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# Waste Minimization Program Air Force Plant 3

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Prepared for:

U.S. Air Force System Command  
Aeronautical Systems Division/PMD  
Wright-Patterson, AFB, OH 45433  
Contract - F09603-84-G-1462-SC01

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# **Waste Minimization Program**

## **Air Force Plant 3**

**Prepared for:**

**U.S. Air Force System Command  
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Wright-Patterson, AFB, OH 45433  
Contract - F09603-84-G-1462-SC01**

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## 1.0 INTRODUCTION

This report presents the findings of an assessment of waste minimization opportunities at Air Force Plant 3 in Tulsa, Oklahoma. It is part of the Waste Minimization Program being conducted by the Air Force Systems Command, Aeronautical Systems Division/Facilities Management Division (ASD/PMD) for eight (8) Government-Owned, Contractor-Operated (GOCO) facilities to promote prudent waste management by exploiting opportunities to limit land disposal, reduce costs and conserve resources.

A project team completed a site investigation of McDonnell Douglas-Tulsa and Rockwell International-Tulsa Division operations during the week of June 10-15, 1985 to review facility operations and discuss opportunities for waste reduction with plant engineering staffs. Based upon this investigation and subsequent analyses, this report presents the status of current waste generation and minimization programs and recommends other potential methods for reducing current waste volumes. Tables of waste volumes before and after minimization have been prepared to provide an indication of planned and projected waste reduction through system modifications. Finally, recommendations for implementation of opportunities which could further reduce waste generation and disposal are provided.

### 1.1 BACKGROUND

Interest in waste minimization has long been promoted by Federal legislation such as the Federal Water Pollution Control Act Amendments of 1972, the Energy Policy and Conservation Act of 1975 and the Used Oil Recycling Act as well as DOD directives such as AFR 78-22 and DODD 19-14. More recently, the impetus for waste minimization has become even stronger. The reauthorization of RCRA includes bans on landfilling of certain waste types and a request for certification that waste minimization is being conducted by hazardous waste generators. Similarly, DOD has issued directives requiring zero land disposal of solvents by October, 1986 through its Used Solvent Elimination Program.

ASD/PMD anticipated these developments and initiated programs in 1983 to address these issues. A preliminary identification of resource conservation and recovery activities and opportunities was included in an environmental audit program conducted in 1983 for fifteen (15) facilities. ASD/PMD contracted a further study of resource conservation and recovery opportunities at eleven (11) GOCO facilities in 1984. This effort resulted in a preliminary assessment of opportunities for industrial and non-industrial (i.e., solid or municipal) waste streams.

The methodology for this effort relied primarily on data acquired during the environmental audit program conducted in 1983 supplemented with conversations and information exchanges between the study team and GOCO contractor personnel. The results of this investigation were an indication of the areas where resource conservation and recovery opportunities appeared to be most substantial, and the areas where opportunities were not promising. Through application of a consistent methodology, facilities with substantial opportunities and measures warranting further investigation were identified.

The 1984 study demonstrated that plant operators were implementing methods that could substantially reduce waste generation volumes and raw material requirements to reduce their waste management costs and potential liabilities associated with waste land disposal. However, other opportunities for waste minimization were identified which appeared both technically and economically feasible but were not being implemented.

In light of the findings of these studies and the new certification requirements of RCRA, ASD/PMD is adopting a Waste Minimization Program. This program is promoting prudent waste management by exploiting opportunities to reduce costs and conserve resources. It is intended to establish for ASD/PMD the status of progress in this area, and to demonstrate facility advances in alternate waste management methods. In addition, it is expected that opportunities determined to be infeasible in the past will be identified for possible implementation.

## 1.2 OBJECTIVES

The ASD/PMD Waste Minimization Program is designed to promote waste management opportunities which reduce the reliance on land disposal by GOCO facilities and which result in increased efficiency in the utilization of resources. As part of this program, this study has the following objectives:

1. Define the status of waste generation and existing minimization measures at AFP 3.
2. Support feasible alternatives identified at AFP 3 by McDonnell Douglas and Rockwell.
3. Identify and evaluate new opportunities not being implemented at AFP 3.
4. Stimulate technology transfer between AFP 3 and other Air Force GOCO facilities as well as with other DOD installations.

5. Continue to increase the awareness of the importance of waste minimization.
6. Provide information needed to confidently certify that waste minimization is being employed at AFP 3 to satisfy RCRA requirements and DOD directives.

## 2.0 CONCLUSIONS AND RECOMMENDATIONS

Air Force Plant 3, located in Tulsa, Oklahoma, is operated by McDonnell Douglas-Tulsa, with Rockwell International-Tulsa Division as a sub-tenant. Operations at AFP 3 cover 332 acres with over 2.1 million square feet of building space. McDonnell Douglas currently has approximately 1,500 employees engaged primarily in F-15 tail assembly and F-15 and conventional plane fuel tank manufacture. Some work is conducted in support of F-4 and DC-8 programs, but these have been significantly cut within the past year. Rockwell personnel have increased in number recently to 3,500 as a result of increased B-1B production activity. Rockwell is also engaged in assembly of Boeing 747, helicopter, and radar antennae sub-assemblies, and modification of Space Shuttle bay doors.

Both McDonnell Douglas and Rockwell generated significant waste streams from metal finishing, cleaning and painting operations. McDonnell Douglas generated 338 million pounds and disposed of 18.4 million pounds of waste in 1984 at a total approximate cost of \$166,000.\* Rockwell generated 16 million pounds and disposed of 1.5 million pounds of waste at an approximate cost of \$85,000. Measures are being incorporated by both McDonnell Douglas and Rockwell to reduce waste volumes requiring land disposal, using recovery and treatment technologies.

A summary of the conclusions, recommendations and economics resulting from an investigation of waste minimization opportunities at McDonnell Douglas and Rockwell is provided below.

### 2.1 MCDONNELL DOUGLAS

#### 2.1.1 Conclusions

This section presents a summary of the waste minimization measures being incorporated by McDonnell Douglas, as well as alternatives being considered as part of waste minimization initiatives at AFP 3 and alternatives requiring further investigation, development or capital resources prior to incorporation.

A summary of 1984 waste disposal volumes, currently planned reductions, and additional potential reductions being considered by McDonnell Douglas, is provided in Table 2-1. A brief description of reduction methods is provided in Table 2-2. An analysis of these data result in the following conclusions:

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\*Figure does not include wastewater treatment sludge disposal costs.

TABLE 2-1  
 AFP 3: MCDONNELL DOUGLAS  
 PROJECTED WASTE DISPOSAL

WASTE STREAM	1984 GENERATION (POUNDS)	1984 LAND DISPOSAL (POUNDS)	PROJECTED LAND DISPOSAL W/PLANNED MINIMIZATION (POUNDS)	PROJECTED LAND DISPOSAL W/PROPOSED MINIMIZATION (POUNDS)
1. Paint Stripper	3.1 x 10 <sup>6</sup>	3.1 x 10 <sup>6</sup>	-	-
2. Paint Stripper Sludge	1,000	1,000	1,000	1,000
3. Waste Oil	12,000	-	-	-
4. Waste Oil Sludge	21,000	21,000	21,000	-
5. Waste Fuel	205,000	-	-	-
6. Waste Fuel Sludge	1,100	1,100	1,100	-
7. Coolant Waste	310,000	310,000	155,000	93,000
8. Solvent Waste	58,000	58,000	58,000	17,000
9. Paint/Waste Solvent	53,000	53,000	53,000	32,000
10. Paint Sludge	16,500	16,500	16,500	16,500
11. Waste Sealant	600	600	600	600
12. Titanium Mill Waste	950,000	-	-	-
13. Titanium Mill Sludge	18,000	18,000	18,000	-
14. Aluminum Mill Waste	158,000	158,000	-	-
15. Scale Conditioner Waste	31,000	31,000	-	-
16. Scale Conditioner Sludge	7,200	7,200	7,200	7,200
17. Anodizing Waste	28,000	28,000	-	-
18. Acid Wastewater	297x10 <sup>6</sup>	-	-	-
19. Alkaline Wastewater	23x10 <sup>6</sup>	-	-	-
20. WWT Sludge	14.6x10 <sup>6</sup>	14.6x10 <sup>6</sup>	1.2x10 <sup>6</sup>	1.2x10 <sup>6</sup>
21. Tank Liners	2,500	2,500	2,500	-
22. Deburrer Sludge	800	800	800	-
TOTAL	338x10 <sup>6</sup>	18.4x10 <sup>6</sup>	1.5x10 <sup>6</sup>	1.3x10 <sup>6</sup>
% Reduction	-	-	92%	93%

TABLE 2-2  
 APP 3: MCDONNELL DOUGLAS  
 SUMMARY OF  
 CURRENT, PLANNED AND PROPOSED  
 WASTE MANAGEMENT METHODS

WASTE STREAM	PRESENT METHOD	PLANNED CHANGES	PROPOSED CHANGES
1. Paint Stripper Waste	Underground injection	On-site WWT	Improved segregation
2. Paint Stripper Sludge	Landfill	None	None
3. Waste Oil	Off-site recycle	None	None
4. Waste Oil Sludge	Landfill	None	None
5. Waste Fuel	Off-site recycle	None	None
6. Waste Fuel Sludge	Landfill	None	None
7. Coolant Waste	Underground injection	Recycle w/ plate filters	Improved management & recycle operations
8. Solvent Waste	Underground injection	None	On-site and off-site recycle
9. Mixed Paint/ Solvent Waste	Landfill	None	On-site recycle
10. Paint Booth Sludge	Landfill	None	Investigate incineration
11. Fuel Tank Sealant Waste	Landfill	None	Investigate incineration
12. Titanium Chem Mill Waste	Neutralization and evaporation	On-site WWT	Bath recycle
13. Titanium Chem Mill Sludge	Landfill	On-site WWT	Bath recycle

TABLE 2-2  
 APP 3: MCDONNELL DOUGLAS  
 SUMMARY OF  
 CURRENT, PLANNED AND PROPOSED  
 WASTE MANAGEMENT METHODS

WASTE STREAM	PRESENT METHOD	PLANNED CHANGES	RECOMMENDED CHANGES
14. Aluminum Chem Mill Waste	Landfill	Bath recycle	None
15. Scale Conditioning Waste	Underground injection	On-site WWT	None
16. Scale Conditioner Sludge	Landfill	Bath recycle	None
17. Anodize/Conversion Coat/Desmut Wastes	Underground-Some to WWT injection	On-site WWT	None
18. Acid Wastewater	To WWT plant	Efficiency improvements	None
19. Alkaline Wastewater	To WWT plant	Efficiency improvements	None
20. WWT Sludge	Surface impoundment storage	Dewatering, off-site disposal	None
21. Tank Liners	Landfill	None	None
22. Vibrating Deburrer Sludge	Landfill	None	None

1. McDonnell Douglas currently has in-place measures to recover the following wastes:

1. Waste maintenance oils are recycled by Hydrocarbon Recyclers Inc.
2. Waste jet fuels are recycled by Hydrocarbon Recyclers Inc.

In addition, McDonnell Douglas is implementing a machine coolant recovery program to reduce disposal of rancid coolants. Through these programs, McDonnell Douglas is reducing land disposal of wastes by 425,600 lbs (53,200 gal) or two percent of total waste currently disposed by land.

2. Rehabilitation of the AFP 3 wastewater treatment system will include capacity to treat several wastes currently disposed off-site:

1. Paint stripper wastewater (356,280 gal)
2. Titanium chem mill wastes (111,700 gal)
3. Aluminum chem mill waste (12,700 gal)
4. Scale conditioner waste (2,500 gal)
5. Anodizing process waste (3,050 gal).

On-site treatment of these wastes represents a reduction in the current need for land disposal of 4.1 million lbs (486,000 gal) or 21 percent of total waste land disposal.

This wastewater treatment up-grade also includes elimination of the wastewater treatment sludge impoundment. Sludges will be dewatered by conventional solids contact settling followed by filtration. Waste sludges will be disposed off-site. The proposed system will reduce waste generation from current levels of 14.6 million lbs (1.76 million gal) (70 percent of total 1984 waste generation) to approximately 1.2 million lbs (140,000 gal), a reduction of 92 percent. If waste sludges are successfully delisted, all waste from wastewater treatment will be eliminated from hazardous waste land disposal.

3. Additional opportunities identified for potential application to minimize wastes generated by McDonnell Douglas include:

1. Recovery of waste solvents would allow an 85 percent reduction in current disposal volumes
2. Recovery of waste paint clean-up solvents at work stations would provide an 85 percent reduction over current disposal levels.
3. Recovery of titanium chem mill baths can eliminate disposal of this waste stream.

Waste solvents can readily be recovered for reuse in some plant activities or for sale to a solvent recovery/fuels blending operation. McDonnell Douglas's major concern with recovery of solvents for reuse is the mil spec required for solvent quality. Use of specialized equipment, quality control procedures, and appropriate management techniques can allow for effective segregation and recycling of solvent waste streams. Implementation of solvent recovery systems can reduce waste disposal by an additional 62,000 lbs (6,740 gal).

Titanium chem mill baths may be regenerated using a proprietary potassium/sodium treatment system being developed by Lancy. Approximately 75 percent, or 710,000 lbs (85,000 gal), of the spent baths currently planned to be treated in the wastewater treatment plant may be recovered upon completion of full scale development of this recovery system.

#### 2.1.2 Recommendations

Based on the findings of this waste minimization investigation of McDonnell Douglas operations at AFP 3, the following is an inventory of recommendations made with the objective of minimizing current waste disposal.

1. Paint Stripper Waste
  1. Investigate and monitor development of dry media stripping technologies.
  2. Review treatment of stripper wastes in rehabilitated wastewater treatment system.
  3. Investigate segregation of stripper solvent from washwater.
  4. Segregate other sources of wastewater in-flow to stripper pits.

2. Coolant Waste

1. Test bactericide additives to further extend the life of coolants.
2. Test removal of tramp oils after the second use.
3. Investigate off-site recycling of recovered tramp oils.
4. Use deionized water for coolant make-up to reduce mineral buildup and extend coolant life.
5. Increase frequency of machine sump pumping to minimize the extent of coolant degradation.

3. Solvent Waste

1. Explore off-site recycling of solvents.
2. Segregate solvents to improve recoverability of wastes.
3. Investigate on-site recovery of solvent wastes as a long-term alternative.

4. Mixed Paint/Solvent Waste

1. Investigate installation of solvent recovery work stations for solvent recovery in paint booth operations.
2. Investigate reuse of mixed flammable solvents in paint booth clean up operations.

5. Titanium Chem Mill Waste

1. Investigate Lancy's recovery technology for recovery of etch bath.
2. Investigate value of spent baths and sludges to titanium refiners.

6. Aluminum Chem Mill Waste

1. Proceed with wastewater treatment system rehabilitation.
2. Investigate lime precipitation process for sludge generation; compare with current waste generation volumes.

7. Paint Stripper Sludge, Waste Oil Sludge, Waste Fuel Sludge, Paint Booth Sludge, Fuel Tank Sealant Waste

1. Investigate off-site incineration as alternative to landfill of these organic wastes.

2.1.3 Economics

Table 2-3 summarizes the economics of some of the waste minimization measures developed through this investigation. Economics are order of magnitude estimates only and should not be used in place of detailed engineering estimates which consider contractor labor, engineering and administration costs and facility specific costs. Where costs were not available from McDonnell Douglas, estimates are based on standard cost references, vendor quotes or experience with similar capital projects.

2.2 ROCKWELL INTERNATIONAL

2.2.1 Conclusions

This section presents a summary of Rockwell waste minimization initiatives, as well as alternatives being considered by Rockwell and opportunities that require further investigation, development or capital resources prior to implementation.

A summary of 1984 waste disposal volumes, currently planned reductions, and additional potential reductions being considered by Rockwell is provided in Table 2-4. A brief description of reduction methods is provided in Table 2-5. An analysis of these data result in the following conclusions:

1. Rockwell is currently recycling waste lubricating oils through Hydrocarbon Recyclers. This program eliminates 92,300 lbs (12,300 gal) from land disposal (8 percent of total waste generation).
2. The upgraded AFP 3 wastewater treatment system will treat the following wastes currently disposed off-site by Rockwell:
  1. Tri-acid etch waste (31,100 gal)
  2. Caustic/alum sludge (17,450 gal)
  3. Sodium aluminate sludge (16,000 gal)
  4. Nitric acid waste (500 gal)
  5. Alodine wastes (7,000 gal)

TABLE 2-3  
 APP 3: MCDONNELL DOUGLAS  
 POTENTIAL WASTE MINIMIZATION ECONOMICS

WASTE	OPTION	CAPITAL COST	ANNUAL O&M COST	INCREASED ANNUAL SAVINGS	PAYBACK
1. Coolant Wastes	Improve management and recycle operations	0	0	\$ 4,100	-
2. Solvent Wastes	o Off-site recycle	0	0	\$ 5,200	-
	o On-site reclamation of trichloroethane	\$14,000	\$ 1,500	\$15,000	0.9 years
3. Mixed Paint Solvent Wastes	On-site recycle	\$12,000	\$ 560	\$11,400	1.0 years
4. Titanium Chem Mill Wastes	Bath recycle	\$70,000	\$60,000	\$28,000	1.9 years

TABLE 2-4  
AFP 3: ROCKWELL  
PROJECTED WASTE DISPOSAL

WASTE STREAM	1984 GENERATION (POUNDS)	1984 LAND DISPOSAL (POUNDS)	PROJECTED LAND DISPOSAL W/PLANNED MINIMIZATION (POUNDS)	PROJECTED LAND DISPOSAL W/PROPOSED MINIMIZATION (POUNDS)
1. Paint Booth Sludge	382,000	382,000	382,000	382,000
2. Mixed Paint Solvent Waste	50,400	50,400	50,400	5,000
3. Coolant Waste	153,000	153,000	153,000	45,000
4. Waste Oil	92,300	-	-	-
5. Tri-Acid Etch Waste	264,000	264,000	-	-
6. Caustic Alum Sludge	221,000	221,000	-	-
7. Sodium Aluminate Sludge	160,000	160,000	-	-
8. Cadmium Oxide Waste	3,000	3,000	-	-
9. Nitric Acid Waste	5,000	5,000	-	-
10. Alodine Waste	59,500	59,500	-	-
11. Phenolic Resin Waste	3,800	3,800	3,800	3,800
12. Epoxy Potting Compound Waste	1,000	1,000	1,000	1,000
13. Tank Sludge	200,000	200,000	200,000	200,000
TOTAL	1.6X10 <sup>6</sup>	1.5X10 <sup>6</sup>	790,000	637,000
% REDUCTION	-	-	47%	58%

TABLE 2-5  
 AFP 3: ROCKWELL  
 SUMMARY OF  
 CURRENT, PLANNED AND PROPOSED  
 WASTE MANAGEMENT METHODS

WASTE STREAM	PRESENT METHOD	PLANNED CHANGES	PROPOSED CHANGES
1. Paint Booth Sludge	Landfill	None	Explore incineration
2. Mixed Paint Waste Solvent	Landfill	Off-site recycle	On-site recycle
3. Coolant Waste	Underground injection	None	On-site recycle
4. Waste Oil	Off-site recycle	None	None
5. Tri-Acid Etch	Underground injection	On-site WWT	None
6. Caustic Alum Sludge	Landfill	On-site WWT	None
7. Sodium Aluminate Sludge	Landfill	Bath recycle	None
8. Cadmium Oxide Waste	Landfill	None	None
9. Nitric Acid Waste	Landfill	None	None
10. Alodine Waste	Landfill	On-site WWT	None
11. Phenolic Resin Waste	Landfill	None	Explore incineration
12. Epoxy Potting Compound Waste	Landfill	None	Explore incineration
13. Tank Sludge	Landfill	None	None

Treatment of these wastes will reduce waste disposal by 710,000 lbs (73,000 gal) (49 percent of total waste generation).

3. Additional opportunities for minimization of wastes generated by Rockwell are:

1. Recovery of waste paint booth solvents
2. Recovery of machine coolants.

Recovery of these two waste streams can further reduce waste disposal by 153,000 lbs (19,600 gal) (13 percent of total waste generation).

4. Rockwell has also identified an opportunity to reduce plant water consumption for once-through cooling of machinery. Installation of closed loop cooling systems can reduce cooling water usage (130 million gal) by 90 percent. This represents savings of over \$166,000/year. The project was submitted for approval to the Air Force in 1983, but was not selected for funding. Total water usage for AFP 3 can be reduced by as much as 36 percent through this project.

#### 2.2.2 Recommendations

Based on the findings of this waste minimization investigation of Rockwell operations at AFP 3, the following is an inventory of recommendations made with the objective of further reducing current waste disposal volumes.

##### 1. Mixed Paint/Solvent Waste

1. Reconstitute the Recyclene paint booth cleanup station for recovery and reuse of MEK at the paint booth.
2. Investigate installation of other work stations for solvent recovery at paint booths.
3. Contact vendor representatives for up-dated employee training on system operation.

##### 2. Coolant Waste

1. Review McDonnell Douglas coolant recovery systems and other available units (e.g. centrifugation) for application to Rockwell wastes.

2. Evaluate economics of system implementation.
3. Tri-Acid Etch Waste
  1. Proceed with wastewater treatment system rehabilitation.
4. Caustic Alum Sludge
  1. Proceed with wastewater treatment system rehabilitation.
5. Sodium Aluminate Sludge
  1. Proceed with development of recovery system as part of wastewater treatment rehabilitation.
  2. Investigate sludge generation volume and dewatering characteristics, process control and feed system reliability, and sludge delisting possibility.
6. Alodine Waste
  1. Proceed with wastewater treatment system rehabilitation.
  2. Monitor development of chrome recovery systems for anodizing wastes.
7. Paint Booth Sludge, Waste Oil, Phenolic Resins, Epoxy Potting Compounds
  1. Investigate incineration as an alternative to landfill of these organic wastes.

#### 2.2.3 Economics

Table 2-6 summarizes the economics of some of the waste minimization measures developed through this investigation. Economics are order of magnitude estimates only and should not be used in place of detailed engineering estimates which consider contractor labor, engineering and administration costs and facility specific costs. Where costs were not available from Rockwell, estimates are based on standard cost references, vendor quotes or experience with similar capital projects.

TABLE 2-6  
 AFP 3: ROCKWELL  
 POTENTIAL WASTE MINIMIZATION ECONOMICS

WASTE	OPTION	CAPITAL COST	ANNUAL O&M COSTS	INCREASED ANNUAL SAVINGS	PAYBACK
1. Mixed Paint Solvent Waste	On-site recycle	12,000	1,400	21,600	0.6 yr
2. Coolant Wastes	On-site recycle				
	1. Plate filtration	10,000	Negligible	6,400	1.5 yr
	2. Centrifigation	50,000	Negligible	6,400	8 yr

### 3.0 WASTE MINIMIZATION PROGRAM: MCDONNELL DOUGLAS

This section provides a description of current waste generation and management practices by waste stream at AFP 3 - McDonnell Douglas. A summary of these current practices is provided in Table 3-1. The following subsections present detailed descriptions of each waste stream and current management methods; waste stream material balances (where appropriate); opportunities for waste minimization; system economics; and recommendations for system implementation. This information is provided in support of the conclusions and recommendations provided in Section 2. Work sheets for each waste stream are included in Appendix B.

#### 3.1 PAINT STRIPPER WASTE/PAINT STRIPPER SLUDGE

##### 3.1.1. Waste Description and Management Practices

Paint stripping is currently conducted by McDonnell Douglas to prepare wing tanks for recoating. Stripping is conducted in Buildings 3 and 62. The larger operation (Building 3) consists of applying a conventional methylene chloride/phenol paint stripping solution (B&B 5075) and rinsing with water. Rinse water, stripper and removed paint solids are collected through a floor drain system into two holding sumps. Waste is pumped from the collection sumps for contracted bulk transport to Chemical Resources, Inc. in Tulsa, OK where it is disposed by deep well injection. The smaller operation located in Building 62 involves dip stripping of smaller components followed by steam cleaning. Wastewater from this system drains to the acid wastewater collection system for treatment in the Industrial Waste-General (IWG) wastewater treatment system.

