DRAFT FINAL REPORT

REGULATORY IMPACT ANALYSIS
OF THE PROPOSED RULE FOR
A 180-DAY ACCUMULATION TIME FOR
F006 WASTEWATER TREATMENT SLUDGES

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1.0 EXECUTIVE SUMMARY

As an outgrowth of the U.S. Environmental Protection Agency's (EPA) Common Sense Initiative, The EPA is proposing to allow large quantity generators of the listed hazardous waste F006 (wastewater treatment sludge from electroplating operations) to accumulate this waste on site for up 180 days and in certain instances, up to 270 days without a RCRA permit. The Agency is proposing this action to promote increased recovery of metals from F006 sludges. The expected effects of this regulatory modification include decreased costs associated with handling and transporting F006 and possibly an increase in costs associated with accumulating F006 compared to the costs associated with current storage and transportation management practices employed by most generators of F006. This Regulatory Impact Analysis (RIA) assesses the likely regulatory impacts associated with this proposed extension to the generator accumulation time limit. Costs and economic impacts and the expected benefits associated with this proposed extension are assessed. Facility-specific data on current F006 generation and management practices are obtained from the EPA 1995 Biennial Reporting System (BRS).

Executive Order No. 12866 requires that regulatory agencies determine whether a new regulation constitutes a significant regulatory action. The estimated costs and potential economic impacts of this proposal to extend the accumulation period for generators of F006 indicate this proposed action is not a significant regulatory action as defined by the Executive Order. The action will result in a potential savings to generators of F006 of between $3.9 million and $4.9 million annually and therefore will not have an annual effect on the economy of $100 million or more. Nor, does the rule adversely affect the economy, a sector of the economy, productivity, competition, jobs, the environment, health or public safety.

This proposed rule potentially affects 1,317 electroplating facilities that currently generate less than 60 tons of F006 wastewater treatment sludge per year (i.e., one full 15-ton truckload every 90 days) and are classified as large quantity generators (LQGs, i.e., generators who generate more than 1000 kg. of hazardous waste per calendar month) under RCRA. Under RCRA, LQGs are allowed to accumulate hazardous wastes for a period up to 90 days on site without obtaining a RCRA permit. An LQG will potentially benefit from a modification to this rule that allows generators to accumulate F006 for up to 180 days (or 270 days when waste must be shipped more than 200 miles to a recycling facility) prior to sending the waste off-site for management. The affected generators of F006, collectively, ship more than 24,000 tons of F006 waste off site per year. According to BRS data, approximately 40 percent of this quantity is currently shipped to metals recovery facilities with most of the remaining waste disposed in landfills.

Two scenarios based upon projected recycling rates are evaluated in this RIA to estimate the potential cost savings associated with the proposal to extend the generator accumulation period. The effect of the proposed extension to the accumulation period will be to increase post-regulatory recycling rates. Under the first scenario, a lower bound recycling rate is estimated to increase to between 65 and 80 percent of the F006 generated across different generator size categories. The recycling rate will increase above the current 40 percent because recycling will become more economical for many generators who now landfill F006 wastes. The resulting total cost savings associated with reduced waste management and transportation cost are estimated to be $3.9 million per year. For the second scenario, an upper bound recycling rate of 80 to 100 percent of F006 generated across different generator size categories is estimated. The resulting total cost savings is $4.9 million per year. Total cost savings therefore are estimated to range from $3.9 to $4.9 million annually on a before-tax basis. As a result of these cost savings, the recycling rate of affected facilities is expected to increase, ranging from 71 to 87 percent.

The greatest cost reductions are expected to be realized by the facilities that generate the smallest volume of waste, those facilities generating less than 40 tons of F006 waste per year. This would include job shops (facilities which provide electroplating services on a contract or job basis) as well as small captive plating shops.

This analysis also describes the Agency's consideration of the Regulatory Flexibility Act, the Unfunded Mandates Reform Act, the Paperwork Reduction Act, the National Technology Transfer and Advancement Act, Executive Order 12875 (Enhancing the Intergovernmental Partnership), Executive Order 13045 (Protection of Children from Environmental Health Risks and Safety Risks) and Executive Order 12898 (Environmental Justice).

Extending the length of time that generators may accumulate F006 waste on site, will make it more economical for a greater number of generators to recycle F006 waste instead of placing it in a landfill. Savings to generators may result in two ways. First, the ability to accumulate a greater amount of waste will allow more generators to surpass minimum load charges and second, for many generators the number of loads (i.e., trips to a recycling facility during a given year) may be reduced, resulting in lower transportation and shipping costs.

Additionally, increased recycling of F006 waste may result in a net benefit to both society and the environment. Some of the expected potential benefits include lessening the future burden on landfill capacity; conserving scarce metal resources which provides environmental benefits in terms of energy savings, reduced volumes of waste, reduced disturbance to land, and reduced pollution; and lessening the dependance of the United States on foreign metal supplies and increasing recovery of the strategic metal chromium.[1]

[1] A strategic metal is a metal which is required for critical military and/or civilian use and for which the United States is dependent upon from vulnerable sources of supply.

2.0 INTRODUCTION

This RIA presents a cost and economic impact analysis corresponding to the proposed rule to extend the accumulation period for generators of F006 wastewater treatment sludges. This action is an outgrowth of the EPA's Common Sense Initiative. The expected effects of this regulatory modification include decreased costs to generators for handling and transporting F006 sludges and possibly an increase in the costs associated with expansion of the accumulation area compared to current storage and transportation management practices incurred by most firms in the affected industry.

Executive Order No. 12866 (58 FR 51735, October 4, 1993) requires that regulatory agencies determine whether a new regulation constitutes a significant regulatory action. A significant regulatory action is defined as an action likely to result in a rule that may:

- Have an annual effect on the economy of $100 million or more or adversely affect in a material way the economy, a sector of the economy, productivity, competition, jobs, the environment, public health or safety, or state, local, or tribal governments or communities;

- Create a serious inconsistency or otherwise interfere with an action taken or planned by another agency;

- Materially alter the budgetary impact of entitlements, grants, user fees, or loan programs or the rights and obligations of recipients thereof; or

- Raise novel legal or policy issues arising out of legal mandates, the President's priorities, or the principles set forth in Executive Order 12866.

This analysis is designed to address the first factor listed above. To accomplish this, The EPA estimated the costs and potential economic impacts upon generators of F006 of this regulatory modification to the accumulation time limit for F006 wastes to determine if it is a significant regulatory action as defined by the Executive Order.

2.1 Purpose

Wastewater treatment sludges from electroplating operations, EPA hazardous waste number F006, represents one of the largest untapped metal-bearing listed secondary materials amenable to metal recovery in the United States. In spite of the fact that these sludges contain a large concentration of recoverable metals, a number of regulatory and non-regulatory factors (e.g., cost, perceived liability risk, and market price of virgin metals) have resulted in a relatively low recovery rate. This regulatory impact analysis (RIA) assesses the costs and benefits of relieving one of the regulatory burdens that elecroplaters claim inhibits metal recovery from F006 sludges. The EPA is proposing to allow generators to accumulate wastewater treatment sludges from electroplating operations for a period of up to 180 days without obtaining a permit or without having interim status for their storage activities (40 CFR Part 262) to allow generators to accumulate sufficient quantities of sludge for recycling and therefore encourage environmentally sound recovery of metals from this material. Generators who must transport F006 sludge over 200 miles to a recycling facility would be able to accumulate F006 for up to 270 days to encourage environmentally sound recovery of metals from this material. However, generators may accumulate no more than 16,000 kilograms of F006 waste on-site at any one time.

This analysis estimates how facilities in the electroplating industry may economically benefit from the proposed regulatory modification, as well as how the electroplating industry as a whole may be affected. Estimates of the cost effects of the regulation were determined on both a facility-specific and industry-wide basis.

2.2 Scope of Study

The scope of the study is an assessment of the potential impacts that will be borne by the electroplating industry, for which new accumulation times under Part 262 of RCRA are being proposed. This industry produces plated metal products for a wide variety of industries, although the automotive, electronics, and consumer durable industries are the most prevalent.[2]

Data from the 1995 Biennial Reporting System (BRS) were used to complete this analysis. A total of 1,934 electroplating facilities (SIC 3471) submitted a 1995 Biennial Report on their F006 sludge generation and waste management practices. The total amount of waste generated by these facilities in 1995 was 1.4 million tons.

It should be noted that small quantity generators (SQGs, i.e., generators who generate less than 1,000 kilograms of hazardous waste in a calendar month) are not required to complete a Biennial Report. Therefore, the BRS data used in this analysis under represents the total number of electroplating facilities currently generating F006 waste and therefore, affected by the proposed rule. Other sources provide the following information on the industry:

- Information available from the Common Sense Initiative report indicates that the metal finishing industry consists of more than three thousand job shops and more than eight thousand captive shops.

- An earlier study, *Development Document for Effluent Limitations Guidelines and Standards for the Metal Finishing Point Source Category*, concluded that there were

[2] U.S. EPA, Office of Enforcement Compliance Assurance, "EPA Office of Compliance Sector Notebook Profile of the Fabricated Metal Products Industry."

approximately 13,000 job and captive electroplating shops in the U.S. in 1979.[3]

- The Census Bureau, 1992 Census of Manufacturers, reported that there were 3,294 plating and polishing establishments (SIC 3471) in the U.S. in 1992 (which includes job shops, but not captive shops).

Of the 1,934 electroplating facilities that completed the 1995 BRS, approximately 32 percent (617 facilities) are "large" LQGs that generated enough sludge to ship a full truck load (i.e., 15 tons or more) of F006 sludges off site every 90 days or less. These generators may experience limited benefits from the proposed extension to the generator accumulation time limit because the current 90-day accumulation period provides sufficient time for these generators to accumulate a large enough quantity of F006 to support economical recycling. Therefore, this study does not address possible benefits to large LQGs because the benefits to this category of generators are very limited. The study, instead, addresses potential reductions in compliance costs and assesses their economic impacts to the remaining 68 percent (1,317 facilities) of F006 generators referred to as "small" LQGs (i.e., generators who generate less than 15 tons of F006 within a 90-day period) in this analysis.[4] Small quantity generators (SQGs) (i.e., generators who generate more than 100 kilograms and less than 1,000 kilograms of hazardous waste in one calendar month) already are allowed to accumulate F006 waste for a period of up to 180 days; therefore, SQGs will not be affected by this regulatory modification.

2.3 Limitations of Analysis

This analysis does not capture all of the variables that may affect a generator's decision to recycle or to landfill F006 sludges. Besides cost, a generator's decision may be affected by factors such as the presence of multiple metals in one waste stream, total metal content, technical feasibility of recovering available metals, and CERCLA liability. This study also does not consider the impact on F006 SQGs who are located more than 200 miles away from a metals recovery facility who may now accumulate F006 wastes for up to 270 days. Other limitations include the following:

- The presence of multiple metals in F006 waste may impact both the marketability and feasibility of recycling F006 waste. It is common practice for metal finishers to co-mingle rinse waters from a variety of different metal plating lines into one treatment tank, resulting in a poly-metal F006 waste precipitate. While this F006 sludge may contain recoverable levels of each metal present, commercial recyclers tend to prefer plating rinse waters of different metals to be kept separate so as to avoid having to separate the metals

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[3] "Development Document for Effluent Limitations Guidelines and Standards for the Metal Finishing Point Source Category," EPA 440/1-83/091, June 1983, p. III-19. Based upon industry journal mailing lists, there were approximately 13,500 manufacturing facilities covered by the Metal Finishing Category.

