Metal Plating and Finishing Industry
Project Feasibility Overview

The purpose of this overview is to present the results of a feasibility study that has led to Department of Toxic Substances Control (DTSC) decision to develop a specific Pollution Prevention (P2) program that targets Hexavalent Chrome (Cr-6) and Cyanide waste streams in the metal plating and finishing industry throughout California.

This overview summarizes the metal plating and finishing industry's Cyanide and Cr-6 wastes and emissions with alternatives, advantages, disadvantages to these specific waste streams, goals for the project, reasons to development and implement a P2 outreach program.

Although Cr-6 and Cyanide are the parts being studied for P2, other aspects of metal finishing and plating cannot be over looked in the P2 process. Those parts include housekeeping, monitoring, additives, equipment modification, and on-site recycling and recovery, along with various other aspects. Other P2 options for plating specific metals such as: brass, cadmium, chromium, copper, nickel, precious metals, and zinc should be included along with additional types of plating processes, such as: electroless, aluminum, chemical and electrical conversion.

Other organizations, such as the National Metal Finishing Strategic Goals Program (SPG) have performance goals that reduce water consumption by 50 percent, energy by 25 percent, land disposal of hazardous waste by 50 percent, metals emissions to water by 50 percent, TRI emissions by 90 percent, and human exposure to toxic chemicals with increasing metals utilization by 90 percent. This organization is designed to help companies achieve their goals for both environmental and economic by giving free environmental audits, on-site assistance, and Environmental Management Systems (EMS) training.

To develop a successful P2 program, such as the SGP, more information gathering on P2 options, technologies, innovative equipment, plating processes, including site visits are needed before the Office of Pollution Prevention and Technology Development (OPPTD) personnel can ultimately become experts and trainers in this field.

Feasibility study is organized as follows:

1. Industry Background
2. Cr-6 Wastes
3. Cr-6 P2 Alternatives
4. Cr-6 Goals
5. Cyanide Wastes
6. Cyanide Alternatives
7. Cyanide Goals
8. Sources
9. P2 options
10. Potential partners
11. Expected outcomes and measurement
12. Basis of decision to go forward

1. Industry Background

The metal plating and finishing industry falls under the Standard Industrial Code (SIC) 3471.

- In California, there is a total of 876 facilities that are listed under SIC 3471.
- In Los Angeles County there are 403 metal finishers comprising 46 percent of the State's total.
- In the five counties of the Los Angeles basin, there are 590 metal finishers comprising 67 percent of the State's total.
- The San Francisco bay area counties have 143 facilities comprising 16 percent of the State's total.
- San Diego, with its 61 facilities comprises 7 percent of the State's total.
- The entire valley region has only 38 facilities and comprising only 4 percent of the State's total.

Of the top sixteen Cr-6 waste generators (see Table I) eleven are located in the Los Angeles basin, two are located in the Central Valley, two are located in the San Francisco Bay area, and one is located in San Diego County.

2. Cr-6 Waste

One of the largest waste streams generated in metal finishing is liquids containing various metals. This waste is generated in the plating process from spent plating baths and aqueous rinses. Air emissions from the baths and liquid wastes containing hexavalent chromium (Cr-6) are of great concern because of the negative health effects from exposure to Cr-6. The hexavalent form of chromium is highly toxic and strongly suspected of causing lung cancer. Trivalent chromium (Cr-3) is an alternative for the manufacturing of some products. However, the perception is that for some products, Cr-3 is not a good substitute and only Cr-6 plating will do. These products are generally known as hard chrome (or functional) and decorative chrome. For example, in making some machinery parts that must have a very hard surface, the long accepted industry practice is that Cr-6 will meet the needs, but Cr-3 or other alternatives will not. For decorative surface finishes, such as car bumpers, the accepted past industry practice has been to use Cr-6 and nothing else will do. Most emissions from chromium electroplating and chromium anodizing baths are found in the fine mists formed by the process.