Paint stripping waste generation in 1984 was 3.1 million lbs (356,280 gal). This generation rate has decreased over the past two years (from 1.14 million gallons in 1982) due to discontinuation of the F-4 program at AFP 3, but still accounts for about 15 percent of all wastes generated by McDonnell Douglas. It also accounts for 62 percent of wastes disposed off-site. Waste stripper solution disposed off-site is typically 95 percent water and 5 percent paint residue and stripper chemicals. A waste analysis of stripper liquid waste showed 8 percent solids, 4.5 pH, 25 ppm methylene chloride, 61 ppm phenol, and low concentrations of metals. Disposal of stripper waste in 1984 cost \$51,370 at \$0.12/gal for disposal and \$132.50/load for transportation/demurrage.

In addition to the liquid wastes generated in the stripping operation, 1000 lbs (two drums) of paint stripper sludge were generated in 1984. Sludges were transported by Chemical Waste

TABLE 3-1  
 APP 3: MCDONNELL DOUGLAS  
 WASTE GENERATION RATES AND MANAGEMENT PRACTICES

WASTE	SOURCE/CONTENT	1984		CURRENT MANAGEMENT PRACTICES	CURRENT COSTS	CHANGES PROJECTED/COMMENTS
		GENERATION RATE (POUNDS)				
1. Paint Stripper Waste	Wing Tank Paint Stripping: -Water-92% -Solids-8% -Methylene chloride	3.1 x 10 <sup>6</sup> (356,280 gal)		Collected in pit Bulk transport DWI by CRI	\$51,370	Planned treatment in WWT system
2. Paint Stripper Sludge	Wing Tank Stripping: -Solids -Water -Methylene chloride -Phenol	1000 (2 drums)		Collected in drums Drum transport Landfill by CWM	\$330	None
3. Waste Oil	Machine/Equipment Maintenance: -Mixed weight oils	12,000 (1,600 gal)		Collected in tank Bulk transport Recycled by HR	\$640 (revenue)	None
4. Waste Oil Sludge	Air System Maintenance: -Mixed weight oils ->50% solids	21,000 (2,420 gal)		Collected in drums Drum transport Landfill by USPCI	\$2,320	None
5. Waste Fuel	Wing Tank Testing: -Contaminated aircraft fuels	205,000 (32,900 gal)		Collected in drums Bulk transport Recycled by HR	\$13,160 (revenue)	Decreased generation due to decreased production
6. Waste Fuel Sludge	Wing Tank Testing: Contaminated aircraft fuel sludges	1100 (165 gal)		Collected in drums Drum transport Landfill by CWM	\$370	Decreased generation due to decreased production
7. Coolant Waste	Tooling Operations: -95% water -5% oil -Solids	310,000 (37,310 gal)		Collected in tank Bulk transport DWI by CRI	\$5,400	Recently installed plate coalescing separators for coolant recovery
8. Solvent Waste	Degreasing/Clean-Up Operations: -Mixed solvents -Solids -Water	50,000 (5,800 gal)		Collected in drums Bulk transport DWI by CRI	\$030	None

Unit costs are provided in Appendix A.

TABLE 3-1  
 APP 3: MCDONNELL DOUGLAS  
 WASTE GENERATION RATES AND MANAGEMENT PRACTICES

WASTE	SOURCE/CONTENT	1984 GENERATION RATE (POUNDS)	CURRENT MANAGEMENT PRACTICES	CURRENT <sup>1</sup> COSTS	CHANGES PROJECTED/COMMENTS
9. Mixed Paint/ Solvent Waste	Paint Spray Booth Clean-Up: -50% Paint solids -50% Mixed solvents (MEK, acetone, toluene, xylene)	53,000 (6,600 gal)	Collected in drums Drum transport Landfill by CWM	\$14,660	Investigating off-site recovery
10. Paint Booth Sludge	Paint Booth Clean-Up: -Paint solids -Water	16,500 (1,650 gal)	Collected in drums Drum transport Landfill by USPCI	\$1,600	None
11. Fuel Tank Sealant Waste	Fuel Tank Sealing: -Waste solidified fuel tank sealant	600 (55 gal)	Collected in drums Drum transport Landfill by USPCI	\$50	None
12. Titanium Chem Mill Waste	Titanium Chem Milling: -Nitric acid -Hydrofluoric acid -35-40g/l Titanium -Trace Tin	950,000 (111,700 gal)	Pumped from process tank Bulk transport Treatment by USPCI	\$97,200	Planned treatment in WWT system
13. Titanium Chem Mill Sludge	Titanium Chem Milling: -Solids -Titanium precipitant -Nitric acid -HP acid	18,000 (1,760 gal)	Collected in drums Drum transport Landfilled by USPCI	\$1,740	None
14. Aluminum Chem Mill Waste	Aluminum Chem Milling: -Sodium hydroxide -Sodium sulfide -Sodium aluminate	150,000 (12,700 gal)	Pumped from process tank Bulk transport DWI by CRI	\$1,920	Planned treatment in WWT system
15. Scale Con- ditioning Waste	Aluminum Conditioning: -50% Sodium hydroxide -2% Sodium dichromate	31,000 (2,500 gal)	Pumped from process tank Bulk transport DWI by CRI	\$430	Planned treatment in WWT system

<sup>1</sup>Unit costs are provided in Appendix A.

TABLE 3-1  
APP 3: MCDONNELL DOUGLAS  
WASTE GENERATION RATES AND MANAGEMENT PRACTICES

WASTE	SOURCE/CONTENT	1984 GENERATION RATE (POUNDS)	CURRENT MANAGEMENT PRACTICES	CURRENT <sup>1</sup> COSTS	CHANGES PROJECTED/COMMENTS
16. Scale Con- ditioning Sludge	Aluminum conditioning: -Sodium hydroxide -Sodium dichromate	7200 (550 gal)	Collected in drums Drum transport Landfill by USPCI	\$530	None
17. Anodize/Con- version Coat/ Desmut Wastes	Anodize/Conversion Coat/Desmut Operations: -Sulfuric acid -Chromic acid -Complexed cyanides -Solids	28,000 (3,050 gal)	Pumped from process tank Bulk transport DWI by CRI or treatment in WWT system	\$500	Planned treatment in WWT system
18. Acid Waste- water	Metal Finishing Operations: -Water, Metals, Acids Alkaline cleaners	297 x 106 (35.6 x 106)	Collected in plant industrial acid waste system Treat in WWT	Unknown	Planned modifications to existing WWT system, may increase flow
19. Alkaline Wastewater	Metal Finishing Operations: -Water, Metals, Acids	23 x 106 (2.77 x 106)	Collected in plant industrial acid waste system Treat in WWT	Unknown	Planned modifications to existing WWT system, may increase flow
20. WWT Plant Sludge	Wastewater Treatment: -Metal hydroxides -2% solids -98% H <sub>2</sub> O	14.6 x 106 (1.76x106gal)	Pumped from WWT system to sludge lagoons	Unknown	Planned modifications to WWT system include sludge dewatering and off-site sludge disposal
21. Tank Liners	Liners from tank overhaul	2500 (4 drums)	Collected in drums Drum transport Landfill by USPCI	\$210	None
22. Vibrating Deburrer Sludge	Deburring operations: -Solids -Metals -Water	800 (1 drum)	Collected in drums Drum transport Landfill by USPCI	\$ 50	None

<sup>1</sup>Unit costs are provided in Appendix A.

Management, Inc. (CWM) for landfill disposal at their Carlyss, LA facility. Stripper sludges are primarily paint solids with some water, phenol and methylene chloride. The 1984 cost for drum disposal was \$330 based on unit costs of \$144/drum for disposal and \$23/drum for transportation.

A detailed material balance of the paint stripping operation is not necessary as virtually all waste solvent is contained by the wastewater used to rinse wing tanks. Approximately 6 drums (330 gallons) of B&B 5075 Stripper and 356,000 gallons of water are used annually.

### 3.1.2 Waste Minimization Opportunities

Approaches to minimizing the generation of stripper wastes being developed for application to the aerospace industry include:

- o Reducing generation through segregation and reuse.
- o On-site treatment
- o Alternative stripping techniques.

Each of these approaches is discussed in the following subsections.

#### 3.1.2.1 Waste Generation Reduction

Paint stripping operations in Building 3 present two possible opportunities to reduce current levels of waste generation:

1. Separation of other wastewater from stripping collection sumps
2. Solvent segregation from wastewater for reuse in the stripping operation.

Currently, all wastewater generated in Building 3 drains to the paint stripper collection sumps. Wastewater from other operations in Building 3 can be segregated from the paint stripping collection sumps, thereby reducing the volume of waste generated. In the past, an estimated 50-75 percent of wastes collected in these sumps was from other Building 3 operations. By rerouting these wastewaters to the IWG or IWC treatment operations, a reduction in total stripper waste disposal volumes could be achieved. McDonnell Douglas personnel state that reduced activity in Building 3 has made this less of a problem than it has been in the past. Presently, it appears that wastes from other sources have been reduced to near zero, such that separation of these streams would not have a significant impact on current stripper waste volumes. Nonetheless, with fluctuating plant activity, an opportunity to reduce paint stripping waste volumes may exist.

Additional reductions may be achieved by collecting stripper and paint residues prior to rinsing parts. Collection of stripper solvents by "squeegeeing" parts has been successfully used in similar industrial operations to reduce stripping waste volumes. Reuse of solvent as is or following treatment (i.e. filtration) may be possible. Rinse water can then be collected with a significant reduction in concentrations of stripper and paint residues. The wastewater resulting from such an operation may be suitable for treatment in the existing treatment system or in a modified treatment process, utilizing techniques such as chemical oxidation of phenol and methylene chloride and precipitation of metals, as described below.

This segregation/treatment scheme would substantially reduce current waste disposal volumes as well as reduce the quantity of stripper currently used. Assuming that all water (92 percent of waste stream) can be segregated from the paint stripper residue waste stream and that 50 percent of the stripper can be recycled by using a filtration system, annual waste volumes requiring off-site disposal can be reduced from current levels of 356,390 gallons to approximately 28,000 gallons. This reduction represents a 92 percent reduction in paint stripping wastes. Paint stripper use will also be reduced through the reuse of collected stripper for stripping operation.

#### 3.1.2.2 Waste Treatment

In conjunction with waste generation reduction techniques or alone, waste treatment represents a viable approach to reducing off-site waste disposal. In a January, 1983 Environmental Pollution Control Study at AFP 3 by Wilson & Company, paint stripper waste treatment was recommended as part of a long range wastewater treatment plan. Wilson recommended batch treatment of liquid stripper wastes with hydrogen peroxide in the presence of an iron catalyst to oxidize organics. Treated paint stripping waste would then be discharged to the IWG system for further treatment. Through this treatment scheme all waste, except sludges currently generated in collection sumps, would be eliminated from off-site disposal. Some increase in sludge volumes from waste treatment would occur, but these would be insignificant. This batch treatment system is now being designed by Wilson for implementation as part of the wastewater treatment system rehabilitation. It is being designed to treat waste stripper volumes resulting from full plant production in 1982 (1.2 million gallons/year).

This option appears to be viable, if sufficient treatment of paint stripper wastewater is achieved to meet effluent standards. Treatability of stripper waste may be enhanced through segregation of stripper solvent from wastewater, which would result in decreased wastewater strength. In the proposed treatment scheme, all stripper wastewater would be eliminated from land disposal.

### 3.1.2.3 Dry Media Stripping

Several alternative paint stripping techniques are currently being studied by DoD. One of the most promising methods is dry media stripping with plastic beads. Hill Air Force Base in Ogden, Utah has successfully demonstrated plastic media stripping for aircraft renovation. In the Hill AFB process, conventional sand blasting equipment is being employed with recoverable plastic beads for paint removal. A dry waste of paint and plastic beads is generated which can be separated to produce a relatively small volume of paint waste. Waste volumes and labor requirements were shown to be significantly lower than conventional wet stripping methods. A full scale dry media stripping demonstration operation is currently being implemented at Hill AFB.

In addition to Hill AFB, several other DoD facilities are interested in plastic media stripping methods including Alameda NARF and Pensacola NARF. At Pensacola, dry stripping is currently being tested for fiberglass helicopter components.

Problems with dry media stripping appear to be control of the stripping operation to prevent aircraft damage and dust generation and collection. However, current development efforts are directed at alleviating these problems through careful operation and design of stripping systems.

It appears that dry media stripping may be a viable long-range method of wing tank stripping at AFP 3. Reductions of waste generation volumes to 29,000 gal/year or a 92 percent reduction may be feasible, with a parallel reduction in manpower requirement. Full testing would be required to select appropriate media, control dust generation, protect wing tank components, and achieve stripping required.

### 3.1.3 Recommendations

Dry media stripping appears to be one of the most promising future alternatives to current wet stripping methods. However, in light of development work still required to demonstrate successful use and the incorporation of waste treatment of stripper wastes by McDonnell Douglas, dry media methods are not recommended for AFP 3 at this time. Rather, it is recommended that the planned batch treatment of stripper wastewater be implemented. It is further recommended that McDonnell Douglas:

1. Review with Wilson & Company the treatment system to ensure that adequate phenol and methylene chloride destruction is provided to meet effluent requirements.
2. Investigate the separation of waste stripper solvent from washwater to reduce wastewater strength and enable reuse of stripper solvent.

3. Segregate other sources of wastewater in-flow to the stripper waste collection sumps, particularly if Building 3 operations are increased.

Incorporation of the wastewater treatment system and recommended modifications can reduce current waste disposal resulting from stripping operations by as much as 92 percent.

### 3.2 WASTE OIL/WASTE OIL SLUDGE

#### 3.2.1 Waste Description and Management Practices

Routine maintenance operations on machinery and equipment engines generate waste oils. Waste oils are collected at the point of generation in portable carts from which they are transferred to a bulk storage tank. Waste oils are periodically removed for bulk transport and recycling by Hydrocarbon Recyclers, Inc. located in Tulsa, OK. No direct land disposal of waste oil is conducted. In 1984, only 12,000 lbs (1,600 gal) of waste oils were recycled from McDonnell Douglas operations.

In addition to these waste oils, 21,000 lbs (2420 gal) of waste oil sludges were generated from air cooling filter maintenance operations. Sludges are characterized by high solids content; typical concentrations are 35 percent oils and 65 percent solids. Sludges are collected by McDonnell Douglas in drums and transported and landfilled by U.S. Pollution Control Inc. (USPCI) near Waynoka, OK.

#### 3.2.2 Waste Minimization Opportunities

McDonnell Douglas is currently recycling waste oils through Hydrocarbon Recyclers, Inc., resulting in a net positive revenue. At \$0.40/gal net revenue paid by Hydrocarbon Recyclers, McDonnell Douglas received \$640 in 1984. An additional \$1,500 in avoided disposal costs were realized based on USPCI'S waste oil disposal and transportation rates of \$44/drum and \$1.43/hundred weight, respectively.

It is possible that waste oil sludges currently generated by McDonnell Douglas may also be suitable for recovery or fuel blending operations. Oil sludges may be recoverable by Hydrocarbon Recyclers or may have a fuel value and be eligible for contracted fuel blending operations. If so, current disposal costs may be further reduced. Assuming a break-even on disposal/fuel value, (e.g., Hydrocarbon Recyclers treats waste at no cost) McDonnell Douglas can reduce current costs by \$2,320/year and further reduce their reliance on land disposal of waste.

### 3.2.3 Recommendations

No recommendations are made for waste oil management practices currently employed by McDonnell Douglas. Waste oil sludges should be investigated for recovery at Hydrocarbon Recyclers.

## 3.3 WASTE FUEL

### 3.3.1 Waste Description and Management Practices

Waste fuels are generated as part of McDonnell Douglas aircraft and component testing operations. Waste fuels result from spillover and emptying during filling, testing and maintenance operations. Waste fuels are collected in portable fuel collection carts from which they are transferred to drums for transport off-site. In 1984, 205,000 lbs (32,900 gal) of recoverable fuels were pumped from drums and transported in bulk to Hydrocarbon Recyclers for recovery. An additional 1100 lbs (165 gal) were removed by CWM for land disposal at their Port Arthur, TX facility prior to its shutdown. In the future, wastes will be shipped to the Carlyss, LA facility. Waste fuels typically are mixed jet fuels (e.g. JP-4, JET A) contaminated with low levels of solids, water and other materials. Generation has been substantially reduced from these levels as a result of decreased aircraft production.

### 3.3.2 Waste Minimization Opportunities

McDonnell Douglas is currently recovering 99.5 percent of waste fuels generated at AFP 3 through Hydrocarbon Recyclers. The remaining waste has been determined to be unrecoverable (i.e. low fuel value, high recovery cost) and are therefore landfilled by CWM. McDonnell Douglas receives \$0.40/gallon net revenue from Hydrocarbon Recyclers for recovered fuels; total revenue for 1984 was \$13,200. In addition, avoided disposal costs are approximately \$50,900 based on CWM costs of \$62/drum (disposal) and \$23/drum (transportation). Disposal of the remaining waste fuels cost approximately \$370 based on CWM's disposal cost of \$99/drum and transportation cost of \$23/drum (\$1,850/80 drum load).

### 3.3.3 Recommendations

No recommendations for alternative waste management are made; current recovery methods appear to be sound, cost-effective, measures to minimize land disposal of waste fuels.

## 3.4 COOLANT WASTE

### 3.4.1 Waste Description and Management Practices

Metalworking operations (e.g., cutting, tooling, turning) at McDonnell Douglas require coolants consisting of an emulsion of soluble oils and water. After prolonged use of the soluble oil/water emulsion, it becomes degraded as evidenced by rancidity,

floating tramp oils or ineffective lubrication. Upon failure, coolants are collected from coolant sumps by a portable vacuum wagon and transferred to a storage tank. When a full shipment is collected, coolant waste is transported and deepwell injected by Chemical Resources, Inc. In 1984, 310,000 lbs (37,310 gal) of coolant waste was disposed by this method, at a cost of \$5,400.

Soluble oil coolants are supplied by a number of manufacturers in the United States and, therefore, vary in composition. McDonnell Douglas utilizes Van Statler coolant. Typically cutting fluids consist of:

- o 60-90% mineral oils
- o 1-5% water
- o 5-30% emulsifiers
- o 1-20% coupling agents
- o 1-10% rust inhibitors
- o 0-10% bactericides (e.g. chlorophenols, formaldehyde).

Cutting fluids are diluted with water to a 20:1 to 50:1 (water:oil) mix. Waste coolants generated from machining operations will typically be the oil/water coolant mix with 3-5 percent tramp oil and suspended metal particles. Waste coolants will also have reduced concentrations of additives such as emulsifiers and bactericides.

McDonnell Douglas is now modifying the handling practices for waste cutting fluids. They have purchased six Turbo Fram coalescing plate filtration units (Model #6280-8011) to separate free tramp oil from waste coolant. Two of these are located in Buildings 406 and 635. Remaining units are being placed in other machining areas of AFP 3. By removing tramp oils from waste coolant, McDonnell Douglas is able to reuse coolants by minimizing the deleterious effects caused by tramp oil such as reduced coolant effect, loss of wetting and increased growth of bacteria. This new operation involves collection of failed coolant as in the current system and pumping to a portable coalescing unit. The influent mixture passes through a series of coalescing plates which enhance oil-water gravity separation. Tramp oil is skimmed from the surface and collected in drums for off-site disposal. Cleaned coolant is mixed with new components and reused in metalworking operations. Solids are also removed in the coalescing unit and require periodic collection and disposal. Some prefiltration of waste coolant may be necessary to reduce fouling of the coalescing plate filtration system.

McDonnell Douglas has operated two of the plate filtration units for approximately 6 months. This short operational history has shown extended life of coolants as well as improved cooling and

wetting by reused coolant. McDonnell Douglas has found that after one month, coolant requires cleaning in the filtration unit to remove rancid tramp oils. Typically, 10-20 gallons of tramp oil is removed from one coolant sump (approximately 20-50 percent of original cutting fluid). Coolant mixes are made up with additional cutting fluid and replaced into coolant sumps for reuse. Tramp oil production is said to be reduced during reuse of the coolant. After another month, coolant is removed for disposal because of employee complaints about rancidity. In this system, McDonnell Douglas has extended coolant use from one month to two months which represents a 35 percent reduction in total cutting fluid usage and a 50 percent reduction in water usage. In addition, a reduction in waste generation of almost 50 percent is achieved. Other benefits of these units described by McDonnell Douglas, are relative low cost, portability (i.e. can be transported to machine sump for recovery), and ease of use.

#### 3.4.2 Waste Minimization Opportunities

The coalescing systems being incorporated by McDonnell Douglas have been shown to effectively reduce current waste generation from machining operations by as much as 50 percent. They also reduce oil usage by 35 percent. At Chemical Resource's current disposal costs of \$0.12/gal and transportation/demurrage costs of \$132.50/load, McDonnell-Douglas is paying \$5,400 for waste disposal. Costs will be reduced to approximately \$2,800. In addition, current costs for new cutting oils are reduced from \$6,000/year to \$4,000/year, based on Van Statler cutting oil costs of \$0.405/lb.

The coolant recycle system being installed by McDonnell Douglas should be capable of additional reductions in current waste generation and off-site disposal. In 1984, 37,310 gallons of oil/water mixture (approximately 1800 gallons of oil) was used and disposed. Typically, 20-30 percent of the oil in emulsion becomes tramp oil (i.e. is released from emulsion). If made up with fresh cutting fluid and additional bactericide additives, recovered coolant should be able to be reused longer than the one month currently experienced by McDonnell Douglas. If operated routinely on coolants, water in the emulsion may never require disposal; it will be continuously recycled as recovered coolant. Total waste generation can be reduced to 900 gal/year, a reduction of 98 percent. Inputs to the coolant system will be limited to approximately 900 gal/year of make-up cutting oil emulsion, rust inhibitor and bactericide additives, as needed, and water to make-up coolant losses during operation.

Of course, some cost will be incurred for cutting oil additives

required to upgrade recycled coolant. However, by this analysis, costs can be reduced by approximately \$8,200/year as a result of avoided disposal costs and cutting oil costs. In addition, if routine pumping of machine sumps is employed, further savings can be realized as a result of reduced machine down time required for sump clean-out.

### 3.4.3 Recommendations

Coolant recovery is a viable opportunity to reduce waste disposal as demonstrated by McDonnell Douglas. It is recommended that the planned coalescing plate filtration systems be operated at AFP 3. It is further recommended that McDonnell Douglas:

1. Test the use of bactericide additives to further extend the life of coolants. If added at the point of recycle and coolant make-up, use periods can be extended beyond the two months currently achieved.
2. Test removal of tramp oils from coolants after the second use. Coolants may be used beyond the two month period currently experienced.
3. Investigate the opportunity for recycle of recovered tramp oils by Hydrocarbon Recyclers. Disposal costs may be further reduced, because of the fuel value of recovered oils.
4. Use deionized water when preparing and upgrading coolant solution. Mineral build-up in coolants has been determined to be the primary reason for splitting of oil/water emulsions.
5. Increase the frequency of machine sump pumping to reduce sump cleaning requirements and reduce the level of coolant degradation.

Control of the major factors causing coolant failure can result in even greater reduction in waste disposal volumes and costs associated with coolant purchase and disposal.