[4] Note: The classification of generators as "large" LQG, and "small" LQG presented here is for the purposes of this analysis only as does not represent Federal classification criteria.

again into a mono-metal or bi-metal sludge.[5] In certain instances, recyclers may charge a generator a process or treatment fee for the presence of any impurities (metals considered not to be of value by the recycler) in excess of a specified concentration.[6]

- The type and percent concentration of metals present in a generator's F006 sludge may impact the price they must pay a recycling facility to manage their waste. The price recyclers charge generators to manage F006 waste is influenced by the market price the recyclers can obtain for the metals they recover. In certain instances, an F006 waste stream with a high percentage of a valuable metal, may earn a generator a credit (i.e., the recycler pays the generator for the waste).

- Typically, recycling facilities do not accept all types of F006 waste. For certain generators the cost of transporting their waste to a recycling facility that will accept it may remain prohibitive, given the alternative of paying a landfill tipping fee even with a 180-day or 270-day accumulation period.

- Generators tend to be located closer to landfills than to recycling facilities. For the 1,317 generators examined, it was noted that some are shipping their waste to a landfill located in the same city as their business. For these generators, the proximity of their business to a landfill is likely to continue to heavily influence their waste management decisions due to the savings associated with the reduced transportation costs.

- The extent to which CERCLA liability might affect a generator's decision to either manage their F006 at a landfill or send the sludge to a metals recovery facility was not considered.

- Only one type of recycling scenario was considered. This analysis is based on the costs associated with a generator who ships F006 waste to a recycling facility for metals recovery. In some cases, F006 waste is recycled by cement kilns; but, this is for the purpose of manufacturing cement which is a lower-value use of the metals contained within the sludge. This proposed rule does not pertain to cement kiln recycling of F006. Although the exact extent of F006 recycling in cement kilns is unknown, it is not believed to be substantial.

- The cost estimates for landfill management are overstated, particularly for smaller generators, because other forms of hazardous waste (e.g., spent F007 and F008 wastes) are generated in electroplating operations. These wastes may be shipped with the F006

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[5] Borst, Paul A., U.S. EPA, Office of Solid Waste, Economic, Methods and Risk Assessment Division, "Recycling of Wastewater Treatment Sludges from Electroplating Operations," F006, 18th AESF/EPA Pollution Prevention and Control Conference, January 27-29, 1997, p. 179.

[6] Lamancusa, James P.,P.E.,CEF, "Strategies at a Decorative Chromium Electroplating Facility: On-line vs. Off-line Recycling," Plating and Surface Finishing, April 1995, p.48.

wastewater treatment sludge to the landfill in the same truck if the wastes are compatible, resulting in lower per-unit transportation costs due to a generator's ability to take advantage of economies of scale and avoid incurring the minimum landfill charge on multiple loads.

- Recycling costs are overstated, particularly for small generators, because transporters may stop at two or more electroplating facilities creating fuller loads, thereby reducing per-unit transportation costs. Economies of scale may be achieved that exceed the minimum recycling charge.

- Increased costs to the generator associated with storing F006 waste for a greater length of time were not considered in this analysis (e.g., costs of additional containers and storage space).

- Finally, there may exist instances where LQGs segregate their F006 streams to improve the quality of the sludge (i.e., segregate sludges by particular type of metal content) for recycling and allowing them to accumulate more economic quantities for recycling. Also, some LQGs will have more flexibility to accumulate the waste for up to 180 days to try to gain a better price. This study does not address these possible benefits.

2.4 Organization of Report

The remainder of this report is divided into five sections. An economic profile of the electroplating industry is presented in Section 3. For this industry, available economic profile data are presented including products manufactured, profile of facilities, market structure, and an assessment of the market value of industry shipments. In addition, an estimate of the quantity of F006 hazardous waste affected by this change in the accumulation time limit are presented.

Estimates of unit costs for current and compliance hazardous waste transportation and off-site management practices are presented in Section 4. The associated regulatory cost impacts and economic impacts are documented in Section 5. Potential qualitative benefits associated with the regulation are summarized in Section 6. Other issues related to the regulation are discussed in Section 7.

3.0 INDUSTRY PROFILE

3.1 Overview of Products and Processes

Electroplating includes a wide range of production processes, including common and precious metal electroplating, anodizing, chemical conversion coating, electroless plating, chemical etching and milling, and printed circuit board manufacturing. Electroplating is the application of a metal surface coating which will increase wear or erosion resistance, or simply provide decoration. The piece to be coated is immersed in a plating bath or solution. Typically, a plating line is composed of a series of plating units applying a sequence of coatings.[13] Metals employed in electroplating operations include chromium, copper, nickel, zinc, gold and silver. Cyanides also are frequently found in plating, stripping and cleaning solutions.[14]

In 1980, the U.S. EPA listed wastewater treatment sludges from electroplating operations as hazardous waste and assigned the material the waste code F006. F006 waste was listed for the hazardous constituents cadmium, hexavalent chromium, nickel, and complexed cyanides. It also may contain lead, arsenic, and organics. The listing excludes wastewater treatment sludges generated from the following processes: 1) sulfuric acid anodizing of aluminum, 2) tin plating on carbon steel, 3) zinc plating (segregated basis) on carbon steel, 4) aluminum or zinc-aluminum plating on carbon steel, 5) cleaning/stripping associated with tin, zinc or aluminum on carbon steel, and 6) chemical etching and milling of aluminum. The listing extends to any material removed from an electroplating wastewater treatment system other than the treated effluent.

The composition of F006 sludge is dependent on the reagent or technology used to treat plating rinse waters, the configuration of plating lines with rinse tanks and the number of treatment tanks, the electrolyte in the plating bath (acid and alkaline or cyanide and noncyanide), and process controls on the plating line. Metals are typically precipitated with a hydroxide (lime) reagent to form a metal hydroxide sludge. Sulfide precipitation may follow the lime precipitation as a polishing step which typically generates only small quantities of metal precipitates. Therefore, other reagents used include sulfides and phosphates. Ion exchange technologies produce wastes having a different physical form than chemical precipitation technologies. Also, rinsewaters are typically co-mingled from several different plating lines resulting in many different metals being present in the F006 sludge. Therefore, segregation of rinse waters increases the metal recovery efficiency. Sludges containing one or two metals (e.g., copper, nickel, zinc, or chromium) are more marketable than those containing three or more. Waste composition data from 1981 to 1984 identify the presence of recyclable metals in F006 to be in the following concentration

[13] Environron Corporation, Characterization of Waste Streams Listed in 40 CFR Section 261: Waste Profiles, Volume I, prepared for the U.S. EPA, Waste Identification Branch, undated.

[14] Ibid.

ranges: chromium (0.002 - 4%), copper (<0.006 - 1.5%), nickel (<0.006 - 1.5%), and zinc (0.003 - 3.3%).[15, 16]

Sampling data collected by the EPA for this rulemaking indicated that approximately ten percent of electroplaters generate F006 sludge that is not amenable to metals recovery because the sludge contains too high a concentration of cadmium. Cadmium is an impurity that is undesirable for smelters. Therefore, it is assumed that approximately 90 percent of the electroplaters generate a sludge that can be recycled without technical limitations with regard to its composition and use as feedstock material.

Certain plating wastes are more marketable than others. Copper-only and nickel-only F006 sludges have the highest value. Bi-metal copper and nickel sludge (with limited chromium and lead), bi-metal nickel and chromium sludge (with limited copper), and bi-metal zinc and copper sludge (with limited chromium and nickel) also have good marketability due to the fact that these metals are relatively amenable to metals recovery. These sludges are more marketable than chromium-only and poly-metal nickel/chromium/copper F006 sludges.[17]

3.2 Profile of Affected F006 Generators

Annual hazardous waste generation data for F006 sludge are available on a facility-specific level in the EPA's 1995 BRS database. In 1995, there were 1,934 LQGs of F006 wastewater treatment sludge.[18] Of this total, 1,317 LQGs generate less than 15 tons of F006 within a 90-day period which represent the population of LQGs affected by this rule. F006 sludge generation statistics and distributions are presented in Tables 3-1 and 3-2.

The affected population of 1,317 LQGS account for approximately 1.6 percent (24,324 tons) of the total quantity of F006 waste generated in 1995 according to BRS data. For the affected population, the average generation rate is approximately 18.5 tons per year and the median generation rate is approximately 14.1 tons per year.

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15 Ibid.

16 Borst, Paul A., pp. 174.

17 Borst, Paul A., pp. 174, and DPRA confidential communication.

18 This number underestimates the total number of facilities generating F006, since SQGs are not required to complete a Biennial Report.

Table 3-1. F006 Hazardous Waste Generation Statistics		
F006 Generator Characteristics	**Total Population of F006 LQGS**	**Population of Affected F006 LQGs (< 60 tons/yr)**
No. of Large Quantity Generators	1,934	1,317 (68%)
Total Quantity (tons/year)	1,486,453	24,324 (1.6%)
Maximum Generation Quantity (tons/year)	789,722	60.0
90^{th} Percentile Generation Quantity (tons/year)	227	44.6
Average Generation Quantity (tons/year)	769	18.5
Median Generation Quantity (tons/year)	27	14.1
10^{th} Percentile Generation Quantity (tons/year)	2	1.3
Minimum Generation Quantity (tons/year)	0.003	0.003

Source: U.S. EPA, 1995 Biennial Reporting System

Table 3-2. Generator Count and Quantity Distributions of Affected F006 Large Quantity Generators						
Quantity Interval (Tons/Year)	**Generator-Weighted**			**Quantity-Weighted**		
	Number of LQGs	**Percent**	**Cum. Percent**	**Quantity (tons/yr)**	**Percent**	**Cum. Percent**
0 - 13.2	633	48%	48%	3,245	13%	14%
13.2 - 23.2	261	20%	68%	4,733	19%	33%
23.2 - 33.2	159	12%	80%	4,423	18%	51%
33.2 - 43.2	116	9%	89%	4,356	18%	69%
43.2 - 53.2	95	7%	96%	4,577	19%	88%
53.2 - 60	53	4%	100%	2,991	12%	100%
Totals	1,317	100%		24,324	99% [1]	

Source: U.S. EPA, 1995 Biennial Reporting System

[1] Total does not add to 100 percent due to rounding.

3.3 Market Structure

The metal finishing industry can be divided into two major segments, job shops and captive shops. Job shops tend to be small independently owned metal finishing companies that employ 15 to 20 people and generate $800,000 to $1 million in annual gross revenues. Typically, captive shops conduct metal finishing operations as part of a larger manufacturing operation. It is estimated that within the U.S. there are three times as many captive shops as there are job shops.[19]

In 1992, according to the U.S. Department of Commerce, there were approximately 3,296 plating and polishing facilities in the U.S. California had the largest number of facilities with 17 percent of the total. Illinois, Ohio, and Michigan also reported large numbers of plating and polishing facilities with 8.5, 8.3, and 7.6 percent respectively.[20]

In 1995, the plating and polishing industry employed 75,900 people. Table 3-3 presents the total number of people employed by the industry from 1992 through 1995. Table 3-4 provides 1992 employment statistics by facility size. As shown in Table 3-4, 71 percent of all electroplating facilities employ less then 20 employees.

