to RG&E for RDF delivered at Russell Station.

Coal Cost = Market price of coal to burn at Russell Station.

C= Return of capital charge, for cost of modifications to Russell Station borne by RG&E, to accommodate the RDF burn. Depreciation based upon 20 years.

O= Operating costs to operate RDF receiving facilities, plus any additional operating costs related to burning RDF at Russell Station.

M= Maintenance cost to maintain RDF receiving facilities, plus any additional maintenance cost related to burning RDF at Russell Station.

A= Administration and general expense to administer the program of burning RDF at Russell Station. Additional costs will include those items not included as direct wages or materials, such as: employee's welfare costs, social security taxes, workmen's compensation insurance, and excess public liability insurance. It will also include incidental office and other clerical expenses required to control and relate costs to the above formula.

P_e= Penalty charge incurred by the requirements to keep any boiler-turbine unit at Russell Station on-line in order to consume RDF, rather than buying available lower priced electric energy.

P_c= Coal purchase penalty that may occur due to burning RDF at Russell Station, which would be imposed by entities other than RG&E or County.