## 3.5 SOLVENT WASTE

### 3.5.1 Waste Description and Management Practices

A wide variety of solvent wastes are generated by vapor degreasing, cold cleaning and hand-applied solvent cleaning operations at McDonnell Douglas. Solvent wastes are currently hand carried to drums located at various locations throughout AFP 3. When full, these drums are removed to storage. Liquids

are pumped from drums and then transported and disposed by deep well injection by Chemical Resources, Inc. A total of 58,000 lbs (5,800 gal) of solvent wastes were generated in 1984, excluding the solvents from painting operations described in Section 3.6. The mixture of solvents in this waste stream have been identified but could not be quantified by McDonnell Douglas. Transportation and disposal costs for solvent wastes were \$830 in 1984.

The exact determination of the fates of purchased solvents is not possible owing to their widely disseminated use and relative low volumes. Table 3-2 presents an estimate of the fates of the solvents purchased in significant quantities in 1984 based on disposal records and evaluation of use patterns. As shown by this estimation, the majority of the solvent waste stream appears to be contaminated 1,1,1-trichloroethane from McDonnell Douglas' two vapor degreasers. Actual levels may actually be different than these estimates, however these values are used as an example of economic benefits possible.

### 3.5.2 Waste Minimization Opportunities

All of the solvent waste shown in Table 3-2 are amenable to distillative recovery, either on-site using a small package still or off-site by a commercial solvent recycler. However, economic constraints will probably limit recycling activities to solvents generated in significant quantities.

#### 3.5.2.1 Off-Site Recycling

The estimated 4,300 gallons of waste 1,1,1-trichloroethane generated annually by McDonnell Douglas could be sold to an off-site recycler for reclamation. The revenue from these sales could be expected to range from \$0.90/gal to \$1.25/gal or from \$3,870/year to \$5,375/year. To improve the economics of off-site recycling, it would probably be necessary to accumulate the 1,1,1-trichloroethane in batches of 80 drums, or approximately one year's generation (this requirement may vary between recyclers depending on their proximity to the facility and other relevant market factors). Further, the waste would require segregation and management in such a manner as to minimize contamination by other waste streams.

Additional savings would be realized through this approach by avoiding current 1,1,1-trichloroethane disposal costs. Approximately \$600/year in transportation and disposal costs would be avoided, resulting in total savings through off-site recycling of \$4,400 to \$6,000/year.

The potential for off-site recycling of the other 1500 gallons of solvent waste identified in Table 3-2 is less certain. If these wastes are carefully segregated and accumulated on-site,

TABLE 3-2  
 ESTIMATED FATES OF SOLVENTS  
 AT APP 3: MCDONNELL DOUGLAS

SOLVENT	PURCHASES (GAL) <sup>1</sup>	ESTIMATED FATES (GAL) <sup>2</sup>		
		VAPOR LOSSES	WASTE	CARRY OUT
1,1,1-Trichloro-ethane	11,320	7,000	4,300	40
Butyl Cellosolve	2,970	1,000	920	1,000
Acetone	1,174	1,070	100	0
Perchloroethylene	1,027	980	50	0
Douglas No. 2	583	200	180	200
Toluene	478	460	20	0
Naptha	600	200	200	200
Methylisobutyl-ketone	452	430	20	0

<sup>1</sup> From Purchasing Department records.

<sup>2</sup> Estimated based on relative vapor pressures and knowledge of use patterns

NOTE: Table is provided as an estimate, actual waste quantities may vary

they may prove to be economically viable off-site recycling candidates. The total cost savings achievable if all of the solvent waste streams prove to be acceptable recycling candidates is approximately \$1,000/year.

A final off-site recycling option which merits consideration is the use of an alternative mineral spirits solvent. The Douglas No. 2 solvent could potentially be replaced with a similar mineral spirit which is periodically removed for off-site recycling by the vendor and replaced with clean solvent. Vendors such as Safety Kleen are able to operate economical recycling programs for these materials by providing similar services to a large number of small-quantity users within a given geographical area. Although such a program would remove 200 to 400 gal from McDonnell Douglas' waste stream, it would not result in appreciable cost savings.

#### 3.5.2.2 On-Site Recycling

The acquisition of a stand-alone distillative recovery system would allow the recycling of approximately 90 percent of the 5,800 gallons of solvents currently disposed of as wastes.

Some uncertainties exist, however, regarding the applicability of military specifications (mil specs) to solvents recycled on-site for continued use. While it appears that available distillative systems cannot produce products which meet rigid mil specs for new solvents, they can serve to bring solvent quality back within acceptable operating ranges, thereby extending its useful life. Some facility operators have interpreted the mil specs as applicable to solvents recycled on-site and, therefore, have not instituted on-site recycling. Other facilities, however, recycle solvents on-site utilizing purity standards which, although lower than mil specs, have allowed significant reductions in solvent waste volumes with no compromise of solvent use patterns or applicability.

As an example, General Electric (GE) has been utilizing a simple distillation system for 7 years to extend the useful life of 1,1,1-trichloroethane in its vapor degreasers at AFP 59. Solvent is removed from the degreasers when pH or specific gravity analyses show that the solvent is outside established acceptance limits. These same limits, which are less stringent than mil specs for new solvents, are applied to the solvents after on-site recycling. If the recycled solvents fail to meet the minimum acceptance limits they are discarded. Otherwise they are reused in AFP 59 vapor degreasers. A similar approach appears feasible at McDonnell Douglas AFP 3 operations, although not all solvent wastes could be economically recovered in this manner.

Several distillation systems are available which could meet McDonnell Douglas' needs. These systems range in capacity from 15 gal/shift to 100 gal/shift. Data on a representative group of these systems are presented in Table 3-3. A system utilizing disposable bag liners between the solvent and the heating surfaces to eliminate fouling, thereby decreasing maintenance costs over unlined systems, appears best suited to this type of application (e.g., The Finish Engineering and Recyclene systems).

If solvents with boiling points above 320°F are to be recycled (i.e. butyl cellosolve and Douglas No. 2), it will be necessary to utilize systems with vacuum units or other means to recover high boiling point solvents. This capability would add approximately \$1,100 to \$1,900 to the cost of the system while reducing waste disposal and new product purchase costs by about \$2,300/year.

It appears that a unit with a capacity of approximately 55 gal/shift would be best suited to McDonnell Douglas' needs. This would allow for efficient solvent management in 55-gallon drums and would provide approximately 140 percent excess capacity.

Careful system cleaning and drum management would be required, particularly when switching the type of solvent being recycled, to avoid cross contamination. To minimize the additional work associated with cleaning between batches of different solvents, wastes should be accumulated for extended periods until several drums can be recycled at the same time.

Operation and maintenance costs for distillation systems are typically in the range of \$0.15/gal to \$0.20/gal. As these systems are highly automated, very little additional labor is required for their operation. Simple quality control analyses are generally sufficient to assure the quality of recycled solvents. As an example, GE recycles 1,1,1-trichloroethane at AFP 59 utilizing only pH and specific gravity measurements. It should be noted, however, that GE does not attempt to reconstitute spent acid acceptors in their recycled solvents. As a result, their recycling program allows an average of three use cycles for degreaser solvents before acid build-up precludes further use. To further extend solvent life, it would be necessary to periodically rejuvenate solvents with new acid acceptor. It is anticipated that a maximum reuse program of this type would require some additional solvent analyses to correlate pH levels to acid acceptor make-up levels in the first few months of operation.

TABLE 3-3  
TYPICAL SOLVENT DISTILLATION SYSTEM SPECIFICATIONS

MANUFACTURER	UNIT	MAX. SOLVENT BOILING POINT	CAPACITY	COST
Finish Engineering	LS-15	320°F	15 gal/shift	\$ 5,030
	LS-15V	500°F	15 gal/shift	6,110
	LS-55	320°F	55 gal/shift	12,806
	LS-55V	500°F	55 gal/shift	13,911
Recyclene	RS-25	400°F	35 gal/shift	11,900
	RS-70	400°F	70 gal/shift	20,200
Venus	SRS-5	320°F	56 gal/shift	10,560
	SRS-5	500°F	56 gal/shift	12,410
	SRS-20	320°F	100 gal/shift	20,595
	SRS-20	500°F	100 gal/shift	22,445
Brighton	7.5 GPH	350°F	60 gal/shift	17,500

The economics of on-site recycling will depend on the extent to which solvents can be reclaimed and the actual quantities present in solvent wastes. If the system is used solely to extend the life of 1,1,1-trichloroethane without periodic replenishment of acid acceptors, \$6,000/year savings could be realized. This savings would increase to \$8,400/year if rejected solvent can be accumulated and periodically sold to an off-site recycler. Through the monitoring and adjustment of acid acceptor levels, this savings would increase to an estimated level of \$15,000/year. Recovery of 68 percent of the solvent wastes other than 1,1,1-trichloroethane shown in Table 3-2 (i.e. 85 percent of the streams generated at a rate of 100 gal/year or more) would result in an additional estimated savings of \$2,300/year.

#### 3.5.4 Recommendations

Table 3-4 summarizes the projected economics of the waste minimization options described based on the distribution of solvents shown in Table 3-2. The direct sale of waste 1,1,1-trichloroethane to an off-site recycler is an attractive option which would result in a 74 percent decrease in solvent waste disposal rates and a projected savings of \$5,200/year. In addition, if the waste butyl cellosolve could also be sold to a recycler, an estimated 90 percent solvent waste reduction and \$5,700/year in savings could be realized. It is recommended that McDonnell Douglas explore the off-site recycling option for each of its solvent waste streams as a short-term minimization step. As noted previously, careful segregation of wastes as well as accumulation over time can improve the viability of this approach.

It should be noted that McDonnell Douglas is currently in the design stages of a drum storage facility. An integral part of this facility are storage tanks for bulking of drummed wastes, including one for solvent wastes. Solvent wastes will be consolidated from drums to this tank and shipped off-site for recovery. McDonnell Douglas should consider in this design the need for segregation of solvent wastes to improve their recoverability. Contact with recovery facilities will give an indication of segregation requirements.

In the long-term, it is recommended that McDonnell Douglas investigate an on-site waste solvent recycling program. A distillation system capable of reclaiming solvents with boiling points above 320°F and a capacity of approximately 55-gallons per shift should be investigated for application. Initially, the on-site recycling program should focus on the recycle of waste 1,1,1-trichloroethane. Communication should be established with the solvent supplier as well as potential additive suppliers to develop a rejuvenation program involving acid acceptor replenishment.

TABLE 3-4  
 APP 3: MCDONNELL DOUGLAS  
 SOLVENT WASTE MINIMIZATION OPTIONS

ALTERNATIVE	WASTE REDUCTION (GALLONS/YR)	CAPITAL COST (\$)	AVOIDED COSTS (\$/YR)	O&M COSTS (\$)	NET SAVINGS (\$/YR)	PAYBACK PERIOD (YRS)
1. Sale of spent solvent to off site recycler	4300 (74%)	0	600	0	5,200	
2. Extending solvent life through on-site recovery	1900 (33%) (4300)(74%) <sup>1</sup>	14,000	6,500	500	6,000 (8,400)*	2.3 (1.7)*
3. Continuous reuse of solvent through on-site recovery and additive replenishment	4100 (71%)	14,000	16,500	1,500	15,000	0.9
4. Recycling of solvent as in No. 2 and 68% of other solvent wastes	3100 (53%) (5500)(95%) <sup>1</sup>	14,000	8,800	2,000	6,800	2.1 (1.6)*
5. Recycling of solvent as in No. 3 above and 60% of other solvent wastes	5300 (91%)	14,000	18,000	3,000	15,000	0.9

<sup>1</sup> Figures are for on-site recycling of solvent followed by sale of off-spec solvent to off-site recyclers.

As the on-site recycling program is developed, procedures for recycling other solvents should also be developed. Care must be exercised to assure that cross contamination does not occur during handling and the recycling step. The operating and maintenance cost estimates provided in Table 3-4 may actually be lower as experience is gained with the system and the frequency of quality control analyses is reduced.

### 3.6 MIXED PAINT/SOLVENT WASTE

#### 3.6.1 Waste Description and Management Practices

A paint solvent waste stream is generated during cleanup of spray painting equipment. Methyl ethyl ketone (MEK) is used as the primary cleanup solvent and is estimated to represent 50 percent of the waste stream. Other solvents used as paint thinners, such as xylene, toluene and acetone, may also be carried into the waste stream. As much as 50 percent of the waste stream is estimated to be paint solids removed from equipment and booths during cleaning operations. Wastes are generated and collected in drums at paint spray booths located at various locations. Drums have been removed to storage when full and then transported and disposed by CWM at Port Arthur, TX.

During 1984, 53,000 lbs (6,600 gal) of paint/solvent wastes were collected in drums and disposed in a secure chemical landfill by CWM. These disposed wastes account for an estimated 3,300 gallons or approximately one quarter of the 12,200 gallons of MEK purchased in 1984. Based on this estimate, it is assumed that the remainder of the MEK, about 8,900 gallons, was lost to the atmosphere during use and storage. Transportation and disposal costs for paint/solvent wastes were \$14,700 in 1984.

#### 3.6.2 Waste Minimization Opportunities

Waste MEK potentially could be recycled on-site for reuse in cleanup activities through waste segregation and distillative recovery. In addition, some vapor losses of MEK could be reduced through the use of contained cleaning stations, allowing this additional solvent to be recovered.

Off-site distillative recovery of MEK has been explored previously by McDonnell Douglas. These attempts failed when the paint content of the waste caused fouling of the recycler's distillation columns. Further, the recycled product could not routinely meet the 99.5 percent purity required for use as a paint thinner. Although recycled MEK would be suitable for use in cleanup operations, care must be taken in managing recycled MEK in areas where high purity solvent is utilized to avoid inadvertent use of the recycled material. Systems are available, however, which can virtually eliminate the problems of cross use of solvents.

For example, the portable work station distillation systems consist of a distillative recovery system combined with a cleaning station and storage tank which should prevent accidental misuse of recycled MEK. A similar system, owned by Rockwell at AFP 3, is described in Section 4.2 of this report.

MEK waste was generated at a rate of approximately 13 gal/day by McDonnell Douglas in 1984 at spray booths located around two central areas within Buildings 1 and 62. The installation of one work station similar to the Rockwell system in each of these two areas would provide sufficient capacity for convenient recovery and reuse of waste MEK at the point of generation. The smallest commercial units have a recycling capacity of 14 gal/shift, over twice the average daily rate of waste MEK generation. In this system arrangement, waste solvents/paints are dumped into a sink which drains to the distillation unit. At the end of the day, more frequently if necessary, the unit can be switched on; separation of solids and solvent occurs automatically. After operation, solvent can be collected from the unit and reused for cleaning in the paint booth area. In addition, solvent waste can be brought to the units from other locations and recycled for use in paint cleanup operations at these locations. Fouling problems such as those experienced by McDonnell Douglas' off-site recycler are not anticipated, as units of this design do not volatilize materials with boiling points above 320°F. Residues of unvolatilized materials are contained in a disposable bag, which can be removed for disposal.

Because of the high level of solids contamination of the MEK waste streams, a recovery efficiency of 85 percent of solvent content is estimated. Although over 95 percent recovery is achievable, experience has shown that liner life is significantly extended if lower recovery rates are accepted, particularly when high levels of contamination are present. The 85 percent rate would result in an estimated recovery for reuse of 2800 gal/year of MEK. Avoided new material purchase costs are projected to be \$7,000/year with accompanying disposal cost reductions of \$5,000/year. Operation and maintenance costs can be expected to average \$0.20/gal or \$560/year, resulting in a net savings of \$11,400/yr. Based on capital cost estimates of \$6,000 for each of two units, payback would be expected to occur in about one year.

### 3.6.3 Recommendations

McDonnell Douglas should investigate acquiring two stand-alone solvent distillation/storage workstations for recovery and reuse of cleanup solvents at paint booth cleanup stations. These units should be placed in convenient locations such as directly

adjacent to the paint booth solvent collection locations to encourage their use. The amount of contaminants placed in the unit, including other solvents, should be minimized by providing a separate accumulation drum for solids and non-MEK painting solvents. Use should be limited to recovery of non-chlorinated cleanup solvents for reuse in paint booth cleanup operations, to preclude the opportunity for solvents being transferred to other plant areas for use in other operations. Guidance should be provided to paint booth operators to prevent transfer of recovered solvents to other areas. In addition, a routine program should be instituted whereby solvent recovery is conducted on a periodic basis (e.g. at the end of a shift or once a day); solvents are placed directly into the recycling unit (to minimize vapor losses during storage); routine maintenance is conducted; and solids are removed on a regular cycle for disposal.

Through incorporation of these units, solvent disposal can be significantly reduced; solvent vapor losses during storage can be minimized; concern about cross use of recovered solvents can be alleviated; and costs for disposal and new solvents can be reduced.

### 3.7 PAINT BOOTH SLUDGE

Paint booth sludge consists primarily of paint solids and water removed from water-wall air scrubbers in McDonnell Douglas' paint booths. The sludge is generated on a near continuous basis by skimming floating solids from the water sumps as well as in batch from periodic cleanout of sump bottoms and spray booth areas. Approximately 16,500 lbs (1650 gal) of paint booth sludge were accumulated in 55-gallon drums in 1984 and removed by USPCI for disposal in a secure landfill at a cost of \$1600.

No cost-effective approaches for reducing the volume of paint booth sludges have been identified. Although dewatering of the sludges could serve to reduce the volumes sent out for disposal, this approach is not cost-effective.

Alternatives to land disposal of paint booth sludges, particularly high-temperature incineration, should be examined. Although more costly than land disposal, incineration could result in significant reductions in liability exposure.

### 3.8 FUEL TANK SEALANT WASTE

McDonnell Douglas uses an epoxy-type sealant for production of non-metal aircraft fuel tanks. Solidified sealant waste generated from these operations is collected in a 55-gallon drum

for transportation and landfill at USPCI. Only one drum of waste sealant was generated in 1984. Total disposal costs were approximately \$50. No opportunities for minimizing this waste stream are recommended. However, alternative disposal methods such as high-temperature incineration should be investigated to reduce potential liability exposure.

### 3.9 TITANIUM CHEMICAL MILLING WASTE

#### 3.9.1 Waste Description and Management Practices

McDonnell Douglas currently utilizes a chemical process to mill specialty titanium parts. Precut, masked titanium stock is placed in an acid bath containing approximately 50 percent nitric acid, 3 percent hydrofluoric acid and other proprietary compounds for a predetermined length of time. Milling baths are used until titanium reaches its maximum solubility in the bath of 35-40 grams/liter, at which time sludges from the chemical milling operation and the bath is removed and replaced with fresh milling solution.

Baths are removed in bulk, and sludges in 55-gallon drums by USPCI for neutralization and evaporation and landfilling, respectively. The quantities of chemical milling wastes generated in 1984 were 950,000 lbs (111,700 gal) of bulk liquid and 18,000 lbs (1760 gal) of sludge. Analyses by McDonnell Douglas indicate that bath wastes contain 35 to 40 grams/liter of titanium. Although analyses are not available for the sludges, they are estimated to contain 5 to 15 percent titanium by weight.

A detailed mass balance of the chemical milling operation has not been prepared as virtually all milling chemicals remain in the milling tank and are removed as waste liquid and sludge. It is estimated that titanium milling operations result in 37,000 lb/year of titanium removed in the waste liquid and sludge streams.

#### 3.9.2 Waste Minimization Opportunities

The planned renovation of the AFP 3 wastewater treatment system will include a process to allow the neutralization of titanium chemical milling wastes. The spent etchant is to be neutralized to pH of 6 and bled into the IWG stream for further treatment. Current off-site disposal costs of \$0.87/gal (assuming a 12 normal solution) would be eliminated, resulting in an annual savings of approximately \$90,000. Additional savings could be possible by recycling the etch baths.

Lancy International, Inc. of Zelienople, PA has reported the successful development of a proprietary system for the regeneration of virtually identical titanium acid pickling baths. This system is not at the production stage at this time. In the Lancy system, titanium is precipitated from the saturated solution using potassium and sodium treatment chemicals. The system reportedly achieves 75 percent recycle, generating a titanium bifluoride sludge and returning etchant with 19 grams/liter titanium for reuse. The system is reportedly not affected by minor metal constituents present in titanium alloys. The Lancy system, estimated to cost \$70,000, is shown schematically in Figure 3-1. Based on new etchant solution costs of \$1.03/gal, the Lancy system would result in acid purchase cost reductions of approximately \$88,000/year.

Treatment costs, including HF replenishment of the bath, are estimated to be \$0.53/gal or \$60,000/year. The net savings achievable with the system are projected to be \$28,000/year, exclusive of avoided disposal costs (under present management practices) or avoided treatment costs (with the planned wastewater treatment system renovation). Assuming treatment costs of \$0.10/gal in the renovated AFP 3 system, net savings of approximately \$36,000/year are projected. A system payback of 1.9 years is projected based on these estimates.

The economics of the Lancy system may improve significantly if the waste titanium can be reclaimed. Approximately 32,000 pounds of titanium were discarded in the waste stream in 1984. The titanium bifluoride sludge produced by the Lancy system may be a suitable feedstock for oxidation to form titanium dioxide and may be sold to a titanium smelter or recovery firm. (titanium tetrachloride is widely used as an oxidation feedstock in such processes). At the first quarter of 1985 reported market sale price of \$0.68/lb (as TiO<sub>2</sub>), the titanium discarded at AFP 3 in 1984 had a value of \$38,000.

### 3.9.3 Recommendations

It is recommended that McDonnell Douglas explore the feasibility of implementing the Lancy system for etchant recovery and monitor development of a full scale system by Lancy. If the Lancy system is deemed feasible for implementation, additional savings may be possible by downsizing the planned etchant treatment portion of the wastewater treatment system renovation.

The planned renovations should still be instituted with the flexibility to downsize the etchant treatment portion factored into implementation plans, as an estimated 28,000 gal/year of effluent from the Lancy system would still require treatment if



the Lancy system is utilized. Simultaneous with the investigation of the Lancy system, inquiries should be made concerning the feasibility of recycling titanium and other treatment technologies. Points of contacts with major U.S. titanium refiners and TiO<sub>2</sub> producers have been requested from the Bureau of Mines. This information as well as information requested on other etch tank recovery systems will be forwarded when received.

### 3.10 ALUMINUM CHEMICAL MILLING WASTE

#### 3.10.1 Waste Description and Management Procedures

Aluminum is chemically milled by McDonnell Douglas using a solution of sodium hydroxide, sodium sulfide and triethanolamine. When the milling bath becomes depleted, it is collected in a holding tank for bulk removal and disposal through deep well injection by Chemical Resources, Inc. In 1984, 158,000 lbs (12,700 gal) of the waste bath, which also contains sodium aluminate, were disposed in this manner.

#### 3.10.2 Waste Minimization Opportunities

The waste aluminum milling stream is readily treatable using conventional wastewater treatment technologies. McDonnell Douglas is currently in the process of renovating the AFP 3 wastewater treatment plant to include an aluminum chem mill waste treatment line. This process will eliminate the need to send the chem mill wastes off-site. In addition, it will utilize lime to precipitate aluminum from the waste, thus allowing the etchant to be returned to the milling process for reuse. This change would result in significant cost savings, as approximately 10,000 gal/year of etchant with a value of \$21,800 would be recovered for reuse.

The process which will be used to recover the etchant involves the lime precipitation of aluminum as calcium aluminate by the following reactions:



The calcium aluminate is settled, along with sulfide smut in the etchant, as an insoluble sludge. The sludge will be carbonated with carbon dioxide to remove excess lime, washed to remove excess caustic and dewatered for disposal. Reclaimed etchant will be stored in a separate holding tank for conveyance back to the chem mill operation.