Table 3-3. Total Number of Employees

	1992	1993	1994	1995
Total Number of Employees	65,400	67,300	70,600	75,900

Source: U.S. Department of Commerce, 1992 Census of Manufacturers

Table 3-4. Employment Statistics by Facility Size

Size of Facility	Number of Facilities	Percentage of Facilities
1 to 4 employees	962	29%
5 to 9 employees	668	20%
10 to 19 employees	716	22%
20 to 49 employees	650	20%

[19] U.S. EPA, Office of Enforcement Compliance Assurance, “EPA Office of Compliance Sector Notebook Project Profile of the Fabricated Metal Products Industry,” pp. 5,8.

[20] U.S. Department of Commerce, 1992 Census of Manufacturers.

Table 3-4. Employment Statistics by Facility Size		
Size of Facility	**Number of Facilities**	**Percentage of Facilities**
50 to 99 employees	219	7%
100 to 249 employees	71	2%
250 to 499 employees	8	0%
500 to 999 employees	2	0%
Total	3,296	100%

Source: U.S. Department of Commerce, 1992 Census of Manufacturers

3.4 SIC 3471 Industry Shipments

The market value of industry shipments for the plating and polishing industry, increased by approximately 22 percent from 1992 to 1995 from over $4.7 billion to nearly $5.8 billion. This represents an annual growth rate of seven percent, which exceeds the overall growth rate for the economy as a whole. Table 3-5 provides data on the value of 1992 shipments by facility size.

Table 3-5. Value of 1992 Shipments by Facility Size			
Size of Facility	**Number of Facilities**	**Value of Shipments (millions)**	**Percent of Total Value of Shipments**
1 to 4 employees	962	$127	3%
5 to 9 employees	668	$280	6%
10 to 19 employees	716	$591	13%
20 to 49 employees	650	$1,319	28%
50 to 99 employees	219	$1,126	24%
100 to 249 employees	71	$959	20%
250 to 499 employees	8	$324	7%
500 to 999 employees	2	NA	NA
Total	3,296	$4,726	100%

Source: U.S. Department of Commerce, 1992 Census of Manufacturers

4.0 UNIT COST ANALYSIS

4.1 Recycling Costs

Recycling costs for recovering metals from F006 wastewater treatment sludges are estimated from 1993 cost data provided in Exhibit 7-1 of Cushnie, George C., CAI Engineering, "Pollution Prevention and Control Technology for Plating Operations," prepared for NCMS/NAMF. Table 4-1 presents an estimate of the metal recycling/recovery unit costs being paid by F006 sludge generators. Transportation costs were subtracted from the estimated recycling costs. 1997 unit transportation prices reported in Environmental Cost Handling Options and Solutions (ECHOS), Environmental Remediation Cost Data-Unit Price, 4th Annual Addition, published by R.S. Means and Delta Technologies Group, Inc., 1998, were used to estimate transportation costs.

ECHOS lists the minimum 1997 charge for a bulk shipment of hazardous waste (not requiring stabilization) at $1,350 for commercial landfill disposal. For this analysis, this value serves as a proxy for the minimum recycling charge for commercial metal recycling/recovery. The value is a good proxy because while the stabilized landfill price is, in economic theory, the highest minimum recycling charge, the unstabilized price reflects the practice of recyclers providing some credit to the generators for a percentage of the market value received for base metals and precious metals recovered from the sludge against the processing fee that generators pay the recyclers. Differences in average unit recycling costs are the result of variability in the amount various recyclers charge generators. A major factor contributing to the differences in recycling costs is metal content (i.e., concentration and type of metals present in the waste). The generally lower costs for the small facilities may be due to the fact that these facilities tend to generate single-metal wastes which are more amenable to recycling.

An average unit recycling cost of $400/ton ($0.20/lb) is assumed as an upper-end typical price charged by a metals recovery facility based on the 1993 data provided in Cushnie. One recycler that was contacted provided an average 1998 price of approximately $200/ton ($0.10/lb). For this analysis, impacts are evaluated based on average recycling prices ranging from $200/ton to $400/ton with a minimum recycling charge of $1,350 per shipment.

4.2 Landfill Costs

ECHOS list the following 1997 commercial landfill disposal prices: 1) minimum charge for bulk shipments is $1,350, 2) with stabilization the minimum charge is $2,267, 3) landfill of hazardous solid bulk waste is $141.67/ton ($0.07/lb), 4) with stabilization the solid bulk waste price is $241.33/ton ($0.12/lb), and 5) landfill of jumbo bags requiring stabilization is $335/each ($0.17/lb, assuming one ton per supersack).

For this analysis, the ECHOS data provides the best approximation of the landfill prices currently being charged to small LQGs that may or may not have a full shipment of waste. Because of the presence of hazardous metals, prices including stabilization are used to reflect current pretreatment requirements under Land Disposal Restriction (LDR) regulations. A unit price of $335/supersack ($335/ton) is assumed with a minimum shipment charge of $2,300.

4.3 Transportation Costs

Table 4-2 presents the estimated transportation costs paid by F006 sludge generators based on annual generation rates and accumulation times, assuming partial load shipments. Appendix A presents the calibration of the transportation cost model used in this analysis to 1997 unit transportation prices reported in ECHOS.

Based on the calibrated cost model, the estimate for the minimum shipment charge is $694/load which applies for any shipment of 300 miles or less. For shipments of 400 or 600 miles, transportation costs are estimated to be $2.08/mile. For shipments of 1,000 miles, transportation costs are estimated to be $1.97/mile.

Loading and unloading cost estimates assume a fully-loaded wage of $40 per hour. For every truck load, labor time assumptions include 0.5 hours for the truck driver to perform administrative duties, 0.5 hours for the electroplating facility to perform administrative duties, 0.1 hours to load each palletized, one-ton super sack on the truck and 0.1 hours to unload each palletized, one-ton super sack off the truck.

Table 4-1. Estimated F006 Recycling Unit Costs (1993$)

Generator Type	No. of Data Points	Transport		Recycling	
		Average Unit Cost ($/lb) (+/- st. dev.)	Minimum Median Maximum Unit Cost ($/lb)	Average Unit Cost ($/lb) (+/- st. dev.)	Minimum Median Maximum Unit Cost ($/lb)
Small LQG - small shipment (< 13.2 t/yr)*	31	0.49 +/-0.50	0.11 0.27 2.07	0.02 +/-0.56	-1.77 0.07 0.76
Small LQG - large shipment (13.2 - < 60 t/yr)	36	0.11 +/-0.08	0.02 0.08 0.39	0.20 +/-0.21	-0.14 0.18 1.04
Large LQG (60 t/yr or greater)	20	0.06 +/-0.05	0.02 0.02 0.16	0.17 +/-0.15	0.01 0.14 0.61
Total	87	0.15 +/-0.18	0.02 0.09 1.04	0.22 +/-0.27	-0.74 0.18 0.90

* Assumes all generators are LQGs and ship four times per year. This data may include SQGs which ship at a maximum of 2 times per year. If these facilities are SQGs, the average transport unit cost is $0.25/lb (+/-0.25) and average recycling unit cost is $0.26/lb (+/-0.36).

Assumptions:

Step 1: Used 1993 cost data provided in Exhibit 7-1 of Cushnie, George C., CAI Engineering, "Pollution Prevention and Control Technology for Plating Operations," prepared for NCMS/NAMF.

Step 2: Eliminated seven data records from Cushnie that do not provide either shipping distance, quantity shipped, or unit cost. Based on inspection, four records eliminated as statistical outliers.

Step 3: Assumed the following distances:

- Category < 500 miles = 250 miles,
- Category 500 to 1,000 miles = 750 miles,
- Category 1,000 to 1,500 miles = 1,250 miles,
- Category 1,500 to 2,000 miles = 1,750 miles, and
- Category 2,000 to 2,500 miles = 2,250 miles.

Step 4: Assumed LQG and 90-day storage if > 26,400 lbs generated annually.

Step 5: Assumed a full shipment size of 15 tons based upon the EPA's Common Sense Initiative report.

Step 6. Assumed minimum of 4 shipments/year (i.e., 90-day storage limit) for LQGs.

Step 7: Used 1998 ECHOS transportation unit price estimates ($/mile) for van trailer transportation of hazardous waste. Assume transportation prices have not changed significantly since 1993 given that increased labor costs are likely being balanced by historically low fuel costs.

Step 8. Used 1998 ECHOS minimum charge for van trailer transportation of small hazardous waste loads of $732.33 per shipment as a minimum cost. Assumed $2.64/each supersack for loading on to the truck. Assumed transportation prices have not changed significantly since 1993 given that increased labor costs are likely being balanced by historically low fuel costs.

Table 4-2. Estimated Transportation Costs (Partial Load Shipments -- No Multiple Stops)

Annual Generation Rate (tons)	Shipment Data		Loading/Unloading Costs		Annual Transportation Costs ($/year) [5]			
	Load Size (%) [1]	Load Frequency (loads/yr) [2]	Loading/ Unloading Unit Cost ($/load) [3]	Annual Loading Costs ($/year) [4]	100, 200, and 300 miles/ load(min. $694/load)	400 miles/load ($2.08/mi)	600 miles/load ($2.08/mi)	1,000 miles/load ($1.97/mi)
90-day Accumulation Time Limit: Applicable for Baseline Recycling and Landfill Costs and Post-Regulatory Landfill Costs								
5	8	4	$50	$200	$2,776	$3,328	$4,992	$7,880
10	17	4	$60	$240	$2,776	$3,328	$4,992	$7,880
20	33	4	$80	$320	$2,776	$3,328	$4,992	$7,880
30	50	4	$100	$400	$2,776	$3,328	$4,992	$7,880
40	67	4	$120	$480	$2,776	$3,328	$4,992	$7,880
50	83	4	$140	$560	$2,776	$3,328	$4,992	$7,880
180-day Accumulation Time Limit: Applicable for post-regulatory recycling costs for the following generators: generators < 23.46 tons/year and shipping to a recycling facility < 200 miles away AND generators > 23.46 tons/year and shipping to a recycling facility at any distance [6]								
5	17	2	$60	$120	$1,388	NA	NA	NA
10	33	2	$80	$160	$1,388	NA	NA	NA
20	67	2	$120	$240	$1,388	NA	NA	NA
30	100	2	$160	$320	$1,388	$1,664	$2,496	$3,940
40	100	2.67	$160	$427	$1,851	$2,219	$3,328	$5,253
50	100	3.33	$160	$533	$2,313	$2,773	$4,160	$6,567
270-day Accumulation Time Limit: Applicable for post-regulatory recycling costs for the following generators: generators < 23.46 tons/year and shipping to a recycling facility > 200 miles away [7]								
5	25	1.33	$70	$93	$925	$1,109	$1,664	$2,627
10	50	1.33	$100	$133	$925	$1,109	$1,664	$2,627
20	100	1.33	$160	$213	$925	$1,109	$1,664	$2,627

[1] Load Size = Minimum of either [Annual Generation Rate/(360 days/Accumulation Time Limit)/(15 tons/load)*100%] OR [100%]

[2] Load Frequency = Maximum of either [360 days/Accumulation Time Limit] OR [Annual Generation Rate/(15 tons/load)]

[3] Assumed $40/hour for truck driver (fully loaded), 0.5 administrative trucker hour per stop, 0.1 hours to load/unload a single one ton super sack resting on a pallet, 1.0 hour transport added time for each extra stop, and 0.5 administrative electroplater hour per stop. Assume that electroplaters currently have accumulation storage area capacity to contain a full 15 ton load.

