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BURNING REFUSE DERIVED FUEL - THE TVA CONCEPT

Purpose and Need Statement

Management of municipal solid waste (MSW) in an economically efficient and environmentally acceptable manner has become a critical problem for state and local governments throughout the country. In the Tennessee Valley, more than 24,000 tons of MSW is produced daily by the seven million plus people living in the region. More than 80 percent of this waste ends up in landfills, but with dwindling capacity, public opposition to new disposal capacity, and the higher cost of new landfills, local governments are seeking alternative disposal methods.

Practically all waste management professionals agree that an integrated waste management approach--source reduction, source separation (recycling), combustion, and landfilling--is the preferred MSW management strategy. The primary objective of this strategy is to reduce the volume of waste going into landfills while recovering energy and material resources. One promising alternative which accomplishes that objective is to transform the solid waste into a fuel by separating the non-combustibles from the MSW stream. The fuel fraction, referred to as refuse derived fuel (RDF), can then be fired in a boiler unit to produce steam.

Local governments' interest in the RDF alternative is growing, in part because equipment to turn MSW into RDF is becoming more reliable and is usually competitive with less capital intensive disposal alternatives if there is a long-term customer for the fuel. One of the largest

markets for RDF is electric utilities. Several local government officials have approached TVA about burning RDF in its coal-fired steam plants. In response to these inquiries, and as part of TVA's Waste Technology Program, an Agency task force was formed November 1989 to address the range of issues associated with TVA burning of RDF and to develop a RDF plan to demonstrate a feasible way for TVA to utilize RDF, considering economical, technical, environmental, and institutional issues.

Background

Resource recovery, i.e., the recovery of energy of materials from waste is not a new idea. Since the 1970s, nine U.S. electric utilities have cofired RDF with coal or oil in electric utility boilers(1). Of these, four are continuing to operate in 1989 and the others have discontinued operations for a variety of reasons, mostly economic. Recent emphasis has focused on burning RDF in dedicated boilers. This term refers to a boiler system that is specifically designed and constructed to burn RDF as its primary, not supplemental, fuel(2). One utility, Northern State Power (NSP) is retrofitting three stoker-fired units at an existing plant near Minneapolis, Minnesota, for 100 percent RDF firing. One of the units began operating in 1987. RDF for the facility is produced in a state-of-the art 1,000 tons per day resource-recovery facility, owned and operated by NSP.

Although TVA has no experience burning RDF, several studies have been prepared since 1976 to assess the feasibility of this option. The 1976 study evaluated the feasibility of establishing a regional resource recovery system. Two recent studies assessed which TVA facilities would be potential candidates for burning RDF and the cost of modifying two existing TVA steam plants, Watts Bar in Rhea County, Tennessee, and Kingston in Roane County, Tennessee. All of these studies have confirmed the technical feasibility of burning garbage in combination with coal, but none of the projects were implemented because the cost in all instances were significantly greater than landfilling, the current disposal method of choice of most local communities. In December 1988 the TVA Board decided, on the basis of these studies and a 1988 risk assessment performed by an outside consulting firm, not to burn garbage at TVA coal plants.

Developing the Region's RDF Potential

As a waste management alternative, RDF production linked to a central waste processing facility is an attractive option because it recovers metals, plastics, and other materials from the waste stream and produces a fuel which can be used in several boilers. For example, a typical plant processing 1,000 tons of waste daily could annually recover as much as 10,000 to 20,000 tons of ferrous metals, 1,200 tons of aluminum and other nonferrous metals, 15,000 tons of glass, and produce an RDF fuel with a heat content of about 5,800 Btu/lb.

For all of its benefits, however, RDF is an expensive alternative for most communities, especially those located in regions where the cost of MSW disposal are low, such as in the Tennessee Valley. Therefore, the development of RDF potential in the Valley region will depend upon finding approaches which overcome technical, economic, and institutional constraints. These issues were summarized in a 1980 report prepared by the U.S. House of Representatives' Subcommittee on Energy Development and Applications(3). Although this study is now 10 years' old, most of the findings are still relevant and are summarized as follows.

The process of commercializing an RDF project involves many participants and is time consuming and expensive. Participants involved include state and local governments faced with waste disposal problems, industry groups owning proprietary RDF processing equipment, citizens concerned about environmental and health concerns, private MSW collectors and haulers needing a disposal site and companies interested in processing and purchasing recyclables. Project participants face many risks and uncertainties, such as regulatory problems, legal constraints, and public opposition. Experience to date suggest that even if the groups involved in the project cooperated, that the time required to advance a project from the concept state to full time operation is at least five years and sometimes exceed eight or more years.