Volume of Cr-6 Waste Generated Based on Manifests

There were a total of 157 generators that shipped over 716.45 tons of Cr-6 (723 - LIQUIDS WITH CHROMIUM (VI) >= 500 MG/L) waste in 2002.

a) The top generator in 2002 shipped over nineteen (19) percent of Cr-6 waste
b) The top ten (10) generators shipped over sixty-five (65) percent of Cr-6 waste, &
c) The top sixteen (16) generators shipped seventy-three (73) percent of all the 723 waste generated by California generators.

Listed in Table I below are the top sixteen (16) California generators of 157 total generators that shipped Cr-6 waste (723 - LIQUIDS WITH CHROMIUM (VI) >= 500 MG/L) from 1995 through 2002.

<Table I>

EPA ID	Company Name	Tons 2002	Tons 2001	Tons 2000	Tons 1999	Tons 1998	Tons 1997	Tons 1996	Tons 1995
CAD981377260	DV INDUSTRIES INC	132.61	70.47	200.16	40.87	58.80	87.99	228.31	62.34
CAD118352921	CALIFORNIA STEEL INDUST.. INC	49.72	30.44	30.86	76.28	10.38	7.51	8.76	7.78
CA8170090023	US MARINE CORPS LOG BASE	48.03	29.02	32.65	21.71	29.00	36.42	2.52	13.61
CAD008324055	ROHR INC A SUB OF GOODRICH	44.95	138.64	74.15	28.28	15.59	22.26	41.93	39.19
CAL000122699	SHEFFIELD PLATERS, INC.	39.52	22.87	11.23	2.06				
CAD982400731	PERFECTION PLATING	33.36							
CAR000088443	GENE'S PLATING WORKS	21.39	10.43						
CA0000146068	ENDEVCO CORPORATION	20.47	176.39						0.04
CAD009116211	ELECTRO-COATINGS OF CALIFORNIA INC	19.06	38.18	75.75	67.20	78.54	69.83	12.97	22.62
CAD009125535	LOCKHEED MARTIN SPACE Sys	18.97	24.06	0.01		46.29	0.02	135.60	15.01
CAD066233834	MONITOR POLISHING & PLATING	16.68		1.58					
CAD077264737	GENE'S PLATING WORKS INC	15.60	25.85	40.03	10.01	32.53	29.92		
CAD008304594	K & L ANODIZING CORP	14.60	41.70	32.11					
CAD008302002	ARROWHEAD PRODUCTS CORP	12.93	6.67	8.34		5.21	5.00	5.42	
CAD981369408	ELECTRONIC PRECISION SPEC INC	11.47					1.29	3.72	1.15
CAC002344711	URO CAST	11.20							
Tonnage for top 16 California generators of 2002 thru 1995		510.55	892.40	1147.8	957.83	990.11	950.53	1246.97	761.95
Percent of tonnage per year for top 16 California generators		73.04	64.47	63.16	65.32	59.93	58.71	66.38	55.59
Total number of generators/year in HWTS database		166	249	284	288	258	250	259	299

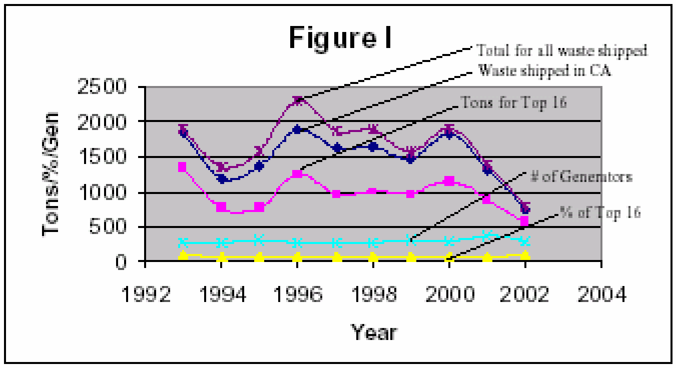
Listed in Table II are the top sixteen (16) California generators of Cr-6 waste from 1993 though 2002. The volume of Cr-6 waste by generators has diminished in 2002 as have the number of large generators. The number of all generators has reduce to 55 percent from the overall average of generators from the previous nine years and the total tons of Cr-6 waste generated have drop to less than 44 percent of the total waste when compared to the overall average of the previous nine years. The total tons of Cr-6 waste generated by the top California generators have drop to less than 47 percent of the total waste when compared to the overall average of the previous nine years.