Loading/Unloading Unit Cost = $40/hr * [0.5 hr admin trucker + 0.5 hr admin electroplater + (0.1 hr loading per ton + 0.1 hr unloading per ton) * (15 ton/load) * (load size/100)]

[4] Annual Loading Costs = Load Frequency * Loading/Unloading Unit Cost

[5] Annual Transportation Costs (>300 miles) = Load Frequency * Miles/Load * $/mile
Annual Transportation Costs (<= 300 miles) = Load Frequency * Minimum Charge of $694/Load

[6] Generators generating more than 23.46 tons/year will accumulate waste too quickly to be able to accumulate wastes up to 270 days.

[7] Generators are allowed to accumulate up to 16,000 kg (23.46 tons/year) of F006 waste on site in a 270 day time limit if shipped more than 200 miles to a metals recovery facility.

5.0 COST AND ECONOMIC IMPACT ANALYSIS

5.1 Methodology for Estimating Generator Incremental Cost Savings

To gain a better understanding of the proposed rule's impacts six generator sizes were examined. The six sizes include 5, 10, 20, 30, 40, and 50 ton/year generators of F006. The costs to recycle pre- and post-regulation were compared with the costs to dispose the F006 waste in a Subtitle C landfill for each of the six generator sizes.

Derived recycling cost data from a 1993 study by George C. Cushnie[21] indicates an average recycling cost for F006 sludge of approximately $400 per ton. Additional recycling cost estimates obtained from one recycling facility indicated a cost range of $100 to $400 per ton and an average cost of approximately $225 per ton; unfortunately the information obtained from the one recycler may not be representative of the entire industry. Consequently, recycling costs are examined using three different recycling fees, $200/ton, $300/ton, and $400/ton. A minimum recycling charge of $1,350 is assumed as the economic breakpoint where the metals recovery facility is willing to accept and process the shipment of F006 sludge. The recycling fee is determined by the recycling facility, depending on the metal content of the sludge, and will vary widely; in some cases the recycler will pay for the sludge when the metal contents are high and the sludge contains a limited number of metals, making it easier to recover the individual metals.

Waste management data from the BRS are used to estimate the distances that F006 sludge has been transported for recycling; it is important to recognize that generators do not necessarily limit management of their wastes to the nearest recycling facility. In short, recyclers frequently specialize in recycling certain types of sludge (and metals); consequently generators may have to ship their wastes to facilities other than the closest facilities. For this analysis, recycling costs are estimated for facilities located at distances of less than 200, 300, 600, and 1000 miles from a generator. Analysis of BRS data indicates that the average distance between an F006 generator and a metals recovery facility is approximately 600 miles. Transportation costs (1997$) are estimated from the data shown in Table 4-2. A minimum transport charge of $694 is assumed as the economic breakpoint where the transporter is willing to ship the F006 sludge to a metals recovery facility or landfill.

ECHOS data (1997$) are used in developing the cost to landfill. For this analysis, a unit price of $335/ton is assumed. A minimum landfill charge of $2,300 is assumed reflecting the economic breakpoint where the landfill operator is willing to accept and pre-treat (i.e., solidify) the shipment of F006 sludge. A minimum transport charge of $694 is assumed reflecting the economic breakpoint where the transporter is willing to ship the F006 sludge to the landfill operator. Transportation costs are developed from the data shown in Table 4-2 at a distances of 100, 200, and 400 miles from a generator. As with the recycling transportation distances, this range of

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[21] Cushnie, George C., CAI Engineering, "Pollution Prevention and Control Technology for Plating Operations," prepared for NCMS/NAMF.

distances was selected based on the BRS data indicating generator and disposal facility locations. Average distance from generator to landfill based on analyses of the BRS data was approximately 200 miles.

Estimated costs for each of the generator size categories are presented in Tables 5-1 and 5-2. Table 5-1 presents estimates of the incremental cost savings incurred by affected generators who currently recycle F006 wastes from an extension of the accumulation time to either 180 or 270 days. Under post-regulatory conditions, these generators will accumulate F006 wastes longer on site resulting in a reduced number of shipments to metals recovery facilities and lower transportation costs. Table 5-2 presents estimates of the incremental cost savings incurred by affected generators who currently landfill F006 wastes from an extension of the accumulation time to either 180 or 270 days. Under post-regulatory conditions, most affected generators will accumulate F006 wastes on site because of incremental savings incurred from the decrease in transportation costs from fewer shipments and the decrease in management charges from larger shipment loads providing economies of scale above minimum recycling charges except at distances of approximately 1,000 miles or more to the nearest metals recovery facility. Costs presented include land disposal cost and recycling costs under baseline and post regulatory conditions.

Table 5-1. Generator Incremental Savings: Post-Regulatory vs. Baseline Recycling Costs

Generator Size (tons/year)	Distance to Recycler (miles)	Baseline Recycling Costs 1/	Post-Regulatory Recycling Costs 2/	Incremental Savings 3/
5	<200	$8,376	$4,208	$4,168
	300	$8,376	$2,819	$5,557
	600	$10,592	$3,557	$7,035
	1,000	$13,480	$4,520	$8,960
10	<200	$8,416	$4,548	$3,868
	300	$8,416	$4,059	$4,357
	600	$10,632	$4,797	$5,835
	1,000	$13,520	$5,760	$7,760
20	<200	$9,096	$7,628	$1,468
	300	$9,096	$7,139	$1,957
	600	$11,312	$7,877	$3,435
	1,000	$14,200	$8,840	$5,360

Table 5-1. Generator Incremental Savings: Post-Regulatory vs. Baseline Recycling Costs				
Generator Size (tons/year)	**Distance to Recycler (miles)**	**Baseline Recycling Costs 1/**	**Post-Regulatory Recycling Costs 2/**	**Incremental Savings 3/**
30	<200	$12,176	$10,708	$1,468
	300	$12,176	$10,708	$1,468
	600	$14,392	$11,816	$2,576
	1,000	$17,280	$13,260	$4,020
40	<200	$15,256	$14,277	$979
	300	$15,256	$14,277	$979
	600	$17,472	$15,755	$1,717
	1,000	$20,360	$17,680	$2,680
50	<200	$18,336	$17,847	$489
	300	$18,336	$17,847	$489
	600	$20,552	$19,693	$859
	1,000	$23,440	$22,100	$1,340

1/ Baseline Recycling Cost Calculations:
Baseline Recycling Unit Cost = $300/ton.
Baseline Recycling Costs = Baseline Recycling Charge + Baseline Recycling Transportation Cost
Baseline Recycling Charge = Maximum of either [$300/ton * Generator Size] OR [Minimum Recycling Charge of $1,350]
Baseline Recycling Transportation Cost = 90-day Accumulation Annual Loading/Unloading Cost + 90-day Accumulation Annual Transportation Cost. These cost estimates are presented in Table 4-2.

2/ Post-Regulatory Recycling Cost Calculations:
Post-Recycling Unit Cost = $300/ton.
Post-Regulatory Recycling Costs = Post-Regulatory Recycling Charge + Post-Regulatory Recycling Transportation Cost
Post-Regulatory Recycling Charge = Maximum of either [$300/ton * Generator Size] OR [Minimum Recycling Charge of $1,350]
Post-Regulatory Recycling Transportation Cost = 180-day (or 270-day) Accumulation Annual Loading/Unloading Cost + 180-day (or 270-day) Accumulation Annual Transportation Cost These cost estimates are presented in Table 4-2.

3/ Incremental Savings Calculation:
Incremental Savings = Post-Regulatory Recycling Costs - Baseline Recycling Costs

Table 5-2. Generator Incremental Savings: Post-Regulatory Recycling vs. Baseline Landfilling Costs

Generator Size (tons/yr)			Distance to Recycler <200 Miles		Distance to Recycler 300 Miles		Distance to Recycler 600 Miles		Distance to Recycler 1,000 Miles	
	Distance to Landfill (miles)	Baseline Landfill Costs[1]	Post-Reg. Rec. Costs [2]	Incremental Savings[3]	Post-Reg. Rec. Costs[2]	Incremental Savings[3]	Post-Reg. Rec. Costs[2]	Incremental Savings[3]	Post-Reg. Rec. Costs[2]	Incremental Savings[3]
5	100	$12,176	$4,208	$7,968	$2,819	$9,357	$3,557	$8,619	$4,520	$7,656
	200	$12,176	$4,208	$7,968	$2,819	$9,357	$3,557	$8,619	$4,520	$7,656
	400	$12,728	$4,208	$8,520	$2,819	$9,909	$3,557	$9,171	$4,520	$8,208
10	100	$12,216	$4,548	$7,668	$4,059	$8,157	$4,797	$7,419	$5,760	$6,456
	200	$12,216	$4,548	$7,668	$4,059	$8,157	$4,797	$7,419	$5,780	$6,436
	400	$12,768	$4,548	$8,220	$4,059	$8,709	$4,797	$7,971	$5,760	$7,008
20	100	$12,296	$7,628	$4,668	$7,139	$5,157	$7,877	$4,419	$8,840	$3,456
	200	$12,296	$7,628	$4,668	$7,139	$5,157	$7,877	$4,419	$8,840	$3,456
	400	$12,848	$7,628	$5,220	$7,139	$5,709	$7,877	$4,971	$8,840	$4,008
30	100	$13,226	$10,708	$2,518	$10,708	$2,518	$11,816	$1,410	$13,260	($34)
	200	$13,226	$10,708	$2,518	$10,708	$2,518	$11,816	$1,410	$13,260	($34)
	400	$13,778	$10,708	$3,070	$10,708	$3,070	$11,816	$1,962	$13,260	$518
40	100	$16,656	$14,277	$2,379	$14,277	$2,379	$15,755	$901	$17,680	($1,024)
	200	$16,656	$14,277	$2,379	$14,277	$2,379	$15,755	$901	$17,680	($1,024)
	400	$17,208	$14,277	$2,931	$14,277	$2,931	$15,755	$1,453	$17,680	($472)

Table 5-2. Generator Incremental Savings: Post-Regulatory Recycling vs. Baseline Landfilling Costs										
Generator Size (tons/yr)			Distance to Recycler <200 Miles		Distance to Recycler 300 Miles		Distance to Recycler 600 Miles		Distance to Recycler 1,000 Miles	
	Distance to Landfill (miles)	Baseline Landfill Costs[1]	Post-Reg. Rec. Costs [2]	Incremental Savings[3]	Post-Reg. Rec. Costs[2]	Incremental Savings[3]	Post-Reg. Rec. Costs[2]	Incremental Savings[3]	Post-Reg. Rec. Costs[2]	Incremental Savings[3]
50	100	$20,086	$17,847	$2,239	$17,847	$2,239	$19,693	$393	$22,100	($2,014)
	200	$20,086	$17,847	$2,239	$17,847	$2,239	$19,693	$393	$22,100	($2,014)
	400	$20,638	$17,847	$2,791	$17,847	$2,791	$19,693	$945	$22,100	($1,462)

[1] Baseline Landfill Cost Calculations:
Baseline Landfill Unit Cost = $335/ton.
Baseline Landfill Costs = Baseline Landfill Charge + Baseline Landfill Transportation Cost
Baseline Landfill Charge = Maximum of either [$335/ton * Generator Size] OR [Minimum Recycling Charge of $2,300]
Baseline Landfill Transportation Cost = 90-day Accumulation Annual Loading/Unloading Cost + 90-day Accumulation Annual Transportation Cost. These cost estimates are presented in Table 4-2.