While institutional constraints are often the most difficult to resolve, there also are technological issues related to RDF processing, as well as the question of economic feasibility, i.e., will a regional RDF project be competitive with the cost of other disposal alternatives.

In view of these uncertainties and risks, it is essential for TVA to evaluate all reasonable alternatives before embarking on a specific project or selecting a specific location for the demonstration.

Alternatives Available to TVA

The goal for any TVA RDF project should be to demonstrate a feasible way for local communities to use the RDF option, considering all economic, technical, environmental, and institutional issues. The range of options available to TVA to accomplish this goal are shown in Table 1 and includes:

- Minimal TVA involvement - TVA provides technical advice on all aspects of the project and agrees to a long-term contract for purchasing either steam or electricity from the organization operating the RDF combustion facility. This alternative would pose the least risk for TVA.

- TVA Ownership and Operation of the RDF Combustion Facility - TVA provides technical advice on all aspects of the project and, in addition, agrees to design, construct, and own the RDF combustion facility and use the steam and/or electricity in its system. This alternative would pose the most risk for TVA.

- o TVA Participation in an RDF Consortium - TVA would cause to be formed a consortium of public and private organizations to provide technical advice on all aspects of the project and to design, construct, and own the RDF combustion facility. TVA would agree to purchase the steam and/or electricity produced. This alternative would present a moderate level of risk for TVA.

Description of the Preferred Alternative

TVA's preferred alternative is the RDF Consortium. In selecting this alternative, TVA considered which of the range of alternatives was responsive to local government needs for solid waste disposal and which would not expose TVA power ratepayers to unacceptable risks. Equally critical was the desire to select an alternative in which TVA would have a lead role in determining whether a regional approach to RDF production and utilization was practical to communities needing to make decisions about waste problems in the next five years. Recent studies indicate that over 75 percent of the Valley region's communities will need new disposal capacity by the year 2000. Given that up to five years may be needed to plan and develop a disposal facility, local governments need to know as soon as possible if RDF processing is competitive with other available alternatives.

The RDF Consortium alternative satisfies the above conditions. Under that alternative, TVA would take the lead in forming a consortium to own and operate the RDF combustion facility. The consortium might include local participating governments, state governments, other federal departments or agencies, equipment vendors, waste managements companies, and other interested parties. The RDF would not be cofired, but burned in a boiler unit specifically dedicated for this type of fuel The facility would be located near an existing TVA steam plant, where the steam would be piped to the TVA facility and used either to reduce the amount of coal burned or to increase the electrical output. The purchase price of steam would be determined by TVA on a site-specific basis, depending on specific use of steam at the location.

Before the development of a RDF combustor is viable, there must be in place a mechanism to assure that fuel is available on a long-term basis. Without a guaranteed fuel supply, the consortium would be unable to obtain financing for the project. Therefore, one of the most critical tasks under this alternative (or either of the the secondary alternatives) is the formation of a regional waste management authority, or similar public entity to build and operate the RDF processing facility and serve as the management entity for local communities participating in the project. TVA would serve as a technical advisor to the communities to help in the formation of the waste management authority and, upon establishment of the authority, assist it in carrying out its responsibilities. Critical project elements are described in the next section.

Critical Elements of a Regional RDF Project

- A specific, overall strategy for all interested parties, individuals, businesses, and governments to participate in the planning and development of TVA's RDF facility.

- A technical and economic analysis of various combustible alternatives (e.g., fluidized bed, suspension-fired boiler, etc.)

- An analysis of solid waste supply and availability.

- A technical assessment of RDF preparation processes and identification of RDF fuel standards.

- Identification of RDF facilities location.

- A description of RDF storage, retrieval, and transportation system, including a proposed process plant design and estimated cost.

- Quantification of recovered materials and identification of product marketing.

- o An assessment of environmental impact of the project and identification of environmental control system for emission control. EPA, on December 20, 1989, issued proposed guidelines and compliance schedules for use by states in developing state regulations to control emissions from municipal waste combustors.

- o An economic analysis of RDF as a fuel to determine the breakeven point, i.e., what amount TVA must charge users of the facility without losing money and without passing costs to ratepayers.