While the number of generators and their Cr-6 waste totals have decreased, the percent of total waste shipped in 2002 from the top 16 California generators has increased from an average of 60 percent from the previous nine years to 75 percent in 2002.

Table II

Year	Total CA	Top 16	%Total	#Gen	Total Tons for all Gen
1993	1837	1340	73	259	1907
1994	1196	747	62	253	1358
1995	1371	762	56	299	1587
1996	1879	1247	66	250	2292
1997	1619	951	59	250	1860
1998	1652	990	60	258	1887
1999	1466	958	65	288	1572
2000	1817	1148	63	284	1901
2001	1311	880	67	349	1384
2002	735	550	75	275	771

Figure I is a graphical representation of Table II that demonstrates a downward trend in the shipment of Cr-6 waste for all generators, California generators, and the Top 16 generators plus the percentage for the Top 10 generators and the total number of generators for each year.



Regulatory Issues for Hexavalent Chrome (Cr-6) as of March 2003:

Increasingly stringent CARB regulations for chrome plating have driven Cr-6 air emissions reduction over the last 15 years. Use of alternative process materials reduces or eliminates the need for scrubbers and fume suppressants as well as the requirements for performance testing, monitoring and recordkeeping needed to comply with the regulations. The proper management methods used for Cr-6 waste are either on-site or off-site treatment. Both on-site and off-site treatment of this higher risk waste can be costly and require proper handling and storage, training and recordkeeping by the generator. There are regulatory and economic incentives to substitute lower risk process materials wherever possible to avoid costs of compliance with hazardous waste regulations.

DTSC Regulations

Currently metal plating and finishing facilities must have a tiered permit authorization for on-site treatment to reduce Cr-6 compounds to trivalent chromium compounds (Cr-3) - for non-cyanide bearing wastes. Depending on the volume and concentration of the waste stream treated, the facility will have to be authorized under one of the tiers, CESQT, CA or PBR. Tiered permitting is also required for Cr-3 treatment. P2 alternatives, such as material substitution and source reduction would seem to provide regulatory relief for these businesses.

Air Regulations

History: The ARB identified Cr-6 as a toxic air contaminant (TAC) in 1986, based on studies that show Cr-6 as a human carcinogen for which there is no safe threshold exposure level. Cr-6 is emitted from the chrome plating process as an aerosol that may be inhaled. Nickel plating is part of the decorative chrome plating process and is a source of nickel emissions. Nickel compounds have also been identified as a TAC as a human carcinogen for which there is no safe threshold exposure level.

The ARB has adopted Airborne Toxic Control Measures (ATCM) to reduce Cr-6 emissions from process baths. Cr-6 emissions are controlled by using fume suppressants on the plating tanks and add-on pollution control devices, such as HEPA filters and scrubbers. The ATCM established requirements that reduced overall emissions from plating facilities by 97 percent. The latest amendments require the largest hard chrome operations to meet a control efficiency of over 99 percent. Decorative chrome plating and chromic acid anodizing operations are required to reduce Cr-6 emissions by 95 percent. The ATCM also requires performance tests to demonstrate compliance, regular inspections and maintenance, monitoring, operations plans, and recordkeeping.