[2] Post-Regulatory Recycling Cost Calculations:
Post-Recycling Unit Cost = $300/ton.
Post-Regulatory Recycling Costs = Post-Regulatory Recycling Charge + Post-Regulatory Recycling Transportation Cost
Post-Regulatory Recycling Charge = Maximum of either [$300/ton * Generator Size] OR [Minimum Recycling Charge of $1,350]
Post-Regulatory Recycling Transportation Cost = 180-day (or 270-day) Accumulation Annual Loading/Unloading Cost + 180-day (or 270-day) Accumulation Annual Transportation Cost. These cost estimates are presented in Table 4-2.

[3] Incremental Savings Calculation:
Incremental Savings = Post-Regulatory Recycling Costs - Baseline Landfill Costs

5.2 Estimated Cost Impacts and Increases in Recycling

Cost impacts associated with the proposed extension to the current accumulation period to F006 generators were estimated by examining potential decreases in recycling costs for the generators affected by the rulemaking. For example, the recycling costs for an electroplater generating five tons of F006 waste per year who currently ships to a metals recycling facility located 300 miles away are estimated to decrease by approximately $5,557 per year (1997$)[22] as a result of the proposed extension to the accumulation time limit. Considering all facilities in this size category, which generate between 2.5 to 7.5 tons of F006 per year, the aggregate cost savings were estimated. Cost savings were estimated for all of the generator configurations developed to approximate the cost savings associated with the regulation. Not all generators will be affected by the proposed regulation; consequently some adjustments were made to approximate the number of generators that would benefit from the extended accumulation period and therefore increase the quantity of F006 that is recycled, as described below. According to the BRS data, the 1995 recycling rate for the affected 1,317 generators of F006 (i.e., generators that generate less than 15 tons of F006 within a 90-day period) is approximately 40 percent. All of the affected generators that currently recycle will benefit from the regulation. The remaining affected generators, those generators that currently do not recycle, will only benefit to the extent they switch from landfilling to recycling.

The number of generators which will shift to recycling, was estimated by comparing the costs of recycling versus land disposal. As noted in the previous sections, a number of variables affect these costs, including travel distance to the respective recycling/disposal facilities and the value of the waste for recycling. In accommodating the different travel distances the approximate milage between generators and landfills, and generators and recyclers were estimated based on a statistical sample of 1995 BRS data (Tables 5-3 and 5-4)

Table 5-3. Frequency Distribution of the Distances Between F006 Generators and Metals Recyclers

Generator to Recycler Distances (Miles)	Percent of Observations	Distance Used in Cost Estimate
0-200	20%	200
201-450	16%	300
451-800	31%	600
801+	33%	1,000

[22] Calculated using values from Table 5-1: $2,819 post-regulatory annual recycling cost - $8,376 baseline annual recycling cost = -$5,557 annual recycling cost savings.

Table 5-4. Frequency Distribution of the Distances Between F006 Generators and Subtitle C Landfills

Generator to Landfill Distances (Miles)	Percent of Observations	Distance Used in Cost Estimate
0-150	42%	100
151-300	29%	200
301+	29%	400

The estimated costs presented in Tables 5-1 and 5-2 were used for the different milage ranges. For example, the landfill distance range 0-150 miles was represented in the cost estimate based on 100 miles; i.e., 42 percent of the generators used landfills 150 or less miles away, which was represented by the cost estimates based on a distance of 100 miles. This is a simplifying assumption so that national estimates could be derived.

Recycling costs are estimated to range from $200 to $400 per ton. This range is likely to vary widely, and in some instances will be negative (i.e., when the metal credit exceeds the processing fee). Unfortunately there is limited information regarding what portion of the total amount of F006 generated waste is actually the most desirable for recycling. Inquiries were made with industry regarding how much of the universe of F006 waste actually has a positive value (i.e., recyclers would actually pay generators for the material). Unfortunately, contacts were unable (or unwilling) to respond with any specificity. Consequently, this analysis is based on a cost of $300/ton of F006 generated.

The impacts associated with the rule are presented in Table 5-5 for the F006 generators submitting waste generation information in the 1995 Biennial Report. In general, the impacts resulting from the regulation will have the greatest effect on smaller generators, including the smaller job shops. Overall, due to potential cost savings associated with the rule, the recycling rate of electroplaters generating less than 60 tons of F006 a year is expected to increase, ranging from 71 to 87 percent.

Two scenarios are presented in Table 5-5 to estimate the potential annual cost savings (1997$) due to increased post-regulatory recycling rates. As is evident from the two scenarios presented, savings to generators may result in two ways. First, the ability to accumulate a greater amount of waste will allow more generators to surpass minimum load charges and second, for many generators the number of loads (i.e., trips to a recycling facility during a given year) may be reduced, resulting in lower transportation and shipping costs. For the first scenario, lower bound recycling rate estimates range from 65 to 80 percent across different generator size categories resulting in a total cost savings estimate of $3.9 million per year. For the second scenario, upper bound recycling rate estimates range from 80 to 100 percent across different generator size categories resulting in a total cost savings estimate of $4.9 million per year. Total cost savings are estimated to range from $3.9 to $4.9 million annually on a before tax basis.

Table 5-5. Summary of Cost Impact Estimates and Changes in F006 Recycling Rates (1997$)								
Generator Size Range (tons/yr)	**Number of Generators**	**Total Quantity Generated (tons)**	**Number of Generators Currently Recycling[1]**	**Average Generator Savings for Current Recyclers ($facility/yr)[2]**	**Number of Generators Switching to Recycling**	**Average Generator Savings for New Post-Reg. Recyclers ($/facility/yr)[3]**	**Post-Regulatory Recycling Rate (%)[4]**	**Total Cost Savings ($1,000/yr) [5]**
0.0-2.5	205	199	NE	NE	NE	NE	NE	NE
2.5-7.5	246	1,167	98	$6,860	98-148	$8,449	80-100	1,510-1,920
7.6-12.5	166	1,674	66	$5,840	66-100	$7,429	80-100	880-1,130
12.6-25.0	315	5,869	126	$3,440	126-189	$4,429	80-100	990-1,270
25.1-35.0	151	4,335	60	$2,654	46-69	$1,949	70-85	250-300
35.1-45.0	108	4,296	43	$1,769	29-43	$1,855	65-80	130-160
45.1-60.0	126	6,597	50	$885	34-51	$1,545	65-80	100-120
Totals	1,317	24,137	443		398-600		76-87	3,860-4,900

NE - Not Estimated. Impacts for the smallest facilities are not estimated because of uncertainties regarding the transport of waste by these small generators, which will likely involve multiple pickups to reduce transport costs.

[1] The baseline recycling rate is estimated at 40% for all categories based on an assessment of 1995 BRS data.

[2] Baseline facility recycling costs minus post-regulatory recycling costs, weighted by the number of facilities in each distance category. The average incremental savings are calculated using the incremental saving estimates presented in Table 5-1, and percentage of facilities in each distance category is presented in Table 5.3 (for recycling distances).

[3] Baseline facility land disposal costs minus post-regulatory recycling costs, weighted by the number of facilities in each distance category. The average incremental savings are calculated using the incremental saving estimates presented in Table 5-2, and percentage of facilities in each distance category are presented in Table 5.3 (for recycling distances) and Table 5.4 (for landfill distances).

[4] Range estimate based on evaluation which indicates a cost advantage for recycling in all scenarios considered. However, given the uncertainties regarding waste quality and other factors 80% is assumed as a lower bound and 100 percent as an upper bound unless not economically viable to recycle given extremely long shipping distances to metals recovery facilities.

[5] As an example calculation, for the 2.5-7.5 size range, lower bound savings for all generators in this size category are calculated as follows:

Incremental Savings from Baseline Recycling to Post-Regulatory Recycling = number of generators currently recycling x [(<200 mile fraction x <200 mile incremental facility savings) + (300 mile fraction x 300 mile incremental facility savings) + (600 mile fraction x 600 mile incremental facility savings) + (1,000 mile fraction x 1,000 mile incremental facility savings)]

= 98 x [(.2 x $4,168) + (.16 x $5,557) + (.31 x $7,035) + (.33 x $8,960)] = $672,316

,Incremental Savings from Baseline Landfilling to Post-Regulatory Recycling = lower bound estimate of number of generators shifting to recycling x [<200 mile recycling fraction x [(100 mile baseline landfill fraction x 100 mile incremental facility savings) + (200 mile baseline landfill fraction x 200 mile incremental facility savings) + (400 mile baseline landfill fraction x 400 mile incremental facility savings)] + [....The proceeding calculation would be repeated for the 300, 600, and 1,000 mile recycling distances]

=98 x [.2 * [(.42 x $9,357) + (.29 x $9,357) + (.29 x $9,909)] + .16 * [...] + .31 * [...] + .33 * [...]] = $831,393

Total Cost Savings = Incremental Savings from Baseline Recycling to Post-Regulatory Recycling + Incremental Savings from Baseline Landfilling to Post-Regulatory Recycling

$672,316 + $831,393 = $1,506,449

Appendix B presents the calculations of total cost savings for the lower and upper bound estimates.

5.3 Economic Impact Analysis

Because this proposed rulemaking will result in cost savings to regulated entities rather than impose costs, no adverse economic impacts to these entities will result from this action. The magnitude of cost savings from this regulatory action can be expressed as a percentage of average firm revenues and profits. Because of the large number of electroplating facilities that conduct electroplating and the proprietary nature of individual firm financial information, an average or model firm is used in this analysis in lieu of actual firm data.

In 1995, approximately 3,300 job shops had revenues of $5.8 billion and estimated profits of $180 million yielding an average of $1.8 million in revenue and $55,000 in profits per firm.[23] Under this proposed rulemaking, average generator savings estimated in Table 5-5 range between $900 and $8,400 per generator. Average generator savings are less than one percent of an average plating firm's revenues. However, these savings represent between 2 and 15 percent of firm profits. Generator savings will be the greatest for the smallest plating firms. These savings will be sufficient to cause a shift from landfilling of F006 waste to recycling for a substantial number of generators.

[23] U.S. EPA Office of Solid Waste And Emergency Response, Draft Regulatory Impact Analysis: Phase IV Land Disposal Restrictions - TC Organometallic Wastes, December 15, 1997, p.2.