### 3.10.3 Recommendations

The planned wastewater treatment system renovation should be implemented. The total renovation cost is estimated to be \$3.7 million; however, the costs for the portion of the renovation associated with the etchant reclamation line have not been identified. The cost savings in avoided disposal and new material costs by incorporation of a chem mill waste regeneration process are estimated to be approximately \$2,000/year. Disposal of wastes would be reduced to landfill of a dewatered sludge.

## 3.11 SCALE CONDITIONING WASTE

### 3.11.1 Waste Description and Management Practices

Fabricated metal parts are descaled using a strong alkaline bath consisting of approximately 50 percent sodium hydroxide and 2 percent sodium dichromate. Baths and accumulated sludges are periodically removed from the conditioning tank and replaced with new scale conditioning liquids. Liquid wastes are transferred to a coroseal-lined steel holding tank, diluted with water and allowed to cool for several days prior to bulk removal by Chemical Resources, Inc. for disposal by deep well injection. Approximately 31,000 lbs (2500 gal) of spent baths were disposed in this manner in 1984 at a cost of \$430. Accumulated sludges are placed in 55-gallon drums for landfill disposal by CWM. Ten drums of sludge (7,200 lbs) were disposed in this manner in 1984 at a cost of \$530.

### 3.11.2 Waste Minimization Opportunities

The scale conditioning wastes are amenable to on-site treatment. McDonnell Douglas has initiated a renovation of the existing AFP 3 wastewater treatment system which will allow for neutralization of the waste stream, chrome reduction and solids precipitation. This change is projected to result in minor cost savings over current practices but will serve to significantly reduce the liability exposure associated with landfilling the descaling wastes.

Employing a stirred tank reactor, sulfuric acid and hydrogen peroxide will be added to reduce the waste's pH to about 6 and to reduce the chemical oxygen demand to low levels. This pretreated waste stream will then be bled into the IWG treatment system. Further pH reduction with sulfuric acid accompanied by addition of ferrous sulfate will serve to reduce hexavalent chrome to the trivalent state in the IWG.

### 3.11.3 Recommendations

The planned wastewater treatment system renovation should be implemented. The cost associated with on-site treatment of the descaling wastes is not readily identifiable as it is part of a major wastewater treatment plant up-grade. The avoided disposal cost savings realized are expected to be approximately \$1,000/year for the descaling wastes.

### 3.12 ANODIZE/CONVERSION COAT/DESMUT WASTES

#### 3.12.1 Waste Generation and Management Practices

McDonnell Douglas metal finishing operations include aluminum acid desmut, conversion coating and anodizing operations. Bath make-up for these operations are:

- o Acid Desmut - Amchem 7-17, 3 oz/gal CrO<sub>3</sub>  
5% H<sub>2</sub>SO<sub>4</sub>
- o Conversion Coat - 1) Alodine 1500, 1 oz/gal CrO<sub>3</sub>  
2) Alodine 600, 1 oz/gal CrO<sub>3</sub>
- o Anodize - Alodine 1200, 6 oz/gal CrO<sub>3</sub>

Periodically, when acid process tanks are determined to be off specification, they are pumped from the tank for bulk transport off-site to Chemical Resources. Acid wastes are disposed by deep well injection. Waste generation in 1984 totalled 28,000 lbs (3,050 gal). Waste generated from these operations vary but are typically strong acid solutions with significant levels of hexavalent chrome as well as other metals, solids and complexed ferro-cyanides. Some other wastes from these operations are treated in the IWG system as part of the acid wastewater stream.

Anodizing solutions -- Amchem products -- used by McDonnell Douglas are diluted to varying degrees to produce process baths. Typically, dilutions range from 2:1 to 5:1 (water:solution). Assuming a 3:1 mixture, approximately 800 gallons of Alodine solutions and 2,300 gallons of water were used to produce McDonnell Douglas process baths. This estimate ignores losses resulting from drag-out, spillage and the anodizing process itself, which are considered to be minimal.

#### 3.12.2 Waste Minimization Opportunities

McDonnell Douglas is currently modifying the AFP 3 wastewater treatment system to allow treatment of all process bath wastes from anodizing operations. An interim wastewater treatment plan

developed by Wilson & Company in January 1983 proposes that concentrated acid wastes should be collected and stored in the "old" acid storage tank. From this tank, concentrated acid wastes will be metered into the flash mix basin of the IWG waste treatment system at a rate which maintains a pH of greater than 2. Acid wastes will then be treated with general plant industrial waste as follows:

1. Ferrous sulfate reduction of hexavalent chromium to trivalent chromium.
2. Lime polymer precipitation of metal hydroxides.
3. pH adjustment with carbon dioxide.

Treated wastewater will be discharged at NPDES Outfall 003. Sludges generated from the process will be handled in the present sludge thickening and impoundment storage operation.

A long-range wastewater treatment plan proposes batch treatment of concentrated chrome acid wastes including chem mill etchants, dioxidizers and anodizing solutions. Batch treatment will consist of two 15,000 gallon tanks equipped with in-tank ejectors for mixing tank contents with caustic, lime slurry, sulfur dioxide or hydrogen peroxide treatment chemicals. The treatment scheme will consist of:

1. Chromium reduction with sulfur dioxide or hydrogen peroxide.
2. Neutralization to pH 6 with lime or caustic.
3. Further treatment in the IWG treatment system (i.e., chemical precipitation, clarification, recarbonation).

In the proposed long-range system, sludge will be dewatered by filtration and disposed off-site. The present sludge impoundment will be removed.

Incorporation of this system will eliminate the current off-site waste management of waste anodizing solutions. All 3050 gallons of waste can be treated in the proposed system. Treated water will be mixed with other IWG and IWC waste streams for discharge from Outfall 003. Sludge generated from treatment of anodizing wastes will be collected with other treatment sludges and disposed. In the proposed treatment plan, an attempt to delist waste sludges will be made, enabling disposal of dewatered

sludge as a non-hazardous waste. The cost savings provided by this treatment scheme are the avoided cost of waste anodizing solution disposal. Based on 1984 disposal figures of 3,050 gallons, disposal costs of \$0.12/gallon and transport costs of \$132.50/load, a total of \$500 would be saved. However, this figure will probably be off-set by additional treatment costs incurred for labor, chemicals, etc. Nonetheless, this system eliminates the reliance on direct land disposal for untreated waste.

### 3.12.3 Recommendations

The proposed treatment of anodizing solutions in the rehabilitated wastewater treatment plant is a sound approach to elimination of off-site disposal of untreated waste. No recommendations regarding the proposed treatment scheme are made. McDonnell Douglas may also consider pursuing the feasibility of recovering chrome or anodizing solutions for reuse in metal finishing operations or sale to reduce waste loading to the proposed treatment plant. Such an arrangement may further reduce waste disposal by reducing sludge generation from the treatment plant. To date, such systems have found only very limited application because of reliability and process limitations. It is unlikely that such a system could be used at AFP 3, therefore treatment as described is recommended until reliability of this alternative can be improved.

## 3.13 GENERAL PLANT WASTEWATER

### 3.13.1 Waste Description and Management Practices

The wastewater treatment system at AFP 3 is undergoing significant rehabilitation to expand its current treatment capability, to provide more efficient and complete treatment, and to eliminate reliance on a sludge lagoon for disposal of wastewater treatment sludges. In 1984, 35.6 million gallons of acid wastewater and 2.8 million gallons of alkaline wastewater were treated in the existing wastewater treatment system. As a result, 1.76 million gallons of hazardous sludge was generated and discharged to the sludge impoundment. Sludges consisted of approximately 2 percent solids, or 4,700 cu yd of dry sludge.

### 3.13.2 Waste Minimization Opportunities

The proposed wastewater treatment system designed by Wilson & Company enables significant reduction in current hazardous waste disposal volumes. As described in other subsections of Sections 3 and 4, several waste streams currently being disposed off-site will be treated in the upgraded wastewater treatment system. Table 3-5 summarizes the waste streams that will be treated in the system. A total of 558,000 gallons of concentrated metal finishing wastes currently being disposed off-site will be treated in the wastewater treatment system.

TABLE 3-5  
DISPOSED WASTES TO BE  
TREATED IN UPGRADED WWT SYSTEM

WASTE STREAM	1984 GENERATION	CURRENT MANAGEMENT	1984 COST
<u>McDonnell Douglas</u>			
Paint Stripper Liquid	356,280 gal	Deep well injection	\$51,400
Titanium Chem Mill	111,700 gal	Neutralization and Evaporation	\$86,000
Aluminum Chem Mill	12,700 gal	Deep well injection	\$ 1,800
Scale Conditioner	2,500 gal	Deep well injection	\$ 400
Anodizing/Conversion Coat/Desmut Waste	3,050 gal	Deep well injection	\$ 500
<u>Rockwell</u>			
Tri-Acid Etch	31,100 gal	Deep well injection	\$ 8,700
Caustic Alum Sludge	17,450 gal	Landfill	\$21,000
Sodium Aluminate Sludge	16,000 gal	Landfill	\$18,000
Nitric Acid	500 gal	Landfill	\$ 400
Anodizing Waste	7,000 gal	Landfill	\$ 9,200
<hr/>			
Total Waste Disposal Avoided =	558,000 gal		

In addition to this reduction in waste disposal, the proposed modifications include a sludge dewatering system to eliminate the sludge impoundment. Sludge will be collected from the solids contact clarifier and chem mill sludge tank into a sludge holding tank. From this tank, sludge will be dewatered in a vacuum or belt filtration system resulting in a dry sludge cake which can be collected in a dumpster. Filtrate water will be recycled to the IWG system. Plans are to delist dewatered sludge to allow disposal at a non-hazardous industrial waste landfill.

Using 1984 sludge volumes of 1.76 million gallons sludge generation reductions can be estimated. Assuming a solids concentration of 2 percent in 1984, dry sludge volume was 4700 cu yd. With the proposed dewatering system, sludge concentrations of 10-40 percent (25 percent average) can be achieved or a total sludge generation rate of approximately 20,000 cu yd (150,000 gal). Thus, sludge generation can be reduced by 91 percent of current generation rates.

### 3.13.3 Recommendations

The wastewater treatment modifications represent an effective method of greatly reducing current waste disposal by off-site firms and on-site surface impoundments. No additional recommendations are made.

### 3.14 TANK LINERS

McDonnell Douglas generated 2,500 lbs (4 drums) of waste resulting from the overhaul of tank liners in 1984. This was a one-time occurrence; therefore, no recommendations regarding waste minimization are provided.

### 3.15 VIBRATING DEBURRER SLUDGE

McDonnell Douglas uses vibrating deburring units to remove burrs from small machined aluminum parts. Periodically, sludges consisting of grinding media solids, aluminum, and other metal solids and water are removed from the deburring operations and collected in a 55-gallon drum. In 1984, one drum of deburring sludge was generated and landfilled by USPCI. Total cost for disposal was approximately \$50. No opportunities for minimizing this waste stream are recommended.

#### 4.0 WASTE MINIMIZATION PROGRAM: ROCKWELL INTERNATIONAL

This section provides a description of current waste generation and management practices by waste stream at AFP 3 - Rockwell International. A summary of these current practices is provided in Table 4-1. The following subsections present detailed descriptions of each waste stream and current management methods; waste stream material balances (where appropriate); opportunities for waste minimization; system economics; and recommendations for system implementation. This information is provided in support of the conclusions and recommendations provided in Section 2. Work sheets for each waste stream are included in Appendix C.

##### 4.1 PAINT BOOTH SLUDGE

Approximately 381,600 lbs (694 drums) of paint sludge consisting of water and paint residues were generated by Rockwell in 1984. These wastes resulted from skimming floating materials from water wall scrubber systems and periodic cleanup of sump bottoms and paint booths. Wastes are collected in 55-gallon drums and disposed in a secure chemical landfill by Chemical Waste Management, Inc at their Carlyss, LA facility. Costs for disposal in 1984 are estimated by Rockwell to be \$12,330.

No viable, cost-effective methods for reducing the volumes of paint sludges generated by Rockwell have been identified. Although the sludge volume could potentially be reduced by up to 50 percent by dewatering, this approach is not cost-effective.

It is recommended that Rockwell explore high-temperature incineration of paint sludges. Although more expensive than land disposal, incineration could significantly reduce liability exposure incurred by land disposal of wastes.

##### 4.2 MIXED PAINT/SOLVENT WASTE

###### 4.2.1 Waste Description and Management Practices

Rockwell generated 50,400 lbs (7,200 gal) of paint solvent wastes and sludges in 1984 during cleanup of painting equipment. This waste consists of approximately 90 percent methyl ethyl ketone (MEK) and 10 percent paints, solids and other solvents.

TABLE 4-1  
APP 3: ROCKWELL  
WASTE GENERATION RATES AND MANAGEMENT PRACTICES

WASTE	SOURCE/CONTENT	1984		CURRENT MANAGEMENT PRACTICES	CURRENT COSTS	CHANGES PROJECTED/COMMENTS
		GENERATION RATE (POUNDS)				
1. Paint Booth Sludges	Paint Booth Clean-Up: -Paint residue -Water	381,600 (694 drums)		Collected in drums Drum transport Landfill by CWM	\$12,330	None
2. Mixed Paint/Solvent Waste	Paint Thinner & Spray Gun Cleaning: -85-95% MEK -Remainder solids -Other solvents	50,400 (7,200 gal)		Collected in drums Drum transport Landfill by CWM	\$ 9,200	Transport to Hydrocarbon Recyclers for recovery
3. Coolant Waste	Machining Operations: -5% cutting oil -95% H <sub>2</sub> O -Metals	153,000 (18,450 gal)		Collected in tank Bulk transport DWI by CRI	\$5,200	Alternate disposal being considered: 1. Disposal at CWM 2. Lomar Reclamation System
4. Waste Oil	Equipment Maintenance: -Waste lube oils	92,300 (12,300 gal)		Collected in tank Bulk transport Recycled by HR	\$1,850 (revenue)	None
5. Tri-Acid Etch Waste	Etching Operations: -Sulfuric Acid -Sodium dichromate -HF acid	264,000 (31,000 gal)		Pumped from process tank Bulk transport DWI by CRI	\$5,600	Planned treatment in WWT system
6. Caustic Alum Sludge	Wastewater Treatment Tank Cleanout: -Metal hydroxides	221,000 (18,400 gal)		Pumpout 1/3 of process tank Bulk transport Landfill by CWM	\$20,960	Planned treatment in WWT system
7. Sodium Aluminate Sludge	Chem Mill Process: -Sodium alluminate sludge -Water -Sodium hydroxide	160,000 (16,000 gal)		Pumpout 1/3 of process tank Bulk Transport Landfill by CWM	\$10,700	Planned treatment in WWT system
8. Cadmium Oxide Waste	Unknown	3,000 (1 drum)		Collected in drum Drum transport Landfill by CWM	\$100	None

Unit costs are provided in Appendix A.

TABLE 4-1  
APP 3: ROCKWELL  
WASTE GENERATION RATES AND MANAGEMENT PRACTICES

WASTE	SOURCE/CONTENT	1984 GENERATION RATE (POUNDS)	CURRENT MANAGEMENT PRACTICES	CURRENT <sup>1</sup> COSTS	CHANGES PROJECTED/COMMENTS
9. Nitric Acid Waste	Contaminated Nitric Acid	5,000 (500 gal)	Pumped from process tank Bulk transport Landfill by CWM	\$2,240	None
10. Alodine Waste	Anodizing operation: -Alodine 1200 o Water o CrO <sub>3</sub> o Sulfuric Acid	59,500 (7,000 gal)	Pumped from process tank Bulk transport Landfill by CWM	\$3,040	Planned treatment in WWT system
11. Phenolic Resin Waste	Unknown	3,800 (7 drums)	Collected in drums Drum transport Landfill by CWM	\$540	None
12. Epoxy Potting Compound Waste	Unknown	1,000 (2 drums)	Collected in drums Drum transport Landfill by CWM	\$154	None
13. Tank Sludges	Chromium Tank Bottoms -Metal hydroxides -Water -Solids	200,000 (16,500 gal)	Pumped from process tank Bulk transport Landfill by CWM	\$17,400	None

Unit costs are provided in Appendix A

Painting wastes are currently collected in 55-gallon drums for transportation to CWM for fuels blending and landfilling of solids. Current annual costs for disposal are \$9,200.

#### 4.2.2 Waste Minimization Opportunities

Rockwell's painting wastes could be recovered by distillative recovery. Both on-site and off-site recycling appear to be viable options, as described below.

##### 4.2.2.1 Off-Site Recovery

Rockwell is currently exploring off-site recycling of its painting wastes with Hydrocarbon Recyclers. Preliminary estimates are that Rockwell will be charged \$35/drum for recycled paint solvent waste. This represents a 50 percent decrease in disposal costs or an annual savings potential of approximately \$4,600.

##### 4.2.2.2 On-Site Recycling

MEK potentially could be recycled and reused in painting equipment cleanup operations. A combination recovery still/storage tank/cleaning station system would allow for rapid cleanup of equipment while purifying and storing MEK for continued cleaning in paint booth cleaning operations. In this system arrangement, paint solvent wastes are dumped into a sink which drains to the distillation unit. At the end of the day, more frequently if necessary, the unit can be switched on; separation of solids and solvent occurs automatically. After operation, solvent can be collected from the unit and reused for cleaning in the paint booth area. In addition, solvent waste can be brought to the units from other locations and recycled for use in paint cleanup operations at these locations. Fouling problems are not anticipated, as units of this design do not volatilize materials with boiling points above 320°F. Residues of unvolatilized materials are contained in a disposable bag, which can be removed for disposal. These systems minimize the potential for inadvertently using recycled MEK in applications requiring high-purity solvents.

Rockwell currently has a Recyclene still which was, until three years ago, used in the paint booths to recover MEK solvent from cleanup operations. Approximately three years ago, all staff trained in operating the unit were transferred and the system has not been successfully operated since that time. Paint solvent wastes mixtures were collected during cleaning

operations and dumped directly into a collection sink on the recovery unit. The sink drained to the distillation unit where it was stored until sufficient volume was available for operation. The unit operated automatically with a switch, shutting down when finished. Solvents were reused in paint cleanup operations. Solids were collected in the recovery unit collection bag until full and then were disposed in drums. This system operated successfully for about 1 1/2 years. Based upon the history of use without problems, on-site recovery appears to be a viable alternative to current methods of disposal.

Adding another unit similar to the 11 gallon/hour system located at Rockwell would provide sufficient solvent recycling capability to handle all of Rockwell's current needs. A third unit may be appropriate if waste volumes exceed the combined 7,000 gal/year capacity of two units (based on one shift of use per day). The economics of these systems are very favorable. Avoided disposal and new solvent purchase costs are anticipated to be \$23,000/year, for an MEK recovery rate of 85 percent. With projected operating costs of \$0.20/gal or \$1400/year, the net estimated cost savings of \$21,600/year would provide payback of the \$12,000 capital costs of two additional units in 0.6 years.

#### 4.2.3 Recommendations

It is recommended that Rockwell begin MEK recovery operations with its existing still as they have planned. A representative from Recyclene Products, Inc., the system manufacturer, should be contacted to arrange for training of Rockwell staff in system operation and maintenance procedures. Provided the existing system performs satisfactorily, one or two additional systems should be acquired. In addition, waste segregation and recycled solvent management practices should be observed to maximize recovery efficiency and prevent inadvertent misuse of recovered MEK.

#### 4.3 COOLANT WASTE

##### 4.3.1 Waste Description and Management Practices

Machining operations at Rockwell require soluble oil/water emulsion coolants for lubrication and cooling of metal parts during metalworking. Coolants are used until they fail, as evidenced by rancid odors or high tramp oil content. Coolants are then collected from machine sumps by a portable vacuum wagon and stored in a tank. From the storage tank, waste coolant is transported and disposed by deep well injection by Chemical Resources, Inc. Rockwell disposed of 153,000 lbs (18,450 gal) of coolant waste in 1984 by this method, at a cost of \$5,200.

Soluble oil coolants are supplied by a number of manufacturers in the United States and, therefore, vary in composition. Typically cutting fluids consist of:

- o 60-90% mineral oils
- o 1-5% water
- o 5-30% emulsifiers
- o 1-20% coupling agents
- o 1-10% rust inhibitors
- o 0-10% bactericides (e.g. chlorophenols, formaldehyde).

Cutting fluids are diluted with water to a 20:1 to 50:1 (water:oil) mix. Waste coolants generated from machining operations will typically be the oil/water coolant mix with 3-5 percent tramp oil and suspended metal particles. Waste coolants will also have reduced concentrations of additives such as emulsifiers and bactericides.

#### 4.3.2 Waste Minimization Opportunities

##### 4.3.2.1 On-Site Coolant Recovery

One of the most promising waste minimization technologies available is coolant recovery. Several technologies are available to remove tramp oils and solids from coolants so they can be up-graded with new cutting fluid and reused in machining operations. As described in Section 3.4 of this report, McDonnell Douglas has acquired six Turbo Fram coalescing plate filtration units for this purpose. These systems operate on a gravity separation concept, with enhanced settling provided by laminar flow induced by coalescing plates.

Another technology being implemented at a number of machining operations (including AFP 44) is centrifugal separation. Although more costly than plate filtration units, they have proven to be more effective at removing free and suspended tramp oils from waste coolant and thereby producing a cleaner recycled coolant.

Implementation of a coolant recycling system, either by plate filtration or centrifugation can significantly reduce waste generation from machining operations. It is estimated that Rockwell could reduce its current waste generation rate by 90 percent to approximately 1,800 gal/year, thereby reducing disposal costs from \$5,200/year to \$600/year. It may also be possible to recycle tramp oils removed from waste coolant (approximately 500 gallons) with Hydrocarbon Recyclers, reducing disposal costs even further. In addition to these

disposal savings, a reduction of cutting fluid purchases by as much as 60-80 percent can be realized. Assuming a 60 percent reduction and a new cutting oil cost of \$3.25/gallon, an additional savings of \$1,800/year can result. Therefore, a total cost savings of \$6,400/year is estimated. Based on centrifuge system costs of \$50,000 or plate filter costs of \$10,000, payback periods of 8 years and 1.5 years can be realized, respectively.

#### 4.3.2.2 Contracted Coolant Recovery

Rockwell is currently investigating the recovery of coolant waste through Lormar Reclamation Systems. In this system, Lormar would send a recovery unit to AFP 3 on a regular basis, reclaim waste coolant for reuse in machining operations and remove tramp oils and solids for disposal. Costs for this service were quoted to be \$0.68/gal for minimum loads of 1000 gallons or \$0.57/gal for minimum loads of 1500 gallons. Based on current waste generation rates of 18,450 gal and the \$0.57/gal reclamation cost, costs for Rockwell using this system are estimated to be \$10,500, or double current disposal costs.

#### 4.3.3 Recommendations

On-site coolant recovery is the most cost effective alternative to current disposal of coolant by deep well injection. It is recommended that Rockwell investigate alternative coolant recovery systems, including coalescing plate filtration and centrifugation units. It appears that the type of filter units being used by McDonnell Douglas represent the most promising technical and economic advantages. As with McDonnell Douglas, the following recommendations are made for such systems:

1. Use bactericide additives for recovered coolant to achieve greatest useful coolant life.
2. Recover coolant on a routine schedule to minimize deterioration sump clean-out requirements, and improve total coolant life.
3. Use deionized-water for coolant makeup to reduce mineral build-up and thus extend coolant life.

#### 4.4 WASTE OIL

Various maintenance activities throughout Rockwell operations result in the generation of lubricating oil wastes. Waste oils are collected at the point of generation in portable carts.

They are transported to a bulk storage tank from which they are pumped to a tank truck by Hydrocarbon Recyclers for recycling. In 1984, all of Rockwell's 92,300 lbs (12,300 gal) of waste oils were recycled in this manner.