A multi-media enforcement project was coordinated by ARB and included state inspectors from ARB, DTSC and SWCRB and local CUPA, Air Quality and POTW staff. Facility inspections of chrome platers were conducted in November 1999 and February 2000. As a result of the multi-media inspections, about 43% of the facilities were found to have at least one violation in each of the air, water and hazardous waste regulations. About 89% of the shops violated at least one hazardous waste handling and storage regulation and about 89% had at least one Cr-6 air emissions violation. About 93% were found to have at least one storm water permit violation. The general perception from the regulators' viewpoint is that the Cr-6 plating industry has compliance problems in all environmental media. Although the plating industry may not be widely visible to the general public, the health hazards of Cr-6 exposures from air, water and waste discharges have been publicized by news media.

Current Regulatory process:

ARB is evaluating the ATCM to ensure that it provides the maximum public protection. The evaluation began with public workshops in November 2002 and industry training in December 2002. In January 2003, ARB began an emissions testing program at facilities.

ARB distributes fact sheets and compliance checklists and conducts training to help plating businesses comply with these regulations and to reduce Cr-6 emissions. Compliance Assistance Handbooks for the industry are available in English and Spanish. The ARB provides information to businesses on safer alternatives and pollution prevention measures to reduce Cr-6 emissions. P2 alternatives, such as material substitution and source reduction would seem to provide regulatory relief for these businesses.

3. Cr-6 Alternatives:

Alternatives to Cr-6 use:

- High Velocity Oxygen Fuel (HVOF)
- Trivalent Chromium
- Majority of other alternatives are still in the experimental stages.

Advantages of Cr-6 Alternatives:

HVOF

- coatings are usually denser
- higher bond strengths
- particularly useful when tough, wear resistant coatings are required
- extremely wear and erosion resistant coatings
- coatings can be ground with a diamond and buff to a high gloss

Trivalent Chromium (Cr-III)

- fewer environmental concerns
- higher productivity
- lower operating costs
- Cr-6 is a plating bath contaminant
- reduced waste disposal problems and costs.

Disadvantages of Cr-6 Alternatives:

HVOF

- (~70%) finishers do custom chroming
- (~30%)functional (Hard Chrome) type plating
- HVOF does work but the equipment cost for the equipment is over $350,000
- too much of a capital investment for the majority of finishers
- not enough of a market for functional plating with HVOF
- cost is much higher than the conventional use of Cr-6
- HVOF can be used for line-of-sight applications only

Trivalent Chromium (Cr-III)

- process is more sensitive to contamination than the Cr-6 process
- trivalent chromium process cannot plate the full range of plate thicknesses
- trivalent chromium process requires more thorough rinsing
- trivalent chromium process requires tighter laboratory control
- can plate only thicknesses ranging up to .103 to 25 pin (0.005 to 1.0 mils)
- Cr-6 process can plate thicknesses up to 762 pin (30 mils).
- cannot be used for most hard chromium plating applications
- distinct comparison which is visible to the majority of people

4. Goals (Cr-6)

Short term goals:

- become familiar with metal plating and finishing processes
- look for alternative processes for Cr-6
- contact metal plating and finishing industry trade groups
- visit metal plating and finishing facilities (top ten)
- obtain more data on top ten facilities
- observe trends of the metal plating and finishing facilities
- review SB14 reports
- work with other federal, State, and local governments
- analyze facts and findings of related data and publications

Intermediate term goals:

- look for partners in metal plating and finishing industry
- develop P2 checklist from supporting material
- develop a P2 toolkit and brochures for the industry(English/Spanish)

- provide a cost/benefit analysis for P2 alternatives
- provide P2 training to metal plating and finishing facilities
- provide on site assistance in implementing P2 options
- possibly develop into a green business sector
- possibly develop a model shop program
- track metal plating and finishing industry closing/leaving/or starting-up
- monitor training and constantly update
- follow-up on training to assure P2 alternatives are be implemented

Long term goals:

- reduce/eliminate use of Cr-6
- measure amount of reduction in Cr-6 waste/use

5) Cyanide Waste

Use of cyanide in the plating industry has been a widely accepted practice in the past. For many metal plating applications, operators have found good substitutes for using cyanide in their process. However, some operators still have the perception that the use of cyanide in the process produces the best product. There are some industrial applications, such as electronics component plating with cadmium, zinc and gold for which substitutions may be made, but the operators are bound by rigid military specifications or they have the perception that a good substitute is not available.