6.0 QUALITATIVE BENEFITS

Extending the length of time generators may accumulate F006 waste, makes it more economical for more generators to recycle F006 waste instead of placing it in a landfill. Increased recycling of F006 waste may result in a net benefit to both society and the environment. Some of the expected benefits include the following:

- **Landfill Capacity:** Approximately 23 million tons of hazardous waste are land disposed annually. In 1995, 1 million tons of hazardous waste were disposed of in landfills along with 208 million tons of municipal waste.[24] Available landfill space is limited and as overcapacity issues are eminent, any increase in recycling will lessen the future burden on landfills.

- **Resource Conservation:** The supply of metals used in electroplating processes is ultimately fixed by nature. Many metals are easily recycled and today recycled metals make up a large portion of the available metals supply. For instance, the U.S. Geological Survey reported that in 1996, 78 million metric tons of metals were recycled in the U.S. The value of these recycled metals was estimated to be approximately $18 billion.[25] As the U.S. Geological Survey states, "Recycling, a significant factor in the supply of many of the key metals used in our society, provides environmental benefits in terms of energy savings, reduced volumes of waste, and reduced emissions. These reductions, in turn, result in reduced disturbance to land, reduced pollution, and reduced energy use."[26]

- **Metals Recovery:** An increase in recycling of domestic metals will lessen the dependance of the United States on foreign metal supplies. In 1991, the United States ran a $9.8 billion balance of trade deficit for metal commodities.[27] Copper, nickel, and zinc, three of the most common metals recovered from F006 waste, accounted for more than $2 billion of this total trade deficit. Additionally, several recyclers of F006 waste reported that metal recovery of nickel, chromium and zinc bearing secondary materials was more efficient in terms of conserving energy and reducing solid waste residuals associated with primary metal/mineral production. Finally, in its Report to Congress on Metal Recovery, Environmental Regulation and Hazardous Waste, the EPA reported that chromium, a

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[24] U.S. EPA, Office of Solid Waste and Emergency Response, "RCRA: Reducing Risk From Waste OSWER," EPA530-K-97-004, September 1997, pp 14-15.

[25] U.S. Geological Survey–Minerals Information, "Recycling–Metals," 1996, p.1.

[26] Ibid.

[27] Based on the difference between imports and exports of each commodity as reported in Jacqueline A. McClaskey and Stephen D. Smith, "Survey Methods and Statistical Summary of Nonfuel Minerals," U.S. Department of the Interior, Bureau of Mines, 1991, supra, Note 38, U.S. EPA, p.134.

strategic metal,[28] is found in sources of secondary materials such as F006 waste. The report indicates that these secondary materials are underutilized as a potential source of secondary chromium to reduce U.S. dependence on foreign primary sources.[29] [30]

[28] A strategic metal is a metal which is required for critical military and/or civilian use and for which the United States is dependent upon from vulnerable sources of supply. Borst, Paul A., "Recycling of Wastewater Treatment Sludges From Electroplating Operations, F006," U.S. EPA, OSW.

[29] Supra, Note 38, pp. 138-139.

[30] Borst, Paul A., "Recycling of Wastewater Treatment Sludges From Electroplating Operations, F006," U.S. EPA, OSW.

7.0 OTHER ADMINISTRATIVE REQUIREMENTS

This section describes the Agency's response to other rulemaking requirements established by statute and executive order, within the context of the proposed 180-day accumulation rule for F006 waste.

7.1 Environmental Justice

The EPA is committed to addressing environmental justice concerns and is assuming a leadership role in environmental justice initiatives to enhance environmental quality for all residents of the United States. The Agency's goals are to ensure that no segment of the population, regardless of race, color, national origin, or income bears disproportionately high and adverse human health and environmental impacts as a result of the EPA's policies, programs, and activities, and that all people live in clean and sustainable communities. In response to Executive Order 12898 and to concerns voiced by many groups outside the Agency, the EPA's Office of Solid Waste and Emergency Response formed an Environmental Justice Task Force to analyze the array of environmental justice issues specific to waste programs and to develop an overall strategy to identify and address these issues (OSWER Directive No. 9200.3-17).

It is not certain whether the environmental problems addressed by the proposed extension of the 90-day accumulation rule for F006 waste could disproportionately affect minority or low income communities, due to the location of some metal finishing operations. Metal finishing operations are distributed throughout the country and many are located within highly populated areas. Because the proposed rule retains requirements for F006 generators to store F006 waste in protective Subpart I tanks, Subpart I containers or Subpart DD container buildings, the Agency does not believe that this rule will increase risks from F006 waste. It is, therefore, not expected to result in any disproportionately negative impacts on minority or low income communities relative to affluent or non-minority communities. Similarly, because the accumulation units are protective, the rule is not expected to result in any increased risk to minority or low-income workers handling F006 waste relative to non-minority or higher-income workers.

7.2 Unfunded Mandates Reform Act

Under Section 202 of the Unfunded Mandates Reform Act of 1995, signed into law on March 22, 1995, the EPA must prepare a statement to accompany any rule for which the estimated costs to state, local, or tribal governments in the aggregate, or to the private sector, will be $100 million or more in any one year. Under Section 205, the EPA must select the most cost-effective and least burdensome alternative that achieves the objective of the rule and is consistent with statutory requirements. Section 203 requires the EPA to establish a plan for informing and advising any small governments that may be significantly affected by the rule.

An analysis of the costs and benefits of the proposed rule was conducted and it was determined that this rule does not include a federal mandate that may result in estimated costs of $100 million or more to either state, local, or tribal governments in the aggregate. The private sector also is not expected to incur costs exceeding $100 million per year in this RIA.

7.3 Protection of Children from Environmental Health Risks and Safety Risks

On April 21, 1997, the President signed an Executive Order (13045) entitled, "Protection of Children from Environmental Health Risks and Safety Risks." The Executive Order requires all economically significant rules[31] that concern an environmental health risk or safety risk that may disproportionately affect children to comply with requirements of the Executive Order. Because the EPA does not consider today's proposed rule to be economically significant, it is not subject to Executive Order 13045. Because this rulemaking retains current container standards for generators accumulating hazardous wastes on site without a permit (40 CFR §262.34), the EPA believes that the extended 180-day accumulation period will not result in increased exposures to children. Generators that accumulate F006 waste on site typically place the waste in containers such as 55 gallon drums or "super sacks"(sacks that are reinforced woven resin and designed to accommodate bulk shipments). The current container standards (40 CFR Part 265, Subpart I) referenced in the generator regulations (40 CFR §262.34) require that waste handlers, including generators, to keep containers in good condition (subject to remedial action if leaks are found), have containers closed during usage except when adding or removing waste, and inspect the containers at least weekly. In addition, for these containers, waste handlers are required under Subpart I to comply with Subpart CC air emission standards for containers (40 CFR §§265.178 and 265.1087). The EPA believes that these container requirements are protective to minimize the likelihood of exposure to hazardous waste managed in these units. For these reasons, the environmental health risks or safety risks addressed by this action do not have a disproportionate effect on children.

[31] An economically significant rule is defined by Executive Order 12866 as any rulemaking that has an annual effect on the economy of $100 million or more, or would adversely affect in a material way the economy, a sector of the economy, productivity, competition, jobs, the environment, public health, or safety, or State, local, or tribal governments or communities.

8.0 CONCLUSION

This proposed regulatory action provides between $3.9 million and $4.9 million in cost savings due to an increase in the accumulation time limit to 180 days and in certain instances, up to 270 days for F006 waste generators. These cost savings will primarily benefit the smallest electroplating operations due to a decrease in transportation costs that will result from a reduction in the frequency of shipments and the shipment of fuller loads that exceed minimum recycling and transporting charges on a per unit basis. These cost savings will lead to an increase in the amount of F006 waste that is recycled. In order to ensure that on-site accumulation of F006 waste is protective of human health and the environment, the management standards for the 180 and 270-day accumulation of F006 waste will be the same as those that currently apply for the 90-day accumulation time limit. Benefits resulting from this proposed rulemaking include conservation of natural resources, conservation of hazardous waste landfill capacity, and increased recovery of metals including strategic metals.

APPENDIX A

Table A-1. Transportation Cost Model Calibration					
Transport Distance	**DPRA Transportation Cost Model**				**ECHOS Price Data ($/one-way mile; 1997 $)**
	Assume Typical Union Wage & Overhead & Profit **Wage = $21.30/hr (including fringe)** **OH & Profit = 53.8 %**		**Assume Other Wage & Overhead & Profit** **Wage = $17.25/hr (including fringe)** **OH & Profit = 45 %**		
	Full Load	Partial Load	Full Load	Partial Load	Full Load
< 200 miles City Driving Truck Use = 90% 20 CY Roll-off & Tilt Frame	$896.16 MPH = 40 6 MPG	$826.52 MPH = 45 6 MPG	$752.25 MPH = 40 6 MPG	$694.61 MPH = 45 6 MPG	$732.33 minimum charge
200-299 miles Highway Driving Truck Use = 95% Van Trailer	$3.19 MPH = 50 8 MPG	$2.92 MPH = 55 10 MPG	$2.50 MPH = 50 8 MPG	$2.42 MPH = 55 10 MPG	2.48
300-399 miles	$2.80 MPH = 55	$2.57 MPH = 60	$2.33 MPH = 55	$2.13 MPH = 60	2.35
400-499 miles	$2.69	$2.46	$2.25	$2.05	2.27
500-599 miles	$2.62 MPH = 65	$2.55 MPH = 65	$2.18 MPH = 65	$2.12 MPH = 65	2.22
600-699 miles	$2.52	$2.46	$2.11	$2.05	2.20
700-799 miles	$2.46	$2.39	$2.05	$1.99	2.16
800-899 miles	$2.60	$2.54	$2.17	$2.11	2.14
900-999 miles	$2.54	$2.47	$2.12	$2.06	2.13
1,000-1,099 miles	$2.49	$2.42	$2.08	$2.02	2.11
1,100-1,199 miles	$2.45	$2.38	$2.05	$1.98	2.09
1,200+	$2.41	$2.35	$2.02	$1.96	2.07

APPENDIX B

Table B-1. Calculation of Total Cost Savings: Lower Bound Estimate

Generator Size Range (tons/year) A	No. of Generators B	Baseline Recycling Rate C	Recycling Distance Pct. Distribution (miles) D	Incremental Recycling Savings [1] E	Subtotal Continued Recycling Savings F	Lower Bound Incremental Recycling Rate G	Recycling Distance Pct. Distribution (miles) H	Landfill Distance Pct. Distibution (miles) I	Incremental Recycling vs. Landfill Savings [1] J	Subtotal New Recycling Savings K	Total Cost Savings L
2.5 - 7.5 **5 tons/yr**	n = 246	40% n = 98	20% (<200) n = 20	$4,168	$82,026	40% n = 98	20% (< 200) n = 20	42% (100) n = 8	$7,968	$65,860	
								29% (200) n = 6	$7,968	$45,475	
								29% (400) n = 6	$8,520	$48,625	
			16% (300) n = 16	$5,557	$87,495		16% (300) n = 16	42% (100) n = 7	$9,357	$61,875	
								29% (200) n = 5	$9,357	$42,723	
								29% (400) n = 5	$9,909	$45,244	
			31% (600) n = 30	$7,035	$214,585		31% (600) n = 30	42% (100) n = 13	$8,619	$110,420	
								29% (200) n = 9	$8,619	$76,242	
								29% (400) n = 9	$9,171	$81,125	
			33% (1,000) n = 32	$8,960	$290,949		33% (1,000) n = 32	42% (100) n = 14	$7,656	$104,414	
								29% (200) n = 9	$7,656	$72,096	
								29% (400) n = 9	$8,208	$77,294	N = 196
			N1 = 98		$675,055			N2 = 98		$831,393	$1,506,449