- o An identification of requirements for participating municipalities and others, and the mechanisms by which TVA would secure commitments from users. Included would be contractual conditions, waste flow provisions, tipping fees, etc.

Project Funding

A project of this scope and magnitude has many uncertainties and will only be implemented if public funding is available to reduce the financial risks to the consortium and participating communities. This project will also be breaking new ground in regional waste management. While the technical means of converting MSW to RDF and the combustion of that fuel in a dedicated boiler has been demonstrated, the formation of a

regional infrastructure made up of rural and metropolitan areas to carry it out has not been proven.

The development costs of a regional RDF project will be substantial. Very preliminary estimates indicate that all elements of a 1,000 tons per day regional RDF project would total at least $110 million, which would include the following costs:

Predevelopment costs, including legal fees, environmental assessments, land purchase, other administrative costs	$10 million
Planning, design, and construction of RDF/recyclables facility	$30 million
Planning, design, and construction of RDF combustion facility	$70 million

To initiate this project, TVA would need a total of $18 million over a 3-year period. (The remaining $92 million would have to be provided by other members of the consortium and the local governments involved in the project.) Half of TVA's funds would be used to help fund the planning and design of the regional RDF processing and recycling facility. The remaining half would be used to fund the majority of the front-end predevelopment expenses incurred by TVA and other public entities involved in the project.

Table 2 displays the major steps we expect will be needed to develop the project. A detailed description of each of these steps, cost estimates, and schedule will be included in the RDF plan.

REFERENCES

1. Rogoff, J. M. 1987. How To Implement Waste-To-Energy Projects, Nowes Publications, Park Ridge, New Jersey.

2. McGowin, E. E. et al. 1988. "Guidelines for Cofiring Refuse-Derived Fuel in Electric Utility Boilers." Epri, American Power Conference Proceedings, Chicago, Illinois, April 18-20, 1988.

3. U.S. House of Representatives. 1980. "Energy From Municipal Solid Wastes." Committee on Science and Technology Ninety-Sixth Congress.

TABLE 1

REFUSE DERIVED FUEL UTILIZATION DEMONSTRATION

Responsibility Matrix

	Preferred Option			Alternative 1		Alternative 2	
	RWA	CNSORT	TVA	RWA	TVA	RWA	TVA
Technical Advice		X	X		X		X
MSW Collection	X			X		X	
RDF/Recyclables Processing Facility							
Own	X			X		X	
Design & Const.	X			X		X	
O&M	X			X		X	
RDF/Recyclables Marketing	X			X		X	
RDF/Recyclables-Reject Landfill	X			X		X	
RDF Combustion Facility							
Own		X			X	X	
Design & Const.		X			X	X	
O&M		X			X	X	
RDF Ash Disposal		X			X	X	
Steam Purchase			X		X		X

RWA - Regional Waste Authority
CNSORT - Consortium (TVA, others)

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TABLE 2

TYPICAL IMPLEMENTATION STEPS OF A WASTE-TO-ENERGY PROJECT (REFERENCE 2)

Phase I - Feasibility Analysis

- o Waste Stream Analysis
- o Waste Disposal Practices Analysis
- o Energy and Materials Market Study
- c Analysis of Feasible Waste-to-Energy Technologies
- o Analysis of Potential Facility Sites
- o Review Permitting Requirements
- o Risk and Legal Assessment
- o Financial Analysis
- o Develop Project Alternatives
- o Determine Local Government Interest
- o Develop Project Consortium
- 0 Go/No-Go Decision

Phase II - Procurement

- o Select Project Alternative
- o Select Site and Acquire
- o Permitting Underway
- o Market Contracts Concluded
- o Waste Stream Guarantee
- o Finalize Regional Management Authority
- o Develop Public Participation Process
- o Develop Financing Plan
- o RFQ/RFP Produced and Issued
- o Contractor Selected
- o Contract Negotiations Concluded
- o Notice-To-Proceed
- o Develop Markets for Recyclables
- o Select Site for Ash Landfill

Phase III - Plant Construction

- o Site Preparation
- o Complete Final Design
- o Equipment Ordered
- o Building Constructed
- o Equipment Installed
- o Testing and Startup
- o Acceptance Testing
- o Certificate of Completion

Phase IV - Plant Operations

- o Service Fee Payment
- o Annual Tipping Fee Adjustment
- o Annual Report (Optional)
- o Facility Retesting (Optional)