Brief exposure to high levels of airborne cyanide damages the brain and heart, and may cause coma and death. Longer exposure to lower levels of cyanide may result in breathing difficulties, heart pains, vomiting, headaches, and enlargement of the thyroid gland. Ingesting cyanide may cause shortness of breath, convulsions, loss of consciousness, and death. Skin contact with cyanide can produce irritation and sores.

Volume of Cyanide Waste Generated Based on Manifests

Listed in Table III are the top sixteen (16) California generators of cyanide waste (711 - LIQUIDS WITH CYANIDES >= 1000 MG/L) in 2002. A total of 216 generators shipped over 640 tons of cyanide waste in California. The top sixteen (16) California generators account for approximately 63 percent of all the 711 waste generated by California generators.

By limiting the project to the top seven (7) percent (16 generators that generate 71 percent of the cyanide waste), a manageable strategy can be developed to the specific needs of each facility. The total tonnage amount of cyanide waste shipped by generators has diminished as have the number of large generators as shown in the following table III:

a) The top (1) generator in 2002 shipped over 19 percent of Cyanide waste
b) The top ten (10) generators shipped over 49 percent of Cyanide waste, &
c) The top sixteen (16) generators shipped 71 percent of all the 711 waste generated by California generators.

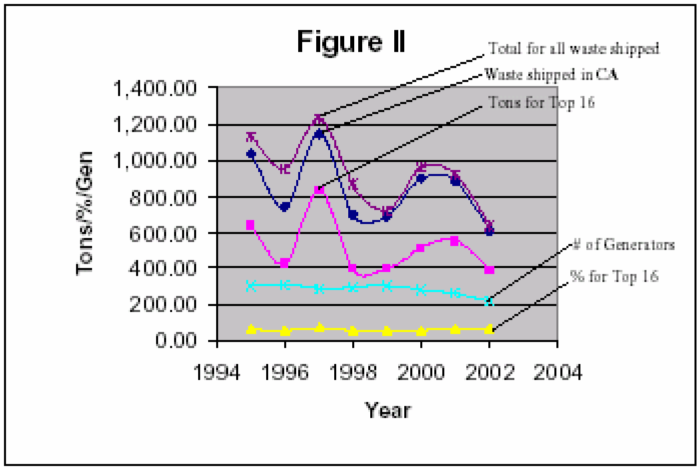
Table III									
EPA ID	Company Name	2002 Tons	2001 Tons	2000 Tons	1999 Tons	1998 Tons	1997 Tons	1996 Tons	1995 Tons
CAD041319294	UNITED AIRLINES MAINTENANCE OPS CENTER	129	73	105	76	94	87	77	33
CAR000055038	POLESE CO INC	62	39	34	0				
CAD060897063	BOEING SATELLITE SYSTEMS INC	33	10	10	10	3		1	4
CAR000034272	BOEING SATELLITE SYSTEMS INC	26	10	11	9	4			
CAD097030993	U S FILTER RECOVERY SERVICES INC	21	181	59	40			4	46
CAR000089474	ADS GOLD INC	18	11						
CAD069124717	MICRO METALLICS CORP.	16	13	10	25	39	38	15	15
CAD008392722	DIXON HARD CHROME INC	15	34	21	22	30	29	10	8
CAD009200031	E-D COAT INC	14							
CAD981399959	ELCON INC	14	43	14	9	7	8	3	0
CAD077176998	ENS TECHNOLOGY LLC	13	15	23	12		3	3	0
CAD008358145	METAL SURFACES INC	11	4						2
CAD009685694	REPUBLIC FASTENER MFG CORP	11	11	8	14	13	18	19	10
CAD066233834	MONITOR POLISHING & PLATING	11	0	0	1		1		
CAD047896097	KYOCERA AMERICA INC	10	22	14	4	3	3		30
CAD009675067	ALL METALS PROCESSING CO OF ORANGE CNTY	9				13			