Rockwell receives \$0.15/gal net revenue for waste oil which resulted in a total of \$1,850 in 1984. In addition, an estimated \$11,200 in disposal costs were avoided by recycling wastes, based on USPCI'S waste oil disposal costs of \$44/drum and transportation costs of \$1.43/hundred-weight.

Rockwell has a sound oil waste management program that results in net revenues for oil recycling and zero land disposal of oils. No recommendations are provided.

#### 4.5 TRI-ACID ETCH WASTE

##### 4.5.1 Waste Description and Management Practices

Approximately 264,000 lbs (31,000 gal) of spent tri-acid aluminum etch baths were generated by Rockwell in 1984. This strongly acidic waste contains sulfuric and hydrofluoric acids and sodium dichromate. Waste baths are removed in bulk by Chemical Resources, Inc. for disposal by deep well injection, at a cost of \$5,600.

##### 4.5.2 Waste Minimization Opportunities

The planned AFP 3 wastewater treatment plant renovation will include the installation of facilities to treat the waste tri-acid etch currently disposed off-site. Chromium reduction will be accomplished through the addition of sulfur dioxide or hydrogen peroxide at a pH of 2.0 or less. Caustic soda or lime slurry will then be added to bring the pH to 6.0 before the waste is bled to the general industrial waste stream for further treatment.

Maintenance and capital costs attributable to treatment of the tri-acid etch waste in the planned system are not available. Implementation of this system will result in elimination of off-site disposal of tri-acid etch waste. Savings associated with avoided disposal costs are \$5,600/year. Some of this cost would be offset by on-site operators time and treatment chemicals, however off-site disposal is eliminated.

##### 4.5.3 Recommendations

It is recommended that Rockwell continue with the planned system renovation, to eliminate off-site disposal of this waste stream.

#### 4.6 CAUSTIC ALUM SLUDGE

##### 4.6.1 Waste Description and Management Practices

Caustic alum sludge is generated on a periodic basis during the cleanout of process tanks. The sludge is currently removed in bulk by CWM for disposal in a secure chemical landfill. In 1984, 221,000 lbs (18,440 gal) of caustic alum sludge were disposed by Rockwell, at a cost of \$21,000.

##### 4.6.2 Waste Minimization Opportunities

The planned AFP 3 wastewater treatment plant renovations will allow for the on-site treatment of the caustic alum sludges. Sulfuric acid will be added to the waste to achieve a pH of 6.0 and hydrogen peroxide utilized to reduce chemical oxygen demand to low levels, as necessary. The pretreated wastes will then be bled into the general industrial waste stream for further treatment. Using this system, all off-site disposal will be eliminated, resulting in avoided disposal costs of \$21,000/year.

##### 4.6.3 Recommendations

It is recommended that Rockwell proceed with the planned system renovation.

#### 4.7 SODIUM ALUMINATE SLUDGE

##### 4.7.1 Waste Description and Management Practices

Aluminum is chemically milled by Rockwell using a solution of sodium hydroxide, sodium sulfide and triethanolamine. The milling tank is routinely replenished by removing one-third of its contents and adding fresh etchant. In 1984, 160,000 lbs (16,000 gal) of waste etchant were removed in bulk by CWM and disposed in a secure chemical landfill, at a cost of \$10,700.

##### 4.7.2 Waste Minimization Opportunities

As described in detail in Section 3.10 of this report, the planned AFP 3 wastewater treatment system renovation includes recovery and reuse of spent etchant. Lime will be utilized to precipitate aluminum from solution as calcium aluminate and the regenerated bath stored for future reuse. Waste calcium aluminate will be neutralized and bled into the general wastewater stream for further treatment. It is estimated that approximately 12,000 gal/year of etchant will be recovered with a value of approximately \$26,000. In addition, avoided disposal costs of \$10,700 will be realized.

#### 4.7.3 Recommendations

It is recommended that Rockwell continue with development of the etchant recovery system. As part of this development, Rockwell should carefully review design specifications, chemical feed requirements and system economics to ensure cost-effective application to the waste etchant at AFP 3. Specific items that should be investigated include:

- o Chemical feed requirements as part of precipitation and neutralization reactions
- o Sludge volumes and dewatering characteristics
- o Delisting of sludges to dispose as a non-hazardous solid waste
- o Reliability of chemical feed control systems.

#### 4.8 CADMIUM OXIDE WASTE

Rockwell generated one 55-gallon drum of cadmium oxide waste in 1984 from unknown sources. It is believed that this is a one-time waste. Therefore, no recommendations are made.

#### 4.9 NITRIC ACID WASTE

Rockwell generated 5,000 lbs (500 gal) of nitric acid waste from an unknown source in the plating shop. This waste was disposed in bulk by Chemical Waste Management in a secure chemical landfill. It is believed that generation of this waste is extremely rare, therefore no recommendations for minimization are made. However, with the wastewater treatment plant rehabilitation, treatment of this waste should be possible, eliminating the need of off-site disposal and avoiding disposal costs of \$560/year.

#### 4.10 ALODINE WASTE

##### 4.10.1 Waste Generation and Management Practices

Rockwell metal finishing operations include anodizing operations. Rockwell utilizes Alodine 1200 solution for bath make-up. Periodically, when acid process tanks are determined to be off specification, they are pumped from the tank for bulk transport and landfilling by CWM. Waste generation in 1984 totalled 59,500 lbs (7,000 gal). Waste generated from these operations vary but are typically strong acid solutions with significant levels of hexavalent chrome as well as other metals, solids and complexed ferro-cyanides. Disposal costs in 1984 are estimated by Rockwell to be approximately \$3,040.

Anodizing solutions are diluted to varying degrees to produce process baths. Typically dilutions range from 2:1 to 5:1 (water:solution). Assuming a 3:1 mixture, approximately 1750 gallons of Alodine solution and 5,250 gallons of water were used to produce process baths. This estimate ignores losses resulting from drag-out, spillage and chemical loss during the anodizing process. However, losses are considered to be minimal.

#### 4.10.2 Waste Minimization Opportunities

McDonnell Douglas is currently modifying the AFP 3 wastewater treatment system to allow treatment of waste process baths from anodizing operations at both McDonnell Douglas and Rockwell. An interim wastewater treatment plan developed by Wilson & Company in January 1983 proposes that concentrated acid waste should be collected and stored in the "old" acid storage tank. From this tank, concentrated acid wastes will be metered into the flash mix basin of the IWG waste treatment system at a rate which maintains a pH of greater than 2. Acid wastes will then be treated with general plant industrial waste as follows:

1. Ferrous sulfate reduction of hexavalent chromium to trivalent chromium.
2. Lime polymer precipitation of metal hydroxides.
3. pH adjustment with carbon dioxide.

Treated wastewater will be discharged at NPDES Outfall 003. Sludges generated from the process will be handled in the sludge thickening and impoundment storage operation.

A long-range wastewater treatment plan proposes batch treatment of concentrated chrome acid wastes including chem mill etchants, deoxidizers and anodizing solutions. Batch treatment will consist of two 15,000 gallon tanks equipped with in-tank ejectors for mixing tank contents with caustic, lime slurry, sulfur dioxide or hydrogen peroxide treatment chemicals. The treatment scheme will consist of:

1. Chromium reduction with sulfur dioxide or hydrogen peroxide.
2. Neutralization to pH 6 with lime or caustic.
3. Further treatment in the IWG treatment system (i.e., chemical precipitation, clarification, recarbonation).

In the proposed long-range system, sludge will be dewatered by filtration and disposed off-site. The present sludge impoundment will be removed.

Incorporation of this system will eliminate the current off-site management of waste anodizing solutions. All 7,000 gallons of waste can be treated in the proposed system. Treated water will be mixed with other IWG and IWC waste streams for discharge from Outfall 003. Sludge generated from treatment of anodizing wastes will be collected with other treatment sludges and disposed. In the proposed treatment plan, an attempt to delist waste sludges will be made, enabling disposal of dewatered sludge as a nonhazardous waste. The cost savings provided by this treatment scheme are the avoided cost of waste anodizing solution disposal. Based on 1984 disposal figures of 7,000 gallons, a total of \$3,040/year would be saved. However, this figure will probably be off-set somewhat by additional treatment costs incurred for labor, chemicals, etc. Nonetheless, this system eliminates the reliance on direct land disposal for untreated waste.

#### 4.10.3 Recommendations

The proposed treatment of anodizing solutions in the rehabilitated wastewater treatment plant is a sound approach to elimination of off-site disposal of untreated waste. No recommendations regarding the proposed treatment scheme are made. Rockwell may also pursue the feasibility of recovering chrome or anodizing solutions for reuse in metal finishing operations or sale to reduce waste loading to the proposed treatment plant. Such an arrangement may further reduce waste disposal by reducing sludge generation from the treatment plant. To date, such systems have found only very limited application because of reliability, economics, and process limitations. It is unlikely that such a system could be implemented at AFP 3; therefore treatment as described is recommended.

#### 4.11 PHENOLIC RESIN WASTE

Seven drums (3850 lbs) of waste phenolic resin was produced by Rockwell in 1984. No methods of waste minimization have been identified, therefore no recommendations are provided.

#### 4.12 EPOXY POTTING COMPOUND WASTE

Rockwell generated two drums of waste epoxy potting compound in 1984. No opportunities for waste minimization were identified.

#### 4.13 TANK SLUDGES

##### 4.13.1 Waste Description and Management Practices

Tank bottoms from anodizing operations which contain significant quantities of chromium are periodically removed for off-site disposal. Approximately 200,000 lbs (16,500 gal) of these tank sludges were removed in bulk in 1984 by CWM for disposal in a secure chemical landfill. Disposal and transportation costs totaled \$17,400.

##### 4.13.2 Waste Minimization Opportunities

The planned AFP 3 wastewater treatment system renovation will include the construction of facilities to treat acidic chromium wastes as described previously. Sulfur dioxide or hydrogen peroxide will be added at a pH of 2.0 or lower to reduce the hexavalent chrome to the trivalent state. The pH will then be adjusted to 6.0 with lime or caustic and the pretreated wastes bled into the general wastewater stream for further treatment. Approximately \$17,400/year savings will be realized through avoided disposal costs.

##### 4.13.3 Recommendations

It is recommended that Rockwell proceed with the planned treatment system renovations.

#### 4.14 N/C MACHINE SHOP COOLING WATER

Although different than the other waste streams discussed in this report, once through cooling water used in Rockwell's N/C Machine Shop represents a large use and discharge of water. Implementation of the recycle cooling system proposed by Rockwell can result in substantial water savings.

##### 4.14.1 Waste Description and Management Practices

Rockwell's N/C Machine Shop Area presently uses once-through water for machine cooling. Considerable volumes of water are used annual for this purpose, representing about 40 percent of AFP 3 total water requirements. Rockwell estimates an average annual water usage of 136 million gallons in 1983. In the six month period of December 1984 through May 1985, cooling water usage has been 62.5 million gallons which is equivalent to 125 million gallons per year. Cooling water is discharged from Outfall 004.

Current costs for water supplied by the City of Tulsa are \$1.33/1000 gallons. Annual water costs for machine cooling are estimated to be \$155,000 at current rates, however, the annual average will actually be higher due to higher rates in summer months.

#### 4.14.2 Waste Minimization Opportunities

Rockwell identified the cost savings potential of a recirculation cooling system for the N/C Machine Shop area in 1983. A proposal submitted to the Air Force by Rockwell in 1983 proposed two closed-loop cooling systems to reduce water usage in these operations. The proposed systems consisted of two forced-air cooling tower units and circulation piping modifications for 24 N/D machines located between columns 14-30 and L-M and for the large Hydropress and Sheridan Gray presses located between columns 40-42 and G-J.

Total capital costs for installation of the closed loop systems were estimated by Rockwell to be \$93,000. Net annual savings are estimated to be over \$166,000/year, resulting in a payback of less than one year. In addition, approximately 90 percent of current water usage for cooling can be eliminated. More details on the proposed system are provided in Appendix D.

#### 4.14.3 Recommendations

It is recommended that the Air Force fund installation of closed loop recirculation systems in the N/C Machine Shop area to eliminate the large volumes of water required by the current once-through systems. These recirculation systems should result in substantial reductions in water use and discharge, as well as significant cost savings. In light of Tulsa's occasional water shortages and rationing requirements, these systems are further justified.

**APPENDIX A**



3. U.S. Pollution Control Inc.  
Fairview, OK
  - A. Deep well injection/transportation - \$0.51/gallon
  - B. Neutralization - \$0.03/gallon -unit normality
  - C. Demurrage - \$16.25/15 min. (1st two hours free)  
usually takes 3 hours
  - D. Drum Disposal - \$44/drum
  - E. Drum Transport - \$1.43/100 wt.
  
4. Hydrocarbon Recyclers, Inc.  
Tulsa, OK
  - A. Oils/Fuel Recovery - \$0.40/gallon net revenue

ROCKWELL

1. Chemical Waste Management, Inc.  
Carlyss, LA

A. Drum Disposal

1. Organic Liquids - \$161/drum
2. Organic Sludges - \$174/drum
3. Inorganic Solids - \$70/drum
4. Inorganic Liquids - \$70/drum
5. Inorganic Sludges - \$77/drum
6. Organic Solids - \$54/drum

B. Drum Fuels/Recycle Program

1. Organic Liquids - <1% Halogen - \$62/drum  
<8% Halogen - \$84/drum  
>8% Halogen - \$110/drum
2. Organic Sludges - <1% Halogen - \$99/drum  
<8% Halogen - \$144/drum

C. Bulk Liquid Inorganic Disposal - \$0.78/gallon.

D. Transportation - \$1,850/load

D. Demurrage - \$65/hr (1st hour free)

2. Chemical Resources, Inc.  
Tulsa, OK

A. Deep Well Injection - \$0.25/gallon

B. Transportation/Demurrage - \$150/truckload

3. Hydrocarbon Recyclers, Inc.  
Tulsa, OK

A. Oil Recovery - \$0.15/gallon net revenue

**APPENDIX B**

PLANT # 3  
OPERATOR: McDOWELL DOUGLAS  
DATE: 6-10-85

WASTE MINIMIZATION PROGRAM  
DATA SHEET

WASTE STREAM: 1. PAINT STRIPPER WASTE

CHARACTERISTICS: 92% H<sub>2</sub>O, 8% SOLIDS, METHYLENE CHLORIDE,  
PHENOL, METALS  
ANALYSIS SHOWED 8% SOLIDS, 4.5 PH, 25PPM MECL, 61PPM PHENOL  
(ATTACH ANALYSIS IF AVAILABLE)

SOURCE/MANAGEMENT: GENERATED FROM WASH DOWN OF WING TANKS FOLLOWING  
CONVENTIONAL SOLVENT STRIPPING. COLLECTED IN SUMPS IN BLDG 3.  
PUMPED OUT IN BULK FOR TRANSPORT & DISPOSAL BY DEEP WELL INJECTION  
AT CHEMICAL RESOURCES, INC.

OPERATION IN 3-DG 62 INVOLVES DIP STRIP FOLLOWED BY STEAM  
WASH DOWN. WASTEWATER TREATED WITH IWG.

GENERATION

1. RATE: 356,280 GAL/YR
2. FREQUENCY: 5500 GAL/2WKS
3. COST: 51370 (CRI RATE)

PROPOSED CHANGES: BATCH TREAT IN NEW WWT SYSTEM. TREATMENT  
INVOLVES OXIDATION OF ORGANICS WITH PEROXIDE AND IRON CATALYST.  
WASTE WILL THEN BE TREATED WITH IWG FOR PRECIPITATION OF SOLIDS

RAW MATERIAL DATA

1. CHARACTERISTICS: B&B 5075 STRIPPER
2. QUANTITY: 6 DRUMS (330 GAL) /YR.
3. COST: \$10.85 /GAL

NOTES: 1. IN PAST, 50-75% OF WASTE WAS WATER FROM OTHER BLDG 3  
SOURCES. PRODUCTION REDUCTION HAS ELIMINATED THESE SOURCES.  
2. WASTE GENERATION IS DECREASING DUE TO F-4 CUTBACKS.

PLANT # 3  
OPERATOR: MCD-D  
DATE: 6-10-85

WASTE MINIMIZATION PROGRAM  
DATA SHEET

WASTE STREAM: 2. PAINT STRIPPER SLUDGE

CHARACTERISTICS: PAINT SOLIDS W/WATER, RESIDUAL  
STRIPPER (METHYLENE CHLORIDE, PHENOL)

(ATTACH ANALYSIS IF AVAILABLE)

SOURCE/MANAGEMENT: COLLECTED FROM STRIPPING TANKS IN BLDG 62  
AND FROM BOTTOM OF COLLECTION PITS IN BLDG 3. WASTES DRUMMED  
AND DISPOSED AT CWM - CARLYSS, LA.

GENERATION  
1. RATE: 2 DRUMS  
2. FREQUENCY: ANNUALLY  
3. COST: \$330 (CWM RATES)

PROPOSED CHANGES: NONE

RAW MATERIAL DATA  
1. CHARACTERISTICS: BEB 5075 STRIPPER  
2. QUANTITY: 6 DRUMS/YR  
3. COST: \$10.85/GAL

NOTES: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

PLANT # 3  
OPERATOR: MCD-D  
DATE: 6-10-85

WASTE MINIMIZATION PROGRAM  
DATA SHEET

WASTE STREAM: 3. WASTE MAINTENANCE OILS

CHARACTERISTICS: MIXED WEIGHT LUBRICATING OILS

(ATTACH ANALYSIS IF AVAILABLE)

SOURCE/MANAGEMENT: COLLECTED DURING CHANGE-OUT OR MAINTENANCE  
OPERATIONS IN PORTABLE CARTS. TRANSFERRED TO STORAGE TANK.  
TRANSPORTED & RECYCLED FOR RESALE BY HYDROCARBON RECYCLERS INC-  
TULSA, OK.  
NO RETURN OF OILS TO MCD-D.

GENERATION 1. RATE: 1600 GAL.  
2. FREQUENCY: CONTINUOUS  
3. COST: \$0.40 /GAL NET REVENUE

PROPOSED CHANGES: NONE

RAW MATERIAL DATA 1. CHARACTERISTICS: VARIES - UNKNOWN  
2. QUANTITY: \_\_\_\_\_  
3. COST: \_\_\_\_\_

NOTES: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

PLANT # 3  
OPERATOR: McD-D  
DATE: 6-10-85

WASTE MINIMIZATION PROGRAM  
DATA SHEET

WASTE STREAM: WASTE OIL SLUDGES

CHARACTERISTICS: 35% OIL, 65% SOLIDS  
RELATIVELY DRY SLUDGE

(ATTACH ANALYSIS IF AVAILABLE)

SOURCE/MANAGEMENT: COLLECTED IN DRUMS DURING AIR COOLING  
SYSTEM FILTER CLEANING. DRUMS TRANSPORTED AND LANDFILLED  
AT USPCI - FAIRVIEW, OK.

GENERATION 1. RATE: 44 DRUMS  
2. FREQUENCY: PERIODICALLY  
3. COST: \$2320 (USPCI RATES)

PROPOSED CHANGES: NONE

RAW MATERIAL DATA 1. CHARACTERISTICS: N/A  
2. QUANTITY: \_\_\_\_\_  
3. COST: \_\_\_\_\_

NOTES: McD-D DOESN'T THINK THERE IS ENOUGH OIL TO BE RECYCLED

PLANT # 3  
OPERATOR: MCD-D  
DATE: 6-10-85

WASTE MINIMIZATION PROGRAM  
DATA SHEET

WASTE STREAM: S. WASTE FUELS

CHARACTERISTICS: CONTAMINATED MIXED JET FUELS (JET A  
JP-4)

(ATTACH ANALYSIS IF AVAILABLE)

SOURCE/MANAGEMENT: COLLECTED FROM FUEL TESTING OPERATIONS  
IN PORTABLE WAGONS. FUELS ARE TRANSPORTED TO A STORAGE  
TANK. BULK TRANSPORT FOR RECYCLING BY HYDROCARBON RECYCLERS.  
NO RETURN TO MCD-D.

GENERATION 1. RATE: 32,900 GAL  
2. FREQUENCY: PERIODICALLY  
3. COST: \$0.40 / GAL NET REVENUE

PROPOSED CHANGES: NONE

RAW MATERIAL DATA 1. CHARACTERISTICS: JET A, JP-4  
2. QUANTITY: UNKNOWN  
3. COST: UNKNOWN

NOTES: 1. DECREASING BECAUSE OF REDUCED TESTING PROGRAMS.

PLANT # 3  
OPERATOR: MCN-D  
DATE: 5-10-85

WASTE MINIMIZATION PROGRAM  
DATA SHEET

WASTE STREAM: 6. WASTE FUEL SLUDGES

CHARACTERISTICS: CONTAMINATED TEST FUELS DETERMINED  
TO BE UNRECYCLABLE, CONTAIN SOLIDS, WATER, OILS  
AND OTHER CONTAMINANTS  
(ATTACH ANALYSIS IF AVAILABLE)

SOURCE/MANAGEMENT: COLLECTED IN DRUMS FROM FUEL TESTING  
OPERATIONS. DRUM TRANSPORT TO CWM FOR LANDFILL

GENERATION 1. RATE: 3 DRUMS  
2. FREQUENCY: PERIODICALLY  
3. COST: \$370 (CWM RATES)

PROPOSED CHANGES: NONE

RAW MATERIAL DATA 1. CHARACTERISTICS: N/A  
2. QUANTITY: \_\_\_\_\_  
3. COST: \_\_\_\_\_

NOTES: 1. DECREASING GENERATION DUE TO DECREASED TESTING.

PLANT # 3  
OPERATOR: McD-D  
DATE: 6-10-25

WASTE MINIMIZATION PROGRAM  
DATA SHEET

WASTE STREAM: 7. WASTE MACHINE COOLANT

CHARACTERISTICS: CUTTING OIL/WATER EMULSION WITH  
METAL SOLIDS & TRAMP OILS  
TYPICALLY 20-50:1 (WATER TO OIL) W.T. + 3-5% TRAMP OIL  
(ATTACH ANALYSIS IF AVAILABLE)

SOURCE/MANAGEMENT: IN THE PAST, COLLECTED FROM MACHINE SUMPS  
WHEN RANCID. STORAGE IN WASTE TANK PRIOR TO BULK TRANSPORT  
AND DEEP WELL INJECTION BY CRI.

RECENTLY INSTALLED FRAN COALESCING PLATE FILTERS TO  
REMOVE TRAMP OIL & REUSE COOLANT. HAVE ONLY RUN WASTES  
THRU UNITS ONCE; 2ND TIME IT FAILS IT IS DISCARDED.

GENERATION 1. RATE: 37310 GAL  
2. FREQUENCY: CONTINUOUSLY  
3. COST: \$5400 (CRI RATES)

PROPOSED CHANGES: INSTALLATION OF 6 FRAN RECOVERY UNITS. EXPECT  
REDUCTION OF COOLANT WASTE BY 50%  
EXTENDS LIFE OF COOLANT FROM 1 MONTH TO 2 MONTHS

RAW MATERIAL DATA 1. CHARACTERISTICS: J653  
1AN STAYLER CUTTING FLUID \*  
2. QUANTITY: EST. 370 GAL/YR.  
3. COST: \$0.405/10 (\$3.25/GAL)

NOTES: 1. BETTER REDUCTION IN WASTE DISPOSAL MAY BE POSSIBLE  
WITH BACTERICIDE ADDITIVES AND MORE FREQUENT CLEANING  
2. ALSO SHOULD BE ABLE TO RUN THRU UNIT MORE THAN ONCE  
BEFORE DISPOSAL

\* MADE UP TO 20-50:1 (WATER:OIL)  
CUTTING OIL, TYPICALLY  
60-90% MINERAL OIL - 0% BACTERICIDE  
1-5% WATER 3-10% BACTERICIDE  
5-10% EMULSIFIER  
1-2% COOLING AGENT

PLANT # 3  
OPERATOR: McD-D  
DATE: 6-10-85

WASTE MINIMIZATION PROGRAM  
DATA SHEET

WASTE STREAM: S. WASTE MIXED SOLIDS

CHARACTERISTICS: MIXED HALOGENATED / NON-HALOGENATED SOLVENTS  
W/ 1 WATER OILS AND SOLIDS CONTENT  
SOLVENTS - 1,1,1 TRICHLOROETHANE, ACETONE, MILK, TOLUENE, DOUGLAS #2, NAPHTHA, BUTYL  
(ATTACH ANALYSIS IF AVAILABLE) (CELLUCOL)

SOURCE/MANAGEMENT: SOLVENTS GENERATED THROUGHOUT PLANT FROM  
DEGREASING, HAND CLEANING & COIL CLEANING OPERATIONS. SOLVENTS  
ARE COLLECTED IN DRUMS LOCATED THROUGHOUT PLANT. FILLED  
DRUMS ARE MOVED TO STORAGE AREA, AND TRANSPORTED IN BULK  
TO CHEMICAL RESOURCES FOR REUSE.