Table B-1. Calculation of Total Cost Savings: Lower Bound Estimate (continued)

Generator Size Range (tons/year) A	No. of Generators B	Baseline Recycling Rate C	Recycling Distance Pct. Distribution (miles) D	Incremental Recycling Savings [1] E	Subtotal Continued Recycling Savings F	Lower Bound Incremental Recycling Rate G	Recycling Distance Pct. Distribution (miles) H	Landfill Distance Pct. Distibution (miles) I	Incremental Recycling vs. Landfill Savings [1] J	Subtotal New Recycling Savings K	Total Cost Savings L
7.6 - 12.5 **10 tons/yr**	n = 166	40% n = 66	20% (<200) n = 13	$3,868	$51,367	40% n = 66	20% (< 200) n = 13	42% (100) n = 6	$7,668	$42,769	
								29% (200) n = 4	$7,668	$29,531	
								29% (400) n = 4	$8,220	$31,657	
			16% (300) n = 11	$4,357	$46,292		16% (300) n = 11	42% (100) n = 4	$8,157	$36,399	
								29% (200) n = 3	$8,157	$25,132	
								29% (400) n = 3	$8,709	$26,833	
			31% (600) n = 20	$5,835	$120,101		31% (600) n = 20	42% (100) n = 9	$7,419	$64,136	
								29% (200) n = 6	$7,419	$44,285	
								29% (400) n = 6	$7,971	$47,580	
			33% (1,000) n = 22	$7,760	$170,037		33% (1,000) n = 22	42% (100) n = 9	$6,456	$59,415	
								29% (200) n = 6	$6,456	$41,025	
								29% (400) n = 6	$7,008	$44,532	N = 132
			N1 = 66		$387,797			N2 = 66		$493,284	$881,091

Table B-1. Calculation of Total Cost Savings: Lower Bound Estimate (continued)

Generator Size Range (tons/year) A	No. of Generators B	Baseline Recycling Rate C	Recycling Distance Pct. Distribution (miles) D	Incremental Recycling Savings [1] E	Subtotal Continued Recycling Savings F	Lower Bound Incremental Recycling Rate G	Recycling Distance Pct. Distribution (miles) H	Landfill Distance Pct. Distibution (miles) I	Incremental Recycling vs. Landfill Savings [1] J	Subtotal New Recycling Savings K	Total Cost Savings L
12.6 - 25.0 **20 tons/yr**	n = 315	40% n = 126	20% (<200) n = 25	$1,468	$36,994	40% n = 126	20% (< 200) n = 25	42% (100) n = 11	$4,668	$49,406	
								29% (200) n = 7	$4,668	$34,114	
								29% (400) n = 7	$5,220	$38,148	
			16% (300) n = 22	$1,957	$39,460		16% (300) n = 22	42% (100) n = 8	$5,157	$43,668	
								29% (200) n = 6	$5,157	$30,152	
								29% (400) n = 6	$5,709	$33,379	
			31% (600) n = 38	$3,435	$134,158		31% (600) n = 38	42% (100) n = 16	$4,419	$72,489	
								29% (200) n = 11	$4,419	$50,052	
								29% (400) n = 11	$4,971	$56,305	
			33% (1,000) n = 41	$5,360	$222,869		33% (1,000) n = 41	42% (100) n = 17	$3,456	$60,354	
								29% (200) n = 12	$3,456	$41,673	
								29% (400) n = 12	$4,008	$48,329	N = 252
			N1 = 126		$433,480			N2 = 126		$558,069	$991,549

Table B-1. Calculation of Total Cost Savings: Lower Bound Estimate (continued)

Generator Size Range (tons/year) A	No. of Generators B	Baseline Recycling Rate C	Recycling Distance Pct. Distribution (miles) D	Incremental Recycling Savings [1] E	Subtotal Continued Recycling Savings F	Lower Bound Incremental Recycling Rate G	Recycling Distance Pct. Distribution (miles) H	Landfill Distance Pct. Distibution (miles) I	Incremental Recycling vs. Landfill Savings [1] J	Subtotal New Recycling Savings K	Total Cost Savings L
25.1 - 35.0 **30 tons/yr**	n = 151	40% n = 60	20% (<200) n = 12	$1,468	$17,733	40% n = 60	20% (< 200) n = 12	42% (100) n = 5	$2,518	$12,755	
								29% (200) n = 4	$2,518	$8,821	
								29% (400) n = 4	$3,070	$10,755	
			16% (300) n = 10	$1,468	$14,187		16% (300) n = 10	42% (100) n = 4	$2,518	$10,220	
								29% (200) n = 3	$2,518	$7,057	
								29% (400) n = 3	$3,070	$8,604	
			31% (600) n = 18	$2,576	$48,233		31% (600) n = 18	42% (100) n = 8	$1,410	$11,088	
								29% (200) n = 5	$1,410	$7,656	
								29% (400) n = 5	$1,963	$10,654	
			33% (1,000) n = 20	$4,020	$80,127		33% (1,000) n = 20	42% (100) n = 8	($34)	$0	
								29% (200) n = 6	($34)	$0	
								29% (400) n = 6	$518	$2,994	N = 106
			N1 = 60		$160,280			N2 = 46		$90,625	$250,904

Table B-1. Calculation of Total Cost Savings: Lower Bound Estimate (continued)

Generator Size Range (tons/year) A	No. of Generators B	Baseline Recycling Rate C	Recycling Distance Pct. Distribution (miles) D	Incremental Recycling Savings [1] E	Subtotal Continued Recycling Savings F	Lower Bound Incremental Recycling Rate G	Recycling Distance Pct. Distribution (miles) H	Landfill Distance Pct. Distibution (miles) I	Incremental Recycling vs. Landfill Savings [1] J	Subtotal New Recycling Savings K	Total Cost Savings L
35.1 - 45.0 **40 tons/yr**	n = 108	40% n = 43	20% (<200) n = 9	$979	$8,456	40% n = 43	20% (< 200) n = 9	42% (100) n = 4	$2,379	$8,632	
								29% (200) n = 3	$2,379	$5,960	
								29% (400) n = 3	$2,931	$7,343	
			16% (300) n = 7	$979	$6,765		16% (300) n = 7	42% (100) n = 3	$2,379	$6,905	
								29% (200) n = 2	$2,379	$4,768	
								29% (400) n = 2	$2,931	$5,874	
			31% (600) n = 13	$1,717	$22,999		31% (600) n = 13	42% (100) n = 6	$901	$5,070	
								29% (200) n = 4	$901	$3,500	
								29% (400) n = 4	$1,453	$5,644	
			33% (1,000) n = 14	$2,680	$38,206		33% (1,000) n = 14	42% (100) n = 6 => 0	($1,024)	$0	
								29% (200) n = 4 => 0	($1,024)	$0	
								29% (400) n = 4 =>0	($472)	$0	N = 72
			N1 = 43		$76,425			N2 = 29		$53,697	$130,122

Table B-1. Calculation of Total Cost Savings: Lower Bound Estimate (continued)

Generator Size Range (tons/year) A	No. of Generators B	Baseline Recycling Rate C	Recycling Distance Pct. Distribution (miles) D	Incremental Recycling Savings [1] E	Subtotal Continued Recycling Savings F	Lower Bound Incremental Recycling Rate G	Recycling Distance Pct. Distribution (miles) H	Landfill Distance Pct. Distibution (miles) I	Incremental Recycling vs. Landfill Savings [1] J	Subtotal New Recycling Savings K	Total Cost Savings L
45.1 - 60.0 **50 tons/yr**	n = 126	40% n = 50	20% (<200) n = 10	$489	$4,932	40% n = 50	20% (< 200) n = 10	42% (100) n = 4	$2,239	$9,480	
								29% (200) n = 3	$2,239	$6,546	
								29% (400) n = 3	$2,791	$8,160	
			16% (300) n = 8	$489	$3,946		16% (300) n = 8	42% (100) n = 3	$2,239	$7,584	
								29% (200) n = 2	$2,239	$5,237	
								29% (400) n = 2	$2,791	$6,528	
			31% (600) n = 16	$859	$13,416		31% (600) n = 16	42% (100) n = 7	$393	$2,577	
								29% (200) n = 5	$393	$1,779	
								29% (400) n = 5	$945	$4,280	
			33% (1,000) n = 17	$1,340	$22,287		33% (1,000) n = 17	42% (100) n = 7 => 0	($2,014)	$0	
								29% (200) n = 5 => 0	($2,014)	$0	
								29% (400) n = 5 => 0	($1,462)	$0	N = 84
			N1 = 50		$44,581			N2 = 34		$52,171	$96,752
										Total	$3,856,868

Column A:	Range of F006 generator sizes included in this total cost savings estimate.
Column B:	Number of F006 generators that reported a quantity in the 1995 BRS within this generator size range.
Column C:	Current F006 recycling rate as reported in the 1995 BRS for those generators that generate less than 60 tons per year.
Column D:	Percentage profile of the distances that F006 generators are currently shipping to recycle their wastes and number of generators (n)(Table 5-3).
Column E:	Incremental cost savings from the extended accumulation time limit for F006 generators that currently recycle (Table 5-1)
Column F:	Calculated subtotals of the cost savings estimated for F006 generators that currently recycle and will continue to recycle post regulation Col. H = Col. B * (Col. C/100) * (Col. D/100) * Col. E
Column G:	Estimated incremental increase in the recycling rate above the baseline recycling rate.
Column H:	Percentage profile of the distances that F006 generators are currently shipping to recycle their wastes (Table 5-3).
Column I:	Percentage profile of the distances that F006 generators are currently shipping to landfill their wastes (Table 5-4).
Column J:	Incremental cost savings from the extended accumulation time limit for F006 generators that currently landfill (Table 5-2).
Column K:	Calculated subtotals of the cost savings estimated for F006 generators that currently landfill and will now recycle post regulation. If the value is negative, it is assumed that landfilling is more economical than recycling at this distance, cost savings are set to $0, and the value for n is subtracted from the total number of new recyclers (N2). Col. K = Col. B * (Col. G/100) * (Col. H/100) * (Col. I/100) * Col. J
Column L:	Total cost savings calculated by generator size range. N equals the total number of generators estimated to be recycling post regulation. N = N1 + N2

[1] Recycling unit costs are assumed to be $300/ton.