Listed in Table IV are the top sixteen (16) California generators of cyanide waste from 1995 through 2002. Table IV lists the total for all cyanide waste shipped each year and the total for cyanide waste shipped only to TSDFs in California. The average tonnage for the top 16 generators for years 1995 through 2001 is 533 tons. Comparing this average to the 382 tons for 2002, there is a twenty-eight (28) percent decrease in cyanide waste shipped. This decrease in cyanide waste is reflected in the reduction of the number of generators. The average number of generators for years 1995 through 2001 is 289 and the number of generators for 2002 is 216. This number shows a twenty-five (25) percent reduction of generators. As the average for tonnage and number of generators has decreased when compared to 2002, the percentage of cyanide waste for the top 16 generators has increased from an average of sixty (60) percent to sixty-three (62) percent in 2002.

<Table IV>

Year	Total CA	Top 16	%Total	#Gen	Total for all Gen
1995	1,035.99	636.06	61.40	297	1,128.31
1996	746.61	420.72	56.35	306	953.31
1997	1,149.61	828.93	72.11	286	1,232.70
1998	703.69	392.61	55.79	293	869.61
1999	690.00	388.56	56.31	297	726.89
2000	898.81	508.97	56.63	277	963.21
2001	887.03	555.72	62.65	265	926.23
2002	606.87	381.96	62.94	216	640.65

Figure II is a graphical representation of Table IV that demonstrates a downward trend in the shipment of cyanide waste for all generators, California generators, and the Top 16 generators plus the percentage for the Top 10 generators and the total number of generators for each year.



Cyanide Regulatory Issues for Cyanide as of March 2003:

DTSC regulations for Cyanide-containing wastewaters

Currently generators must have Standardized permit, Consent Order, or variance from DTSC to authorize treatment of waste water containing up to 1000 ppm cyanide. The consent orders and variances require compliance with PBR regulatory standards for waste management. About 175 facilities are treating cyanide on-site authorized by DTSC consent order or waiting for the consent order to be completed. There may be as many as 250-300 facilities treating cyanide on-site without DTSC or CUPA authorization.

The Draft issue memo dated 5/2/2002 explains the need to authorize treatment under lower risk on-site tiered permitting, Permit by Rule (PBR.) If approved, the treatment of cyanide-containing waste water up to 1000 ppm would be authorized by PBR regulations. Administration and enforcement would be delegated to the CUPA. The regulation will take about 1.5 years to be in place.

Zero discharge facilities and Best Management Practices facilities have higher concentrations of cyanide in their waste water, but generate much smaller volumes of this waste stream. DTSC staff will consider this in the rulemaking to maintain incentives for zero discharge. Most of these facilities would probably be eligible for the lower risk permitting, PBR, in the new regulation.

Air Regulations
Cyanide compounds are regulated Toxic Air Contaminants (TAC) by the ARB.

6) Cyanide Alternatives:

Alternatives to cyanide use:

- Alkaline Non-Cyanide Zinc Plating
- Acid Chloride Zinc Plating

Advantages of the alkaline non-cyanide formulation include:

- the elimination of process cyanide and corrosives,
- relatively low makeup and operating costs,
- less complex and costly waste treatment of process effluent,
- minimal capital cost,
- good throwing and covering power for properly operated baths, and
- good deposit brightness, ductility and chromating properties.
- non-cyanide-based alternatives are available for cyanide-based copper, zinc, and cadmium plating processes
- substitute processes can reduce regulatory and reporting requirements
- lower risks to workers
- decrease environmental impact, and
- reduce corporate liability.