GENERATION 1. RATE: 5800 GAL  
2. FREQUENCY: CONSISTENTLY  
3. COST: \$ 830 (CRI RATES)

PROPOSED CHANGES: NONE

RAW MATERIAL DATA 1. CHARACTERISTICS: SEE ATTACHED  
2. QUANTITY: \_\_\_\_\_  
3. COST: \_\_\_\_\_

NOTES: 1. WASTES ARE NOT SEGREGATED

McDONNELL-DOUGLAS  
SOLVENT SUMMARY

<u>SOLVENT</u>	<u>PURCHASES (GAL)</u>	<u>COST (\$/GAL)</u>
1,1,1-TRICHLOROETHANE	11 220	3.97
BUTYL CELLULOSE	2970	2.78
ACETONE	11 74	2.50*
PERCHLOROETHYLENE	1027	3.56
DOUGLAS #2	523	2.00*
TOLUENE	478	2.50*
NAPHTHA	600	2.00*
WICK	452	2.00*

\* OBTAINED FROM OTHER SOURCES

PLANT # 3  
OPERATOR: MCD-D  
DATE: 6-10-85

WASTE MINIMIZATION PROGRAM  
DATA SHEET

WASTE STREAM: 9. WASTE PAINT SOLVENT

CHARACTERISTICS: 50% PAINT SOLIDS, 50% MIXED  
SOLVENTS - MEK, ACETONE, TOLUENE, XYLENE

(ATTACH ANALYSIS IF AVAILABLE)

SOURCE/MANAGEMENT: WASTE SOLVENT/PAINT MIXTURE GENERATED  
FROM PAINT BOOTH & SPRAY GUN CLEANING. WASTES COLLECTED IN  
DRUMS WHICH ARE TRANSFERRED TO STORAGE WHEN FULL. TRANSPORTED  
TO CWM FOR LANDFILL

NO SOLVENTS DISPOSED IN OVER A YEAR; AWAITING NEW  
CONTRACT WITH CWM

GENERATION      1. RATE: 120 DRUMS (6600 GAL)  
                    2. FREQUENCY: CONSISTENTLY  
                    3. COST: \$ 14660 (CWM RATES)

PROPOSED CHANGES: HAVE INVESTIGATED SOLVENT RECOVERY WITH  
KIMBALL CHEMICAL CO., WITH NO SUCCESS. STILL INTERESTED  
IN RECOVERY, BUT NO FURTHER INVESTIGATION

RAW MATERIAL DATA      1. CHARACTERISTICS: SEE ATTACHED DATA  
                                    2. QUANTITY: \_\_\_\_\_  
                                    3. COST: \_\_\_\_\_

NOTES: APPEARS TO BE SEGREGATED FROM HALOGENATED WASTES  
\_\_\_\_\_  
\_\_\_\_\_

PLANT # 3  
OPERATOR: MCD-D  
DATE: 6-10-85

WASTE MINIMIZATION PROGRAM  
DATA SHEET

WASTE STREAM: 10. PAINT SLUDGES

CHARACTERISTICS: WASTE PAINT SLUDGES - PAINT SOLIDS  
& WATER

(ATTACH ANALYSIS IF AVAILABLE)

SOURCE/MANAGEMENT: COLLECTED DURING WATERWALL SPRAY BOOTH  
CLEAN-UP. WATER DISCHARGED TO WWT PLANT. SLUDGES  
DRUMMED FOR DISPOSAL AT USPCI.

GENERATION 1. RATE: 30 DRUMS (1650 GALS)  
2. FREQUENCY: PERIODICALLY  
3. COST: \$1600 (USPCI COSTS)

PROPOSED CHANGES: NONE

RAW MATERIAL DATA 1. CHARACTERISTICS: N/A  
2. QUANTITY: \_\_\_\_\_  
3. COST: \_\_\_\_\_

NOTES: \_\_\_\_\_

PLANT # 3  
OPERATOR: MCD-13  
DATE: 6-10-85

WASTE MINIMIZATION PROGRAM  
DATA SHEET

WASTE STREAM: 11. WASTE SEALANT

CHARACTERISTICS: SOLIDIFIED EPOXY-TYPE SEALANT

(ATTACH ANALYSIS IF AVAILABLE)

SOURCE/MANAGEMENT: SEALANT IS USED FOR FUEL TANK FABRICATION.  
SOLIDIFIED SEALANT COLLECTED IN DRUM. DISPOSED AT USPCI.

GENERATION 1. RATE: 1 DRUM  
2. FREQUENCY: INFREQUENTLY  
3. COST: \$50 (USPCI RATES)

PROPOSED CHANGES: NONE

RAW MATERIAL DATA 1. CHARACTERISTICS: UNKNOWN  
2. QUANTITY: \_\_\_\_\_  
3. COST: \_\_\_\_\_

NOTES: \_\_\_\_\_

PLANT # 3  
OPERATOR: MCB-D  
DATE: 6-10-85

WASTE MINIMIZATION PROGRAM  
DATA SHEET

WASTE STREAM: 12. TITANIUM CHEM MILL WASTE

CHARACTERISTICS: WASTE BATH: 50% NITRIC ACID  
3% HF, 35-40 GF/L TITANIUM, PROPRIETARY MATERIALS  
EST NORMALITY = 12 eq/l  
(SEE ATTACHED) (ATTACH ANALYSIS IF AVAILABLE)

SOURCE/MANAGEMENT: ACID ETCH BATH IS USED TO MILL TITANIUM  
COMPONENTS. WHEN BATH REACHES SATURATION OF 35-40 GF/L Ti  
IT IS PUMPED FOR DISPOSAL. WASTE IS COLLECTED IN BULK,  
NEUTRALIZED AND DISPOSED BY DWE AT USPCI

GENERATION 1. RATE: 111,700 GAL  
2. FREQUENCY: PERIODICALLY  
3. COST: \$97,200

PROPOSED CHANGES: TREATMENT IN IWC SYSTEM

RAW MATERIAL DATA 1. CHARACTERISTICS: 50% NITRIC 3% HF PROPRIETARY MATERIALS  
2. QUANTITY: EST 120,000 GAL  
3. COST: UNKNOWN

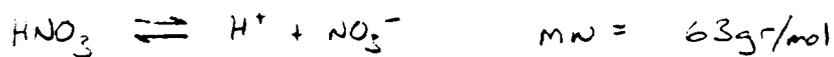
NOTES: 1. 12. TITANIUM CHEM MILL WASTE

TITLE:  
TITANIUM CHEM MILL CALC.

PROJECT NO.: 85-005  
PROJECT NAME: WMP

PAGE \_\_\_\_\_  
OF \_\_\_\_\_

NORMALITY CALCULATION



$$N_{\text{HNO}_3} = \frac{1.26 \text{ gr soln}}{\text{ml soln}} \times \frac{0.50}{1} \times \frac{1000 \text{ ml}}{\text{L}} \times \frac{\text{mol}}{63 \text{ gr}} \times \frac{1 \text{ eq}}{\text{mol}}$$

$$N_{\text{HNO}_3} = 10 \text{ eq/L}$$

$$N_{\text{HF}} = \frac{1.26 \text{ gr}}{\text{ml}} \times \frac{0.03}{1} \times \frac{1000 \text{ ml}}{\text{L}} \times \frac{\text{mol}}{20 \text{ gr}} \times \frac{1 \text{ eq}}{\text{mol}}$$

$$N_{\text{HF}} = 1.9 \text{ eq/L}$$

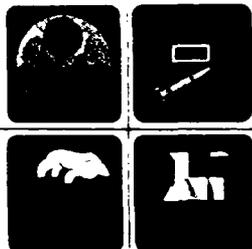
$$N = 11.9 \text{ eq/L}$$

BY  
DATE

CHECKED BY  
DATE

 The Earth Technology  
Corporation

**LANCY**  
International, Inc.



525 West New Castle St. • P.O. Box 490 • Zelienople, PA 16063  
Telephone (412) 452-9360 • Telex 86-6259

July 12, 1985

Earth Technologies  
3000 North Washington Street  
Suite 404  
Alexandria, Virginia 22314

Attention: Mr. Doug Hazelwood

Subject: Regeneration of Titanium Pickling Acid Solution

Dear Mr. Hazelwood:

As per our recent telephone conversations, Lancy is pleased to offer Earth Technologies technical information regarding the regeneration of titanium pickling acid solutions. The system that Lancy proposed is not a new system for the pickling of titanium but rather a system of regenerating the commonly used nitric-hydrofluoric acid solution. This particular system for the regeneration of used nitric-hydrofluoric titanium acid pickling solution is a development of Lancy International, Inc., for which patent applications have been applied, but as yet no patent has been granted. In view of this, any information we would reveal would have to be held in strict confidence to protect our know-how.

It is possible with Lancy's regeneration technique to maintain the titanium total concentration and also maintain the nitric-hydrofluoric acid at an optimum. The chemicals used for the regeneration technique are inexpensive and the titanium is removed in the regeneration as potassium titanium fluoride--a salable by-product.

The Lancy System for regeneration of the titanium pickling solution, as we propose, can be operated on a batch scale; but Lancy does foresee the possibility of using the regeneration technique on a continuous basis.

There are no problems in the efficiency of the regeneration regarding the build-up of minor metal constituents, such as nickel and iron, which may be present in the titanium alloys. These metals will not interfere with the precipitation of the titanium as potassium titanium fluoride.

Consider a typical case of treating a 3,500-gallon acid waste solution. Sample analyses show that the spent solution contained the following:

HNO <sub>3</sub> :	32.7 percent
HF:	11.46 percent
Ti:	35.5 gallons per liter

Earth Technologies  
Attention: Mr. Doug Hazelwood  
July 12, 1985

=====

After using the Lancy regeneration procedure, the following results were obtained:

HNO <sub>3</sub> :	29.6 percent
HF:	12.56 percent
Ti:	18.7 gallons per liter

The titanium reduction was 16.8 gallons per liter and the sludge produced contained 18 percent titanium which indicated that the dry sludge was composed of 97.2 percent titanium bifluoride.

The above Lancy regeneration procedure would use the following approximate chemical quantities and associated costs. Note that lab tests on an individual basis would confirm or deny the following quantities. These following numbers result from the above-mentioned process baths:

950 lbs of potassium chemical	@	\$430
2,000 lbs of sodium precipitant chemical	@	\$780
7000 lbs of hydrofluoric acid replenisher	@	\$450
10 gallons of inorganic stabilization agent	@	\$100
		<hr/>
Total chemical costs per 3,300 gallons:		\$1,760

I have attached a process flow schematic depicting what a typical system would entail. The equipment cost for the system as shown on the process schematic would be approximately \$70,000.

I trust this letter is sufficient for your needs. If you have any further questions, feel free to call at your convenience.

Yours very truly,

LANCY INTERNATIONAL, INC.



Robert J. Trach  
Applications Engineer - Western Region

cc:

Mr. J. Hall	Mr. F. Sassaman
Mr. T. Kolesar	Mr. F. Stevens
Mr. W. Melay	Mr. K. Warheit
Mr. B. Pehrson	Mr. T. Whalen

PLANT # 2  
OPERATOR: MJD-D  
DATE: 6-10-85

WASTE MINIMIZATION PROGRAM  
DATA SHEET

WASTE STREAM: 13. TITANIUM CHEM MILL SLUDGE

CHARACTERISTICS: CHEM MILL TANK SLUDGES - SOLIDS WATER  
TITANIUM PRECIPITANT, NITRIC ACID IF

(ATTACH ANALYSIS IF AVAILABLE)

SOURCE/MANAGEMENT: DURING CHEM MILL BATH REPLACEMENT SLUDGES  
ARE REMOVED AND PLACED IN DRUMS, DRUMS TRANSPORTED  
TO USPCI FOR LANDFILL.

GENERATION 1. RATE: 32 DRUMS (1760 GAL.)  
2. FREQUENCY: PERIODICALLY  
3. COST: \$1740 (USPCI RATES)

PROPOSED CHANGES: NONE

RAW MATERIAL DATA 1. CHARACTERISTICS: N/A  
2. QUANTITY: \_\_\_\_\_  
3. COST: \_\_\_\_\_

NOTES: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

PLANT # 3  
OPERATOR: RLD-D  
DATE: 4-0-85

WASTE MINIMIZATION PROGRAM  
DATA SHEET

WASTE STREAM: H. Aluminum Chemical Waste

CHARACTERISTICS: WASTE Sodium Hydroxide solution  
Sodium Aluminate, Sodium Sulfide & Solids

(ATTACH ANALYSIS IF AVAILABLE)

SOURCE/MANAGEMENT: Pumped from process tanks when bath  
is depleted. Transported in bulk to CRI for DWI

GENERATION

1. RATE: 12,700 GAL.
2. FREQUENCY: PERIODICALLY
3. COST: \$1920 (CRI RATE)

PROPOSED CHANGES: PLANNED TREATMENT IN BATCH TREATMENT  
SYSTEM PROPOSED WITH WWT REHAB. TREATMENT INCLUDES 1. NEUTRALIZATION  
AND SODIUM SULFIDE OXIDATION WITH HYDROGEN PEROXIDE OR.  
2.) REGENERATION BY TREATMENT WITH LIME WHICH PRODUCES CALCIUM ALUMINATE  
PRECIPITANT; CARBONATION WITH CO<sub>2</sub> TO REMOVE EXCESS LIME; AND  
WASHING TO REMOVE EXCESS CALSOL. RECLAIMED ETCHANT IS REUSED

RAW MATERIAL DATA

1. CHARACTERISTICS: NaOH, Na<sub>2</sub>S, NaO-Al<sub>2</sub>O<sub>3</sub>
2. QUANTITY: EST. 13,000 GAL
3. COST: \$2.18/GAL.

NOTES: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

PLANT # 3  
OPERATOR: MCD-D  
DATE: 6-10-85

WASTE MINIMIZATION PROGRAM  
DATA SHEET

WASTE STREAM: 15. SCALE CONDITIONER WASTE

CHARACTERISTICS: WASTE BATH - 50% Sodium Hydroxide  
2% Sodium Dichromate

(ATTACH ANALYSIS IF AVAILABLE)

SOURCE/MANAGEMENT: PUMPED FROM PROCESS TANKS WHEN BATH  
IS DEPLETED. TRANSPORTED IN BULK TO CRE FOR DWI

GENERATION 1. RATE: 2500 GAL  
2. FREQUENCY: PERIODICALLY  
3. COST: \$430 (CRE RATES)

PROPOSED CHANGES: PLANNED TREATMENT IN WWT SYSTEM. BATCH  
TREATMENT IN IWC SYSTEM FOLLOWED BY TREATMENT IN IWA SYSTEM  
TREATMENT WILL INCLUDE NEUTRALIZATION, CHROME REDUCTION &  
PRECIPITATION

RAW MATERIAL DATA 1. CHARACTERISTICS: UNKNOWN  
2. QUANTITY: \_\_\_\_\_  
3. COST: \_\_\_\_\_

NOTES: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

PLANT # 3  
OPERATOR: MCD-D  
DATE: 6-10-85

WASTE MINIMIZATION PROGRAM  
DATA SHEET

WASTE STREAM: 10. SCALE CONDITIONER SLUDGE

CHARACTERISTICS: PATH SLUDGES - SOLIDS, NaOH,  
SODIUM DICHROMATE, METAL HYDROXIDES

(ATTACH ANALYSIS IF AVAILABLE)

SOURCE/MANAGEMENT: DURING BATH CLEAN-OUT, SLUDGES ARE  
COLLECTED FROM PROCESS TANKS TO DRUMS, DRUMS  
TRANSPORTED TO USPCI FOR LANDFILL

GENERATION 1. RATE: 10 DRUMS (550 GAL)  
2. FREQUENCY: PERIODICALLY  
3. COST: \$530 (USPCI RATES)

PROPOSED CHANGES: NONE

RAW MATERIAL DATA 1. CHARACTERISTICS: N/A  
2. QUANTITY: \_\_\_\_\_  
3. COST: \_\_\_\_\_

NOTES: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

PLANT # 3  
OPERATOR: MCD-D  
DATE: 6-10-85

WASTE MINIMIZATION PROGRAM  
DATA SHEET

WASTE STREAM: T. NASTE ANODIZING BATHS

CHARACTERISTICS: ACIDIC WASTE COMPOSITION, TYPICALLY  
1-6 g/gal  $CrO_3$ ,  $H_2SO_4$  ACID, FERROUS CYANIDES

(ATTACH ANALYSIS IF AVAILABLE)

SOURCE/MANAGEMENT: ANODIZING, COATERS ON COAT/DESIGN OPERATIONS:  
DEF-UPOL BATHS ARE PUMPED FROM PROCESS TANKS, BULK  
TRANSFER TO CRT FOR DWI

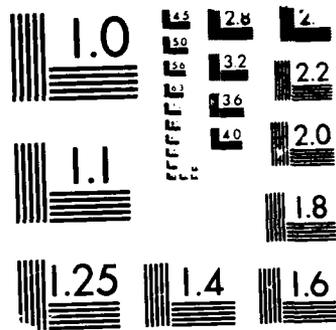
GENERATION 1. RATE: 300 GALS  
2. FREQUENCY: PERIODICALLY  
3. COST: 500 (CRT RATES)

PROPOSED CHANGES: TREATMENT IN BATCH CHEMICAL WASTE  
TREATMENT BATHS INVOLVING MIXING WITH NaOH, LINE  $SO_2$   
OR  $H_2O_2$  FOR REDUCTION OF  $Cr(VI)$ , NEUTRALIZATION.  
FINAL TREATMENT IN LWG SYSTEM

RAW MATERIAL DATA 1. CHARACTERISTICS: UNKNOWN  
2. QUANTITY: \_\_\_\_\_  
3. COST: \_\_\_\_\_

NOTES: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_





MICROCOPY RESOLUTION TEST CHART  
NATIONAL BUREAU OF STANDARDS 1963 A

PLANT # 3  
OPERATOR: MCD-D  
DATE: 6-10-85

WASTE MINIMIZATION PROGRAM  
DATA SHEET

WASTE STREAM: 20. WWT SLUDGE

CHARACTERISTICS: 2% SOLIDS SLUDGE WITH METAL PRECIPITANTS

(ATTACH ANALYSIS IF AVAILABLE)

SOURCE/MANAGEMENT: SLUDGE FROM CLARIFICATION SYSTEM IN WWT PLANT IS PUMPED TO SURFACE IMPOUNDMENT. EVAPORATION IS PRIMARY METHOD OF SLUDGE VOLUME REDUCTION.

GENERATION 1. RATE: 1.76 X 10<sup>6</sup> GAL [4700 CY DRY SOLIDS]  
2. FREQUENCY: CONTINUOUS  
3. COST: UNKNOWN

PROPOSED CHANGES: PLANNED ELIMINATION OF IMPOUNDMENTS, INSTALLATION OF DENATSENG SYSTEM WITH FILTRATION UNIT. SLUDGE PRODUCTION W.T. 25%+ SOLIDS

RAW MATERIAL DATA 1. CHARACTERISTICS: N/A  
2. QUANTITY: \_\_\_\_\_  
3. COST: \_\_\_\_\_

NOTES: 1. SLUDGE MAY BE DELISTED FROM RCRA REGS; DISPOSAL BY IN NON-HAZARDOUS INDUSTRIAL WASTE LANDFILL  
2. SLUDGE GENERATION MAY INCREASE AS A RESULT OF ADDITIONAL WASTE STREAMS.

PLANT # 3  
OPERATOR: MCD-D  
DATE: 6-10-85

WASTE MINIMIZATION PROGRAM  
DATA SHEET

WASTE STREAM: 21. TANK LINERS

CHARACTERISTICS: SYNTHETIC LINERS WITH SOME SLUDGE  
CONTAMINANTS

(ATTACH ANALYSIS IF AVAILABLE)

SOURCE/MANAGEMENT: REMOVED FROM TANKS DURING MAINTENANCE  
PROGRAM. VERY INFREQUENT

GENERATION 1. RATE: 4 DRUMS (220 GAL)  
2. FREQUENCY: INFREQUENT  
3. COST: \$210 (USPCI RATES)

PROPOSED CHANGES: NONE

RAW MATERIAL DATA 1. CHARACTERISTICS: N/A  
2. QUANTITY: \_\_\_\_\_  
3. COST: \_\_\_\_\_

NOTES: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

PLANT # 3  
OPERATOR: MCD-D  
DATE: 6-10-85

WASTE MINIMIZATION PROGRAM  
DATA SHEET

WASTE STREAM: 22. VIBRATING DEBURRER SLUDGE

CHARACTERISTICS: WASTE SLUDGE: METAL SOLIDS  
WATER GRINDING MEDIA

(ATTACH ANALYSIS IF AVAILABLE)

SOURCE/MANAGEMENT: PERIODIC CLEAN-OUT OF UNIT; DRUM WASTES  
ARE DRUMMED FOR TRANSPORT AND LANDFILL BY USPCI

GENERATION 1. RATE: 1 DRUM  
2. FREQUENCY: ANNUALLY  
3. COST: \$50

PROPOSED CHANGES: NONE

RAW MATERIAL DATA 1. CHARACTERISTICS: N/A  
2. QUANTITY: \_\_\_\_\_  
3. COST: \_\_\_\_\_

NOTES: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**APPENDIX C**

PLANT # 3  
OPERATOR: ROXWELL  
DATE: 6-11-85

WASTE MINIMIZATION PROGRAM  
DATA SHEET

WASTE STREAM: 1. PAINT BOOTH SUMP

CHARACTERISTICS: PAINT RESIDUES & WATER

(ATTACH ANALYSIS IF AVAILABLE)

SOURCE/MANAGEMENT: SKIPPED FROM PAINT SPRAY BOOTH  
WATER CURTAIN SUMP; ALSO FROM PERIODIC CLEANOUT  
OF SUMP.

STORED IN 55-GAL DRUMS; LANEFILLED BY  
LOCAL WASTE MANAGEMENT.