Table B-2. Calculation of Total Cost Savings: Upper Bound Estimate

Generator Size Range (tons/year) A	No. of Generators B	Baseline Recycling Rate C	Recycling Distance Pct. Distribution (miles) D	Incremental Recycling Savings [1] E	Subtotal Continued Recycling Savings F	Lower Bound Incremental Recycling Rate G	Recycling Distance Pct. Distribution (miles) H	Landfill Distance Pct. Distibution (miles) I	Incremental Recycling vs. Landfill Savings [1] J	Subtotal New Recycling Savings K	Total Cost Savings L
2.5 - 7.5 **5 tons/yr**	n = 246	40% n = 98	20% (<200) n = 20	$4,168	$82,026	60% n =148	20% (< 200) n = 30	42% (100) n = 12	$7,968	$98,790	
								29% (200) n = 9	$7,968	$68,212	
								29% (400) n = 9	$8,520	$72,938	
			16% (300) n = 16	$5,557	$87,495		16% (300) n = 24	42% (100) n = 10	$9,357	$92,813	
								29% (200) n = 7	$9,357	$64,085	
								29% (400) n = 7	$9,909	$67,865	
			31% (600) n = 30	$7,035	$214,585		31% (600) n = 46	42% (100) n = 19	$8,619	$165,629	
								29% (200) n = 13	$8,619	$114,363	
								29% (400) n = 13	$9,171	$121,688	
			33% (1,000) n = 32	$8,960	$290,949		33% (1,000) n = 49	42% (100) n = 20	$7,656	$156,622	
								29% (200) n = 14	$7,656	$108,143	
								29% (400) n = 14	$8,208	$115,941	N = 246
			N1 = 98		$675,055			N2 = 148		$1,247,090	$1,922,146

Table B-2. Calculation of Total Cost Savings: Upper Bound Estimate (continued)

Generator Size Range (tons/year) A	No. of Generators B	Baseline Recycling Rate C	Recycling Distance Pct. Distribution (miles) D	Incremental Recycling Savings [1] E	Subtotal Continued Recycling Savings F	Lower Bound Incremental Recycling Rate G	Recycling Distance Pct. Distribution (miles) H	Landfill Distance Pct. Distibution (miles) I	Incremental Recycling vs. Landfill Savings [1] J	Subtotal New Recycling Savings K	Total Cost Savings L
7.6 - 12.5 **10 tons/yr**	n = 166	40% n = 66	20% (<200) n = 13	$3,868	$51,367	60% n = 100	20% (< 200) n = 20	42% (100) n = 8	$7,668	$64,154	
								29% (200) n = 6	$7,668	$44,297	
								29% (400) n = 6	$8,220	$47,485	
			16% (300) n = 11	$4,357	$46,292		16% (300) n = 16	42% (100) n = 7	$8,157	$54,598	
								29% (200) n = 5	$8,157	$37,699	
								29% (400) n = 5	$8,709	$40,250	
			31% (600) n = 20	$5,835	$120,101		31% (600) n = 31	42% (100) n = 13	$7,419	$96,205	
								29% (200) n = 9	$7,419	$66,427	
								29% (400) n = 9	$7,971	$71,370	
			33% (1,000) n = 22	$7,760	$170,037		33% (1,000) n = 33	42% (100) n = 14	$6,456	$89,122	
								29% (200) n = 10	$6,456	$61,537	
								29% (400) n = 10	$7,008	$66,798	N = 166
			N1 = 66		$387,797			N2 = 100		$739,940	$1,127,738

Table B-2. Calculation of Total Cost Savings: Upper Bound Estimate (continued)

Generator Size Range (tons/year) A	No. of Generators B	Baseline Recycling Rate C	Recycling Distance Pct. Distribution (miles) D	Incremental Recycling Savings [1] E	Subtotal Continued Recycling Savings F	Lower Bound Incremental Recycling Rate G	Recycling Distance Pct. Distribution (miles) H	Landfill Distance Pct. Distibution (miles) I	Incremental Recycling vs. Landfill Savings [1] J	Subtotal New Recycling Savings K	Total Cost Savings L
12.6 - 25.0 **20 tons/yr**	n = 315	40% n = 126	20% (<200) n = 25	$1,468	$36,994	60% n = 189	20% (< 200) n = 38	42% (100) n = 16	$4,668	$74,109	
								29% (200) n = 11	$4,668	$51,171	
								29% (400) n = 11	$5,220	$57,222	
			16% (300) n = 22	$1,957	$39,460		16% (300) n = 30	42% (100) n = 13	$5,157	$65,502	
								29% (200) n = 9	$5,157	$45,228	
								29% (400) n = 9	$5,709	$50,069	
			31% (600) n = 38	$3,435	$134,158		31% (600) n = 59	42% (100) n = 25	$4,419	$108,734	
								29% (200) n = 17	$4,419	$75,078	
								29% (400) n = 17	$4,971	$84,457	
			33% (1,000) n = 41	$5,360	$222,869		33% (1,000) n = 62	42% (100) n = 26	$3,456	$90,531	
								29% (200) n = 18	$3,456	$62,510	
								29% (400) n = 18	$4,008	$72,494	N = 189
			N1 = 126		$433,480			N2 = 189		$837,104	$1,270,584

Table B-2. Calculation of Total Cost Savings: Upper Bound Estimate (continued)

Generator Size Range (tons/year) A	No. of Generators B	Baseline Recycling Rate C	Recycling Distance Pct. Distribution (miles) D	Incremental Recycling Savings [1] E	Subtotal Continued Recycling Savings F	Lower Bound Incremental Recycling Rate G	Recycling Distance Pct. Distribution (miles) H	Landfill Distance Pct. Distibution (miles) I	Incremental Recycling vs. Landfill Savings [1] J	Subtotal New Recycling Savings K	Total Cost Savings L
25.1 - 35.0 **30 tons/yr**	n = 151	40% n = 60	20% (<200) n = 12	$1,468	$17,733	60% n = 91	20% (< 200) n = 18	42% (100) n = 8	$2,518	$19,163	
								29% (200) n = 5	$2,518	$13,232	
								29% (400) n = 5	$3,070	$16,132	
			16% (300) n = 10	$1,468	$14,187		16% (300) n = 14	42% (100) n = 6	$2,518	$15,330	
								29% (200) n = 4	$2,518	$10,585	
								29% (400) n = 4	$3,070	$12,906	
			31% (600) n = 18	$2,576	$48,233		31% (600) n = 28	42% (100) n = 12	$1,410	$16,633	
								29% (200) n = 8	$1,410	$11,484	
								29% (400) n = 8	$1,963	$15,980	
			33% (1,000) n = 20	$4,020	$80,127		33% (1,000) n = 30	42% (100) n = 13 => 0	($34)	$0	
								29% (200) n = 9 => 0	($34)	$0	
								29% (400) n = 9	$518	$4,491	N = 129
			N1 = 60		$160,280			N2 = 69		$135,937	$296,217

Table B-2. Calculation of Total Cost Savings: Upper Bound Estimate (continued)

Generator Size Range (tons/year) A	No. of Generators B	Baseline Recycling Rate C	Recycling Distance Pct. Distribution (miles) D	Incremental Recycling Savings [1] E	Subtotal Continued Recycling Savings F	Lower Bound Incremental Recycling Rate G	Recycling Distance Pct. Distribution (miles) H	Landfill Distance Pct. Distibution (miles) I	Incremental Recycling vs. Landfill Savings [1] J	Subtotal New Recycling Savings K	Total Cost Savings L
35.1 - 45.0 **40 tons/yr**	n = 108	40% n = 43	20% (<200) n = 9	$979	$8,456	60% n = 65	20% (< 200) n =13	42% (100) n = 5	$2,379	$12,948	
								29% (200) n = 4	$2,379	$8,940	
								29% (400) n = 4	$2,931	$11,015	
			16% (300) n = 7	$979	$6,765		16% (300) n = 10	42% (100) n = 4	$2,379	$10,358	
								29% (200) n = 3	$2,379	$7,152	
								29% (400) n = 3	$2,931	$8,812	
			31% (600) n = 13	$1,717	$22,999		31% (600) n = 20	42% (100) n = 8	$901	$7,605	
								29% (200) n = 6	$901	$5,251	
								29% (400) n = 6	$1,453	$8,466	
			33% (1,000) n = 14	$2,680	$38,206		33% (1,000) n = 21	42% (100) n = 9 => 0	($1,024)	$0	
								29% (200) n = 6 => 0	($1,024)	$0	
								29% (400) n = 6 =>0	($472)	$0	N = 86
			N1 = 43		$76,425			N2 = 43		$80,546	$156,970

Table B-2. Calculation of Total Cost Savings: Upper Bound Estimate (continued)

Generator Size Range (tons/year) A	No. of Generators B	Baseline Recycling Rate C	Recycling Distance Pct. Distribution (miles) D	Incremental Recycling Savings [1] E	Subtotal Continued Recycling Savings F	Lower Bound Incremental Recycling Rate G	Recycling Distance Pct. Distribution (miles) H	Landfill Distance Pct. Distibution (miles) I	Incremental Recycling vs. Landfill Savings [1] J	Subtotal New Recycling Savings K	Total Cost Savings L
45.1 - 60.0 **50 tons/yr**	n = 126	40% n = 50	20% (<200) n = 10	$489	$4,932	60% n = 76	20% (< 200) n = 15	42% (100) n = 6	$2,239	$14,221	
								29% (200) n = 4	$2,239	$9,819	
								29% (400) n = 4	$2,791	$12,239	
			16% (300) n = 8	$489	$3,946		16% (300) n = 12	42% (100) n = 5	$2,239	$11,377	
								29% (200) n = 4	$2,239	$7,855	
								29% (400) n = 4	$2,791	$9,792	
			31% (600) n = 16	$859	$13,416		31% (600) n = 23	42% (100) n = 10	$393	$3,865	
								29% (200) n = 7	$393	$2,669	
								29% (400) n = 7	$945	$6,420	
			33% (1,000) n = 17	$1,340	$22,287		33% (1,000) n = 25	42% (100) n = 10 => 0	($2,014)	$0	
								29% (200) n = 7 => 0	($2,014)	$0	
								29% (400) n = 7 => 0	($1,462)	$0	N = 101
			N1 = 50		$44,581			N2 = 51		$78,257	$122,838
										Total	$4,896,492

Column A: Range of F006 generator sizes included in this total cost savings estimate.
Column B: Number of F006 generators that reported a quantity in the 1995 BRS within this generator size range.
Column C: Current F006 recycling rate as reported in the 1995 BRS for those generators that generate less than 60 tons per year.
Column D: Percentage profile of the distances that F006 generators are currently shipping to recycle their wastes and number of generators (n)(Table 5-3).
Column E: Incremental cost savings from the extended accumulation time limit for F006 generators that currently recycle (Table 5-1)
Column F: Calculated subtotals of the cost savings estimated for F006 generators that currently recycle and will continue to recycle post regulation

Col. H = Col. B * (Col. C/100) * (Col. D/100) * Col. E

Column G: Estimated incremental increase in the recycling rate above the baseline recycling rate.
Column H: Percentage profile of the distances that F006 generators are currently shipping to recycle their wastes (Table 5-3).
Column I: Percentage profile of the distances that F006 generators are currently shipping to landfill their wastes (Table 5-4).
Column J: Incremental cost savings from the extended accumulation time limit for F006 generators that currently landfill (Table 5-2).
Column K: Calculated subtotals of the cost savings estimated for F006 generators that currently landfill and will now recycle post regulation. If the value is negative, it is assumed that landfilling is more economical than recycling at this distance, cost savings are set to $0, and the value for n is subtracted from the total number of new recyclers (N2).

Col. K = Col. B * (Col. G/100) * (Col. H/100) * (Col. I/100) * Col. J

Column L: Total cost savings calculated by generator size range. N equals the total number of generators estimated to be recycling post regulation.

N = N1 + N2

[1] Recycling unit costs are assumed to be $300/ton.