GENERATION 1. RATE: 38,160 GAL/YR  
2. FREQUENCY: CONSISTENTLY  
3. COST: \$69,500 (CWA: 10000)

PROPOSED CHANGES: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

RAW MATERIAL DATA 1. CHARACTERISTICS: \_\_\_\_\_  
2. QUANTITY: \_\_\_\_\_  
3. COST: \_\_\_\_\_

NOTES: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

PLANT # 3  
OPERATOR: K. W. L. L.  
DATE: 6-11-81

WASTE MINIMIZATION PROGRAM  
DATA SHEET

WASTE STREAM: 2. PAINT SOLVENTS & SLUDGES

CHARACTERISTICS: 85-95% MEK, SOLUBLE PIGMENTS  
AND OTHER SOLVENTS (SEE ATTACHED ANALYSES)

(ATTACH ANALYSIS IF AVAILABLE)

SOURCE/MANAGEMENT: MOST FROM CLEANUP OF PAINT GUNS  
COLLECTED IN 55-GALON DRUMS FOR LABELLING  
BY CHEM WASTE MANAGEMENT

- GENERATION
1. RATE: 131 DRUMS/YR (7,205 GAL)
  2. FREQUENCY: CONSISTENTLY
  3. COST: \$2,200 (CUM. RATE)

PROPOSED CHANGES: HYDROCARBON RECYCLERS IS EVALUATING  
POTENTIAL OFF-SITE RECYCLING. THIS IS BEING  
WORKING OUTSIDE FEE TO ABOUT \$35/DRUM.

- RAW MATERIAL DATA
1. CHARACTERISTICS: VIP, 11 MEK
  2. QUANTITY: \_\_\_\_\_
  3. COST: \$2.50/GAL (ETC ESTIMATED)

NOTES: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_



# Waste Management, Inc.

## GENERATOR'S WASTE MATERIAL PROFILE SHEET



WASTE PROFILE SHEET CODE  
E08628  
TSDR

**A GENERAL INFORMATION**

Generator Name: Rockwell International      Recertification of A79720  
 Facility Address: P.O. Box 532002      Transporter: CVI  
Tulsa, Oklahoma 74150      Transporter Phone: (405) 882-9789  
 Generator USEPA ID: OK 000 722 0 2 5 2  
 Generator State ID: OK72051  
 Technical Contact: Debra Sanders      Title: Environmental Spill      Phone: (918) 835-3111  
 Name of Waste: Waste Solvent and Paint Sludge  
 Process Generating Waste: Paint Booths - Equipment Cleaning

**B PHYSICAL CHARACTERISTICS OF WASTE**

<b>COLOR</b> Variable due to paint pigments.	<b>ODOR</b> <input type="checkbox"/> NONE <input type="checkbox"/> MILD <input checked="" type="checkbox"/> STRONG DESCRIBE: <u>Solvent</u>	<b>PHYSICAL STATE @ 70°F</b> <input type="checkbox"/> SOLID <input checked="" type="checkbox"/> SEMI-SOLID <input checked="" type="checkbox"/> LIQUID <input type="checkbox"/> POWDER	<b>LAYERS</b> <input checked="" type="checkbox"/> MULTILAYERED <input type="checkbox"/> BI-LAYERED <input type="checkbox"/> SINGLE PHASED	<b>FREE LIQUIDS</b> <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO VOLUME: <u>85-95</u>
<b>pH</b> <input type="checkbox"/> < 2 <input type="checkbox"/> 7.1-10 <input checked="" type="checkbox"/> N/A <input type="checkbox"/> 2-4 <input type="checkbox"/> 10.1-12.5 <input type="checkbox"/> 4.1-6.9 <input type="checkbox"/> > 12.5 <input type="checkbox"/> 7 <input type="checkbox"/> EXACT	<b>SPECIFIC GRAVITY</b> <input type="checkbox"/> < 8 <input type="checkbox"/> 1.3-1.4 <input checked="" type="checkbox"/> 8-1.0 <input type="checkbox"/> 1.5-1.7 <input type="checkbox"/> 1.1-1.2 <input type="checkbox"/> > 1.7 <input type="checkbox"/> EXACT	<b>FLASH POINT</b> <input checked="" type="checkbox"/> < 70°F <input type="checkbox"/> > 200°F <input type="checkbox"/> 70°F - 100°F <input type="checkbox"/> NO FLASH <input type="checkbox"/> CLOSED CUP <input type="checkbox"/> 101°F - 139°F <input type="checkbox"/> EXACT <input type="checkbox"/> OPEN CUP <input type="checkbox"/> 140°F - 200°F		

**C CHEMICAL COMPOSITION (TOTALS MUST ADD TO 100%)**

Methyl Ethyl Ketone	20%
Methyl Isobutyl ketone	2%
Naphtha	2%
Toluene	2%
Xylene	2%
Isopropyl Alcohol	2%
Urethane & Epoxy Solids	5-10%

**D METALS**     TOTAL (PPM)     EPA EXTRACTION PROCEDURE (mg/L)

ARSENIC (As)	0	SELENIUM (Se)	0
BARIUM (Ba)	0.05%	SILVER (Ag)	0
CADMIUM (Cd)	< 0.0002%	COPPER (Cu)	0.001%
CHROMIUM (Cr)	0.9%	NICKEL (Ni)	< 0.001%
MERCURY (Hg)	0	ZINC (Zn)	0.005%
LEAD (Pb)	0	THALLIUM (Tl)	0
CHROMIUM-HEX (Cr + 6)	0.8%		0.006%

**E OTHER COMPONENTS - TOTAL (PPM)**

CYANIDES	0.001%	PCBS	0
SULFIDES	0	PHENOLICS	0

**F SHIPPING INFORMATION**

DOT HAZARDOUS MATERIAL?  YES     NO  
 Proper Shipping Name: Waste Solvent, N.O.S.  
 Hazard Class: Flammable liquid    ID NO: NA1993    RG: None  
 Method of Shipment:  BULK LIQUID     BULK SOLID  
 DRUM (TYPE/SIZE): 55 gal.  
 Anticipated Volume: 70 GALS    OTHER: drums  
 PER:  ONE TIME     WEEK     MONTH  
 QUARTER     YEAR

**G HAZARDOUS CHARACTERISTICS**

Reactivity:  NONE     PYROPHORIC     SHOCK SENSITIVE  
 EXPLOSIVE     WATER REACTIVE     OTHER  
 Other Hazardous Characteristics:  
 NONE     RADIOACTIVE     ETIOLOGICAL  
 PESTICIDE MANUFACTURING WASTE     OTHER  
 USEPA HAZARDOUS WASTE?  YES     NO  
 USEPA HAZARDOUS CODE(S): U001    D007  
 STATE HAZARDOUS WASTE?  YES     NO  
 STATE CODE(S): 104607 (Oklahoma)

**H SPECIAL HANDLING INFORMATION**  
Flammable liquid - Avoid sources of ignition, do not inhale vapors.

I HEREBY CERTIFY THAT ALL INFORMATION SUBMITTED IN THIS AND ALL ATTACHED DOCUMENTS IS COMPLETE AND ACCURATE AND THAT ALL KNOWN OR SUSPECTED HAZARDS HAVE BEEN DISCLOSED

AUTHORIZED SIGNATURE: Debra Sanders      TITLE: Environmental Specialist      DATE: \_\_\_\_\_

PLANT # 3  
OPERATOR: ROBERTA  
DATE: 5-11-55

WASTE MINIMIZATION PROGRAM  
DATA SHEET

WASTE STREAM: 3. MACHINE TOOLING COOLANT

CHARACTERISTICS: OIL & WATER Mixture in 1:20 ratio  
includes in metal chips, most impurities, bacteria  
and fungi - waste has trace of @ 20-30%  
(ATTACH ANALYSIS IF AVAILABLE)

SOURCE/MANAGEMENT: COOLANT IS DERIVED BY PERIODIC FILLS  
OF THE MACHINE, INCLUDING DILLING & OTHER MACHINES  
AS THE 2 OR MORE OF THE MACHINES OR BEING  
MAINTAINED.  
COLLECTED IN PORTABLE VACUUM LEAKS, STORED IN  
TANK PROVIDED IN BACK OF MACHINE ROOMS  
BY THE AREA INTERCOM.

GENERATION 1. RATE: 18,450 GALS/YR  
2. FREQUENCY: CONSISTENTLY  
3. COST: \$5250/YR

PROPOSED CHANGES: None

RAW MATERIAL DATA 1. CHARACTERISTICS: Oil & Water  
2. QUANTITY: 18,450 GALS/YR  
3. COST: \$5250/YR

NOTES: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

PLANT # 3  
OPERATOR: POKWEEL  
DATE: 5-11-85

WASTE MINIMIZATION PROGRAM  
DATA SHEET

WASTE STREAM: Hydraulic Oils

CHARACTERISTICS: USED LUB OILS, ENGINE OILS  
HYDRAULIC OILS

(ATTACH ANALYSIS IF AVAILABLE)

SOURCE/MANAGEMENT: HYDRAULIC UNITS, METAL TOOLING  
MACHINERY AND VEHICLE MAINTENANCE.

COLLECTED WITH PORTABLE CONT; STORED IN BULK TANK;  
REMOVED BY AUTOMATIC RECYCLING.

- GENERATION
1. RATE: 12,300 GALLONS
  2. FREQUENCY: CONTINUOUS
  3. COST: 12.5% REVENUE

PROPOSED CHANGES: NONE

- RAW MATERIAL DATA
1. CHARACTERISTICS: \_\_\_\_\_
  2. QUANTITY: \_\_\_\_\_
  3. COST: \_\_\_\_\_

NOTES: \_\_\_\_\_

PLANT # 3  
OPERATOR: PAUL W. L.  
DATE: 11-15-85

WASTE MINIMIZATION PROGRAM  
DATA SHEET

WASTE STREAM: S. TR-1-102 SW-10

CHARACTERISTICS: SULFURIC ACID, SODIUM DICHLORATE  
PERCHLORIC ACID, ALUMINUM FLUORIDE

(ATTACH ANALYSIS IF AVAILABLE)

SOURCE/MANAGEMENT: FROM REPLACEMENT OF ALUMINUM  
ETCH UNIT.

REMOVED IN BULK BY SPECIAL RESOURCES AND  
DISPOSED BY UNDERGROUND INJECTION.

GENERATION 1. RATE: 21,000 GALS/YR  
2. FREQUENCY: INTERMITTENT  
3. COST: \$8700/YR (CR1 RATE)

PROPOSED CHANGES: RENOVATION OF WWT SYSTEM  
... (illegible) ...  
... (illegible) ...  
... (illegible) ...

RAW MATERIAL DATA 1. CHARACTERISTICS: \_\_\_\_\_  
2. QUANTITY: \_\_\_\_\_  
3. COST: \_\_\_\_\_

NOTES: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

PLANT # 3  
OPERATOR: FRANK  
DATE: \_\_\_\_\_

WASTE MINIMIZATION PROGRAM  
DATA SHEET

WASTE STREAM: WASTE FROM SODIUM

CHARACTERISTICS: HIGH PH, 40-100

(ATTACH ANALYSIS IF AVAILABLE)

SOURCE/MANAGEMENT: FROM WASTE TANK, PART OF  
WASTE TANK HOLDING TANK.

WASTE IN BACK BY CUP WASTE TANK  
WASTE TANK DISPOSED.

GENERATION 1. RATE: 15,000 GAL/YR  
2. FREQUENCY: ONCE A WEEK  
3. COST: \$30,960/YR

PROPOSED CHANGES: RECOVERY OF WWT SYSTEM  
WILL PROVIDE FOR NEUTRALIZATION WITH  
SULFURIC ACID AND CO<sub>2</sub> RECOVERY WITH  
H<sub>2</sub>O<sub>2</sub> RECOVERY BY BEING INTO IWG SYSTEM.

RAW MATERIAL DATA 1. CHARACTERISTICS: \_\_\_\_\_  
2. QUANTITY: \_\_\_\_\_  
3. COST: \_\_\_\_\_

NOTES: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

PLANT # 3  
OPERATOR: Rosen  
DATE: 2-55

WASTE MINIMIZATION PROGRAM  
DATA SHEET

WASTE STREAM: T. Sodium Hydroxide Sludge

CHARACTERISTICS: NaOH, NaCl, Hydroxide and  
Na<sub>2</sub>CO<sub>3</sub>

(ATTACH ANALYSIS IF AVAILABLE)

SOURCE/MANAGEMENT: FROM PERIODIC REMOVAL OF SPENT  
ALUMINUM ETCHANT

WASTE REMOVAL AND LINDI DISPOSAL BY  
CHINA LINDI WASTE TREATMENT IN LINDI FILL.

GENERATION 1. RATE: 16,000 GAL/YR  
2. FREQUENCY: MONTHLY  
3. COST: \$18,000/YR

PROPOSED CHANGES: REINTEGRATION OF WAST SYSTEM WITH  
WASTE SLUDGE STORAGE AND TREATMENT WITH LIME  
TO BE NEUTRALIZED AND DISPOSED INTO IWR SYSTEM

RAW MATERIAL DATA 1. CHARACTERISTICS:  
2. QUANTITY: 16,000 GAL/YR  
3. COST: \$2.13/GAL

NOTES:

PLANT # 3  
OPERATOR: K. ...  
DATE: ...

WASTE MINIMIZATION PROGRAM  
DATA SHEET

WASTE STREAM: 3.6 (2) ...

CHARACTERISTICS: \_\_\_\_\_  
\_\_\_\_\_

(ATTACH ANALYSIS IF AVAILABLE)

SOURCE/MANAGEMENT: UNKNOWN SOURCE,

STORED IN 55-GAL DRUM  
LANDFILLED BY CHEM WASTE MANAGEMENT

GENERATION 1. RATE: 55 GAL / WK  
2. FREQUENCY: ONE TIME ONLY  
3. COST: \$77

PROPOSED CHANGES: PROCESS NEVER TO BE  
GENERATED

RAW MATERIAL DATA 1. CHARACTERISTICS: \_\_\_\_\_  
2. QUANTITY: \_\_\_\_\_  
3. COST: \_\_\_\_\_

NOTES: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

PLANT # 3  
OPERATOR: ROCKWELL  
DATE: 6-11-85

WASTE MINIMIZATION PROGRAM  
DATA SHEET

WASTE STREAM: 2. NITRIC ACID

CHARACTERISTICS: STRONG NITRIC ACID

(ATTACH ANALYSIS IF AVAILABLE)

SOURCE/MANAGEMENT: UNKNOWN SOURCES IN  
BRIDGE SHOPS

GENERATION 1. RATE: 500 GAL/YR  
2. FREQUENCY: SPERMIC  
3. COST: \$200/YR

PROPOSED CHANGES: RENOVATION OF WWT SYSTEM  
SHOULD BECOME FOR USE OF WASTEWATER AS  
WATER REUSE

RAW MATERIAL DATA 1. CHARACTERISTICS: \_\_\_\_\_  
2. QUANTITY: \_\_\_\_\_  
3. COST: \_\_\_\_\_

NOTES: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

PLANT # 3  
OPERATOR: ROCKWELL  
DATE: 1-15-85

WASTE MINIMIZATION PROGRAM  
DATA SHEET

WASTE STREAM: 10. ALCOHOL WASTES

CHARACTERISTICS: ALCOHOL 1200 → STRONGLY ACIDIC,  
Cr<sup>6+</sup>, METALS, SOLIDS, COMPLEXED FERROCYANIDES  
PH 1.5 AT 2:1 TO 5:1 (WATER:KAWAUCHI)  
(ATTACH ANALYSIS IF AVAILABLE)

SOURCE/MANAGEMENT: FRAM REPLENISHMENT OF  
LITHTING BATTERIES.  
BULK TRANSPORT FOR LANDFILL BY CLEAN WASTE  
MANAGEMENT.

GENERATION 1. RATE: 7,000 GAL/YR  
2. FREQUENCY: INTERMITTENT  
3. COST: \$9,160/YR

PROPOSED CHANGES: TO BE TREATED IN REMOVED  
WASTEWATER SYSTEM. SO<sub>2</sub> TO REDUCE Cr<sup>6+</sup> TO Cr<sup>3+</sup> (POSS)  
OR LIME, BLEED TO WWS SYSTEM.

RAW MATERIAL DATA 1. CHARACTERISTICS: \_\_\_\_\_  
2. QUANTITY: \_\_\_\_\_  
3. COST: \_\_\_\_\_

NOTES: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

PLANT # 3  
OPERATOR: ROCKWELL  
DATE: 2-11-85

WASTE MINIMIZATION PROGRAM  
DATA SHEET

WASTE STREAM: 11. PHENOLIC RESIN

CHARACTERISTICS: VISCOUS RESIN

(ATTACH ANALYSIS IF AVAILABLE)

SOURCE/MANAGEMENT: PAINTED IN 55-GAL DRUMS  
FOR LANDFILL BY CHEM WASTE MANAGEMENT CO.

- GENERATION
- 1. RATE: 255 GAL/YR
  - 2. FREQUENCY: VERY SPORADIC
  - 3. COST: \$540/YR

PROPOSED CHANGES:

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- RAW MATERIAL DATA
- 1. CHARACTERISTICS: \_\_\_\_\_
  - 2. QUANTITY: \_\_\_\_\_
  - 3. COST: \_\_\_\_\_

NOTES:

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PLANT # 3  
OPERATOR: ROCKWELL  
DATE: 6-11-55

WASTE MINIMIZATION PROGRAM  
DATA SHEET

WASTE STREAM: 12. EPOXY POTLINE (CONTAMINATED)

CHARACTERISTICS: WASTE EPOXY FROM  
SPRINKLE OPERATIONS

(ATTACH ANALYSIS IF AVAILABLE)

SOURCE/MANAGEMENT: STORED IN 55 GAL DRUMS  
FOR LANDFILLING BY CHEM WASTE MANAGERS.

GENERATION 1. RATE: 110 GPM/HR  
2. FREQUENCY: INTERMITTENT  
3. COST: \$200/HR

PROPOSED CHANGES: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

RAW MATERIAL DATA 1. CHARACTERISTICS: \_\_\_\_\_  
2. QUANTITY: \_\_\_\_\_  
3. COST: \_\_\_\_\_

NOTES: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

PLANT # 3  
OPERATOR: K. K. WELLS  
DATE: 6-1-65

WASTE MINIMIZATION PROGRAM  
DATA SHEET

WASTE STREAM: 13. TRANK SLAGS

CHARACTERISTICS: AQUEOUS SLUDGE, LOW PH  
Cr+6, Ni+2, SOLIDS, COMPLEX PERIOD-ORGANICS

(ATTACH ANALYSIS IF AVAILABLE)

SOURCE/MANAGEMENT: FROM CLEANSING OF ANODIZING  
BATHS (PERIODIC FLUORINE ADD)  
WASTE DISPOSED IN LANDFILL BY LOCAL WASTE  
MANAGEMENT.

GENERATION 1. RATE: 15,000 GALLONS  
2. FREQUENCY: PERIODIC  
3. COST: \$30,000 PER YEAR

PROPOSED CHANGES: TO BE HANDLED IN 30 GALLON  
WAST SYSTEM. REVISION OF 1964-65  
WITH SOLID OIL HOLE REVISIONS  
40 GALLON WITH CRUSTY TANK LINE, WASTE  
TO 100 G GALLONS.

RAW MATERIAL DATA 1. CHARACTERISTICS: \_\_\_\_\_  
2. QUANTITY: \_\_\_\_\_  
3. COST: \_\_\_\_\_

NOTES: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**APPENDIX D**

RFP #:  
PROJECT: AFP #3 Rockwell's Recirculating  
NC Machines Cooling Water Systems  
PROGRAM: Water Conservation  
AUTHORIZATION: DSR-0241 For USAF/MDC  
DOCUMENT: Project Scope of Work & Preliminary  
Design Analysis

2575-321  
2575-321  
2575-321  
2575-321  
2575-321  
2575-321

### PROJECT DESCRIPTION

Considerable volumes of water are used annually "as one pass coolant" for Rockwell International's N/C Machine Shop Area's. On the average over 136,000,000 gallons per year are used for machine cooling in B001. The conservation program described in this proposal should reduce water usage by 120,000,000 gallons per year by installing a closed loop Heat Rejection System.

Two major areas require machine cooling which are separated by a considerable distance therefore, two separate systems have been proposed. This approach reduces the required amount of horsepower and piping cost.

Both systems would be similar in design. They are closed loop cooling systems with only water losses from evaporation and maintenance flushing. Per attached sketches System ST-858 will serve 24 N/C Machines located between columns 14-30 and L-M. System ST 859 will serve the large Hydrapress, and the large and small Sheridan Gray stretch presses, all located between columns 40-42 and G-J.

### DESIGN REQUIREMENTS

Design criteria for this proposal was established from past usage, using August as our high demand month. With usage during August, being about 15,500,000 gallons for a 26½ day month for two shifts, it was determined that a flow rate of 610 G.P.M., providing 15°F delta and would be required to provide proper cooling. Since these peak requirements occur over a minimum period, two 350 G.P.M. Systems are proposed in ST-858 so only 18 H.P. would be on line most of the time. In addition the two draw through coolant units would be specified to be two speed fan systems to save additional energy.

System ST-859 will only be on line during the actual use of the large Hydrapress with only the circulating pumps on line when the stretch presses are in use. Consequently 9 horsepower will be "on" during the use of the large press and 1½ horsepower for the stretch presses. This system would be sized for a flow rate of 130 G.P.M.

Both systems are designed for an additional heat exchanger load; 15% for ST-859 and 20% for ST-858. Both systems would be designed to maintain the hydraulic oil below 115°F with 90°F return water to the surge tank. Since these systems are located inside B-001, coolant spray water should seldom exceed 75°F.

#### GENERAL DISCUSSION

Rockwell will provide the required engineering analysis and construction documents. The major portion of the work will be performed using an outside contractor.

Rockwell's "Plant Services" (D0986) will relocate any secondary utilities prior to installation. In addition Plant Services will make the final supply and return water connection to the new piping loop systems so that machine down time can be scheduled around manufacturing. During installation Rockwell will set the equipment using the B001 Bridge Cranes.

P.M.'s for all three Heat Rejection Units will be developed, scheduled and performed through Rockwell's Plant Services Department. This will include cleaning, flushing, adding chemicals, screen cleaning and other maintenance.

The H.R.U.'s proposed are not designed for external down stream exhaust air resistance. However, a ducted exhaust with automatic louvers could be installed on the ST-858 system in the future with booster fans. They were not included in this cost estimate proposal. ST-859 has to exhaust into B-001. However, as indicated above the systems have been staged for automatic seasonal and temperature adjustments in order to conserve as much electrical energy as possible.

#### PRELIMINARY JUSTIFICATION

The Tulsa Metropolitan area has experienced water shortages due to seasonal drought like weather conditions and inadequate municipal supply and distribution systems. City water rationing plans have been imposed in the past, during extremely dry weather. Water and Sewer rates were doubled during 1981. The cost of water is now approximately \$0.82/1000 gals. Approximately 400,000 gals/day of one pass water (uncontaminated) is used to cool NC Machines in Rockwell's Machine Shop in Building One at Air Force Plant No. #3. This represents about 40% of Air Force Plant No. 3's total water consumption. Annually, the metered flow through outfall 004 (where this cooling water is discharged) runs about  $136 \times 10^6$  gallons.

At a cost of \$0.82/1000 gals., with 90% recirculation the annual savings will be over \$100,000. It is anticipated that unit cost for water will continue to rise.

Drought conditions also reflect in our electrical utility rates, since the Tulsa area is tied into electrical hydropower. Seasonal rates are adjusted lower when we are tied to the hydro system. Consequently AFP #3 electrical rates vary from 2.9 cents per KW to just under 4 cents per KW. For the purpose of this "Water Conservation" program an electrical cost 3.5 cents per KW has been used.

Again it might be pointed out that 26½ working days per month with two eight hour shifts per day has been assumed as a basic work year. Electrical energy costs for operating these systems have been projected to be:

SYSTEM ST-858

During the time the system has been projected to have 18 horsepower on line (eight months) \$200-/Mo. \$1,600-/Yr.

During the time the system has been projected to have 36 horsepower on line (four months) \$400-/Mo. \$1,600-/Yr. Yearly estimated electrical cost \$3,200-/Yr.

SYSTEM ST-859

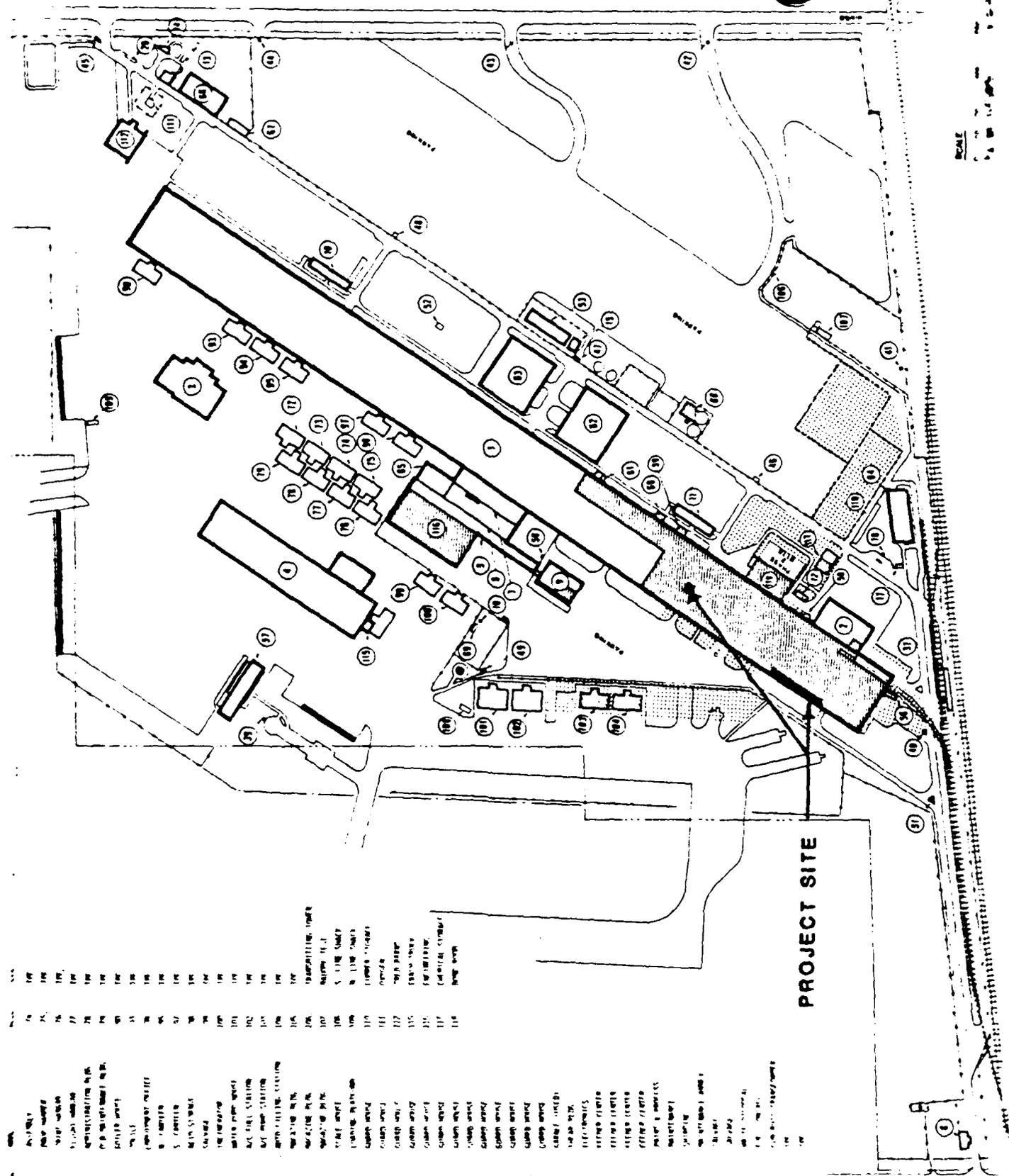
This system projected to have 9 horsepower on line all 12 months \$100-/Mo. \$1,200-/Yr.

Total projected yearly electrical costs \$4,400-/Yr.

Considering the other costs such as maintenance, chemicals, etc.; the projected utility cost savings will still be over \$95,000.00 annually.

IMPLEMENTATION

Completion of this project should be by the end of calander year '83'. And a project schedule has been included as part of this proposal. Since there are only a few secondary utilities lines to relocate, very little site preparation and only four weeks delivery on long lead items, implementation should proceed without any major problems.



SCALE  
1" = 100'

PROJECT AREA AREA: 29,743  
DATE: 11/1/83

- |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 101 | 102 | 103 | 104 | 105 | 106 | 107 | 108 | 109 | 110 | 111 | 112 | 113 | 114 | 115 | 116 | 117 | 118 | 119 | 120 | 121 | 122 | 123 | 124 | 125 | 126 | 127 | 128 | 129 | 130 | 131 | 132 | 133 | 134 | 135 | 136 | 137 | 138 | 139 | 140 | 141 | 142 | 143 | 144 | 145 | 146 | 147 | 148 | 149 | 150 | 151 | 152 | 153 | 154 | 155 | 156 | 157 | 158 | 159 | 160 | 161 | 162 | 163 | 164 | 165 | 166 | 167 | 168 | 169 | 170 | 171 | 172 | 173 | 174 | 175 | 176 | 177 | 178 | 179 | 180 | 181 | 182 | 183 | 184 | 185 | 186 | 187 | 188 | 189 | 190 | 191 | 192 | 193 | 194 | 195 | 196 | 197 | 198 | 199 | 200 |
| 101 | 102 | 103 | 104 | 105 | 106 | 107 | 108 | 109 | 110 | 111 | 112 | 113 | 114 | 115 | 116 | 117 | 118 | 119 | 120 | 121 | 122 | 123 | 124 | 125 | 126 | 127 | 128 | 129 | 130 | 131 | 132 | 133 | 134 | 135 | 136 | 137 | 138 | 139 | 140 | 141 | 142 | 143 | 144 | 145 | 146 | 147 | 148 | 149 | 150 | 151 | 152 | 153 | 154 | 155 | 156 | 157 | 158 | 159 | 160 | 161 | 162 | 163 | 164 | 165 | 166 | 167 | 168 | 169 | 170 | 171 | 172 | 173 | 174 | 175 | 176 | 177 | 178 | 179 | 180 | 181 | 182 | 183 | 184 | 185 | 186 | 187 | 188 | 189 | 190 | 191 | 192 | 193 | 194 | 195 | 196 | 197 | 198 | 199 | 200 |
| 101 | 102 | 103 | 104 | 105 | 106 | 107 | 108 | 109 | 110 | 111 | 112 | 113 | 114 | 115 | 116 | 117 | 118 | 119 | 120 | 121 | 122 | 123 | 124 | 125 | 126 | 127 | 128 | 129 | 130 | 131 | 132 | 133 | 134 | 135 | 136 | 137 | 138 | 139 | 140 | 141 | 142 | 143 | 144 | 145 | 146 | 147 | 148 | 149 | 150 | 151 | 152 | 153 | 154 | 155 | 156 | 157 | 158 | 159 | 160 | 161 | 162 | 163 | 164 | 165 | 166 | 167 | 168 | 169 | 170 | 171 | 172 | 173 | 174 | 175 | 176 | 177 | 178 | 179 | 180 | 181 | 182 | 183 | 184 | 185 | 186 | 187 | 188 | 189 | 190 | 191 | 192 | 193 | 194 | 195 | 196 | 197 | 198 | 199 | 200 |

PROJECT SITE



ROCKWELL INTERNATIONAL  
TULSA DIVISION  
TULSA, OKLAHOMA

ENGINEERING SPECIFICATION

NO. ST-860

DATED MARCH 21, 1983

FOR

WATER CONSERVATION PROJECT

N C MACHINE SHOP

AIR FORCE PLANT NO. 3  
B-001 ROCKWELL FACILITIES

PREPARED BY:

J. E. Bradshaw  
J.E. Bradshaw  
Senior Facilities  
Design Engineer

APPROVED BY:

D.P. Phillips  
D.P. Phillips, Supervisor  
Facilities Design

D.A. Sanders  
D. A. Sanders  
Facilities Environmental  
Control Specialist

ENGINEERING SPECIFICATION NO. ST-860

INDEX

SECTION I	SCOPE OF WORK
SECTION II	STATEMENT OF SERVICES
SECTION III	BASIS FOR DESIGN
SECTION IV	GENERAL REQUIREMENTS
SECTION V	DESIGN ANALYSIS
SECTION VI	DRAWINGS
SECTION VII	COST ESTIMATES
SECTION VIII	SPECIAL CONFERENCES
SECTION IX	ON BOARD REVIEW
SECTION X	DESIGN CONSTRUCTION MODIFICATIONS

## SECTION I

### 1.0 SCOPE OF WORK

- 1.1 Rockwell International Facilities Engineering will perform all works described in this specification under A&E. The water conservation systems are to be acceptable to the U.S. Air Force, the Government Controlling Agencies and the prime facility lessor McDonnell Douglas Corporation. To accomplish this the A & E will provide construction drawings, specifications and design analysis for review.
- 1.2 Rockwell will provide a Project Engineer/Contract Coordinator during the construction phase of the project.
- 1.3 Rockwell's Plant Services Department will relocate any necessary utilities. In addition Plant Services will make all final plumbing connections to the NC Machines in order to schedule machine shutdown with manufacturing.

## SECTION II

### 2.0 STATEMENT OF SERVICES

2.1 The A & E will perform the following Title I-A and I-B services:

- A. Determine the location and size of existing utility systems as related to this project.
- B. Provide construction drawings and specification documents for bid.
- C. Provide design basis as required.
- D. Provide engineering data and conduct contractor job walk.
- E. Prepare cost estimates.

2.2 The A & E will perform the following Title II services:

- A. Provide consultation and interpretation of the construction bid data.
- B. Establish and conduct weekly review as construction proceeds.
- C. Construction inspection and site surveillance to verify construction procedures in accordance with the construction data.
- D. Any contract changes will be directed by Rockwells Project Manager.
- E. Revise any construction documents to "As Build" drawings.
- F. Rockwell will organize, schedule and chair job contract review meetings during the construction phase, with all key contractors as required.
- G. Administer any necessary contract changes required during the construction period of the contract.

## SECTION III

### 3.0 BASIS FOR DESIGN

- 3.1 Rockwell will provide all design documents in conformance with Air Force Regulation (AFR) 78-22, dated 26 July, 1976 and with applicable portions of the following:
  - A. All current local and national codes, regulations and specification involving structural, mechanical and electrical disciplines and associated crafts.
  - B. Project and/or job description and special design criteria.
- 3.2 Rockwell will limit the scope of the design in order to keep the construction costs within the projected costs. Any cost effective alternatives which might require additional funding will be brought to attention of all involved parties so that the proper funding agency can be advised.
- 3.3 The design possibilities will not be restrictive, so that several manufactures and contractors will be able to meet design criteria.

## SECTION IV

### 4.0 GENERAL REQUIREMENTS

- 4.1 Project Engineer will serve as the single point of contact for all work under Section I of these specification. All contacts pertaining to the technical development of the design will be coordinated with Rockwell's Project Engineer.
- 4.2 Rockwell will prepare written records of all meetings, discussion, site investigation and other directions related to this contract. These discussions will be titled "Confirmation Notice", numbered, dated, discussed subjects, conclusions and decision.
- 4.3 A "Pre-Design Development Conference" will be tabled and scheduled by Rockwell's Project Engineer.
- 4.4 Rockwells Project Engineer will be responsible for the technical accuracy and coordination of all designs, drawings and specifications furnished by Rockwell.
- 4.5 Rockwell will identify any long-lead items required to complete this contract. All necessary parties will be advised, at the "Pre-Design Development Conference", for review and approval, subject to the time schedule.

## SECTION V

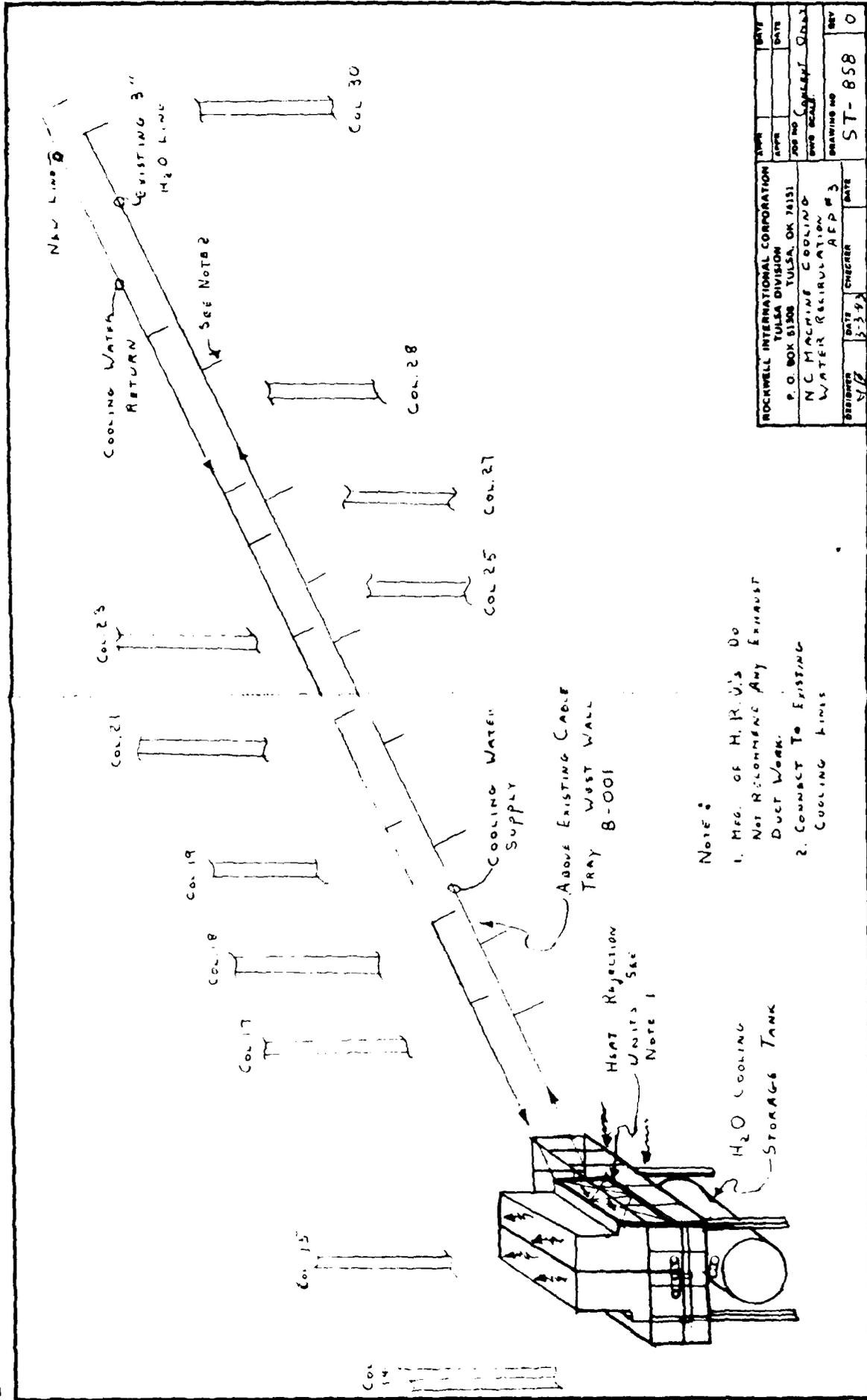
### 5.0 DESIGN ANALYSIS

- 5.1 Overall design criteria should not seriously deviate from the specified requirements.
- 5.2 The systems should incorporate all 'Energy Management Control Methods', as much as possible.
- 5.3 Justification analysis and cost information which was used as criteria to support design requirements will become a part of the preliminary package designated "Preliminary Design Analysis".

## SECTION VI

### 6.0 DRAWINGS

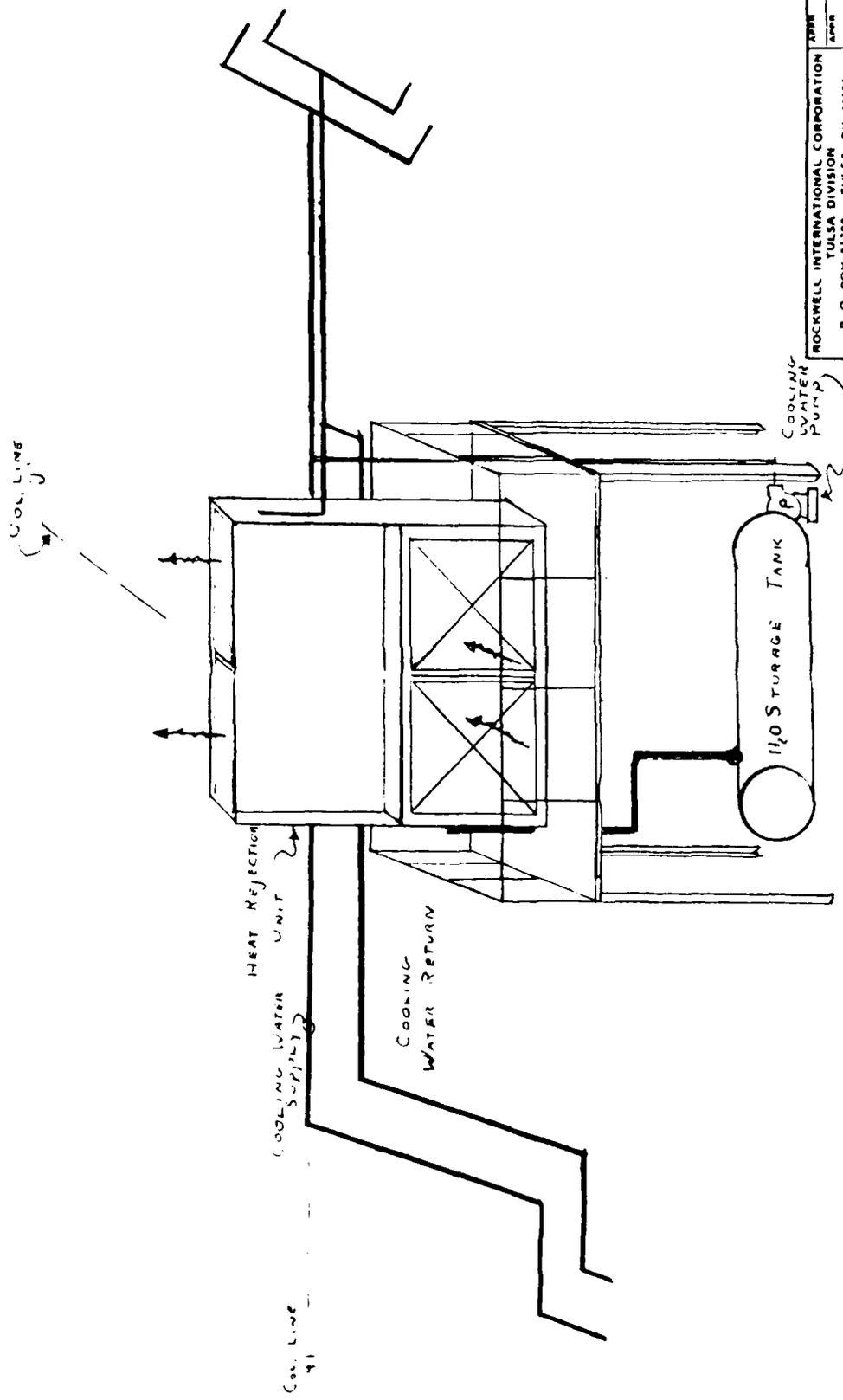
- 6.1 All final drawings and other data submitted for review will be dated and prepared on 28" x 40" sheets unless directed otherwise.
- 6.2 All preliminary drawings will be of sufficient detail to serve as adequate for a 50% review.
- 6.3 Construction drawings will be based upon preliminary drawings and incorporate all data approved upon at the 50% review.
- 6.4 Drawings required:
  - A. Existing Floor Plan
  - B. Existing Secondary Utility
  - C. Structural Layouts and Details
  - D. Mechanical Layouts
  - E. Electrical Layouts



**Note:**

1. Mfg. of H.R.U.'s Do Not Recommend Any Exhaust Duct Work.
2. Connect To Existing Cooling Lines

ROCKWELL INTERNATIONAL CORPORATION		TYPE	DATE
TULSA DIVISION		APP	DATE
P. O. BOX 51308 TULSA, OK 74131		JOB NO	CONTRACT
N.C. MACHINE COOLING		DRWG NO	REV
WATER REGULATION AEP # 3		DRAWING NO	REV
DESIGNED BY	DATE	ENGINEER	DATE
5/2	5-3-94		
		DRAWING NO	REV
		ST-858	0



ROCKWELL INTERNATIONAL CORPORATION		APPN	DATE
TULSA DIVISION		APPN	DATE
P. O. BOX 31308 TULSA, OK 74151		JOB NO	CONCEPT
MACHINE COOLING		DESIGN SCALE	
WATER RECIRCULATION UNIT		DRAWING NO	ST-859
DESIGNER	DATE	CHECKER	DATE
	1/15		
		REV	0

FORM NO 1008 10 IVEILLUMI REV 11 67

## SECTION VII

### 7.0 COST ESTIMATES

- 7.1 Initial cost estimates will be prepared using prevailing labor and material costs from measures and quantities to establish a completed project cost.
- 7.2 Final cost estimates will be a complete and quantitative breakdown of all materials and items of work necessary to complete the project. Each trade and items of cost will be listed separately so they can be evaluated.

COST ESTIMATE SUMMARY SHEET

PROJECT: B-001 Outfall 004

DATE: 3-5-83

ENGINEER: J. E. Bradshaw

I. CONSTRUCTION

Site Work	\$	-
Mechanical		45,250
Electrical		3,650*
Structural		5,350
Roofing		-
Wall & Partitions		-
Door & Hardware		-
Painting		1,750
Plumbing		17,150
Fire Protection		-
Demolition		250
Other D-986		950
60 Hrs. @ 16/HR		

Subtotal	\$	74,350
Fee on Subcontracts *		365
General Fee		6,160

TOTAL COST ESTIMATE - CONSTRUCTION \$ 80,875

II. A&E SERVICES

Title 1-A	\$	-
Title 1-B		-
Title II		-

TOTAL A&E \$ -0-

III. ROCKWELL DESIGN

<u>120 hrs. @ \$ 19.60</u>		<u>2,350</u>
<u>Rockwell Project Management</u>		
<u>40 hrs. @ \$ 19.60</u>	Eng.	<u>785</u>
<u>16 hrs. @ \$ 21.80</u>	Manager	<u>350</u>
<u>176 hrs. @ \$ 23.60</u>	Overhead	<u>4,155</u>
	Travel	<u>-</u>

TOTAL I - III \$ 7,640

IV. ROCKWELL G&A

5.0% of \$88,515 \$ 4,485

PROJECT TOTAL \$ 93,000

## SECTION VIII

### 8.0 SPECIAL CONFERENCES

- 8.1 During the period between the preliminary and the final submittal, that the Statement of Work cannot be followed i.e. discrepancies, excessive costs, alternate proposals, etc., then Rockwell will request a conference with all necessary parties so the problem can be resolved.

SECTION IX

9.0 ON-BOARD REVIEW

- 9.1 Scheduled reviews will be made by Rockwell's Project Engineer. All reviews will be scheduled and involved parties will be notified.

SECTION X

10.0 RE-DESIGN & CONSTRUCTION CHANGES

- 10.1 Rockwell will correct all errors, omissions and inconsistencies in the Final Documents. Such corrections shall consist of revisions to the drawings and/or specifications.
- 10.2 If change orders or new cost estimates are required then these changes must be approved by Rockwell's designated manager.

ENVID

DATE

FILMED

5-88

Dtjc