Disadvantages of Non-Cyanide Alternatives (General considerations)

- More than one non-cyanide process may be required to meet all the needs of a single facility.
- Process controls and cleaning practices must be maintained within tighter limits.
- Without the complexing ability of cyanide, periodic removal of iron and other potential contaminants may be required to assure deposit quality. Filtration is generally necessary when using non-cyanide processes.
- The color shades obtained in chromating over non-cyanide deposits do not always match those obtained with the same colors of chromates over cyanide deposits. Customers should be notified when it is important to segregate products with color shade differences.
- Some non-cyanide processes do not satisfactorily adhere to all surfaces and tend to become brittle at high temperatures.
- Alkaline non-cyanide processes generally provide more ductile deposits for subsequent forming operations than do acid non-cyanide processes.
- Acid non-cyanide substitutes usually incorporate more organic brightening agents than alkaline non-cyanide substitutes. In both acid and alkaline non-cyanide processes, higher levels of organic or non-organic brightening agents provide a more cosmetically appealing result. However, chromating may be more difficult with high levels of brighteners, particularly organic brighteners, as a deposit surface film.
- Acid substitution processes require an appropriate (e.g., plastic) liner.

7) Goals (Cyanide)

Short term goals:

- become familiar with metal plating and finishing processes
- look for alternative processes for cyanide use
- contact metal plating and finishing industry trade groups
- visit metal plating and finishing facilities (top ten)
- obtain more data on top ten facilities that use cyanide
- observe trends of the metal plating and finishing facilities
- review SB14 reports

- work with other federal, State, and local governments
- work with POTWs
- analyze facts and findings of related data and publications

Intermediate term goals:

- look for partners in metal plating and finishing industry
- develop P2 checklist from supporting material
- develop a P2 toolkit and brochures for the industry(English/Spanish)
- provide a cost/benefit analysis for P2 alternatives
- provide P2 training to metal plating and finishing facilities
- provide on site assistance in implementing P2 options
- possibly develop into a green business sector
- possibly develop a model shop program
- track metal plating and finishing industry closing/leaving/or starting-up
- monitor training and constantly update
- follow-up on training to assure P2 alternatives are be implemented

Long term goals:

- reduce/eliminate use of cyanide
- measure amount of reduction in cyanide waste/use

8) Sources (See Table V)

- Internet
- Trade Associations
- Industry

9) P2 options

- Utilize P2 training materials already available from Federal, State, and private companies and organizations
- Create P2 case studies
- Utilize Federal, State, county, and organizational P2 check lists
- Use substitutions for Cr-6 and/or Cyanide
- (see alternatives Section 3 and 6 above)

10) Potential partners

- Metal Finishing and Plating Facilities
- Metal Finishing and Plating Associations
- California Air Resources Board (ARB)
- Local Air Districts
- Department of Health Services (DHS)
- CUPAs
- Local Inspectors
- US EPA
- Other California State Agencies

- State Agencies outside California

11) Expected outcomes and measurement

- Complete individual evaluations at each of the top 16 facilities of both waste streams.
- Implement P2 options on a case by case basis.
- Track waste and/or emission reduction, cost savings, startup costs, etc.
- Note: Until a complete understanding of both waste streams and any P2 options already in place at any of the top 16 facilities, no prediction can be made at this time.

12) Basis of decision to go forward and project design considerations

Since Cr-6 and Cyanide will continue to be used due to unique performance characteristics, it should be our goal to provide sufficient information and leadership to create an impact on Cr-6 and Cyanide waste. This impact can come from P2 information disseminated in a similar fashion as with the Vehicle Service and Repair (VRS) project. As with the VSR project, similar results should be expected. Due to the competitiveness of this industry, the introduction of any new Cr-6 technologies and/or substitutions for Cr-6 and/or Cyanide must be fully demonstrated as a viable option before the implementation of any technology. There are proven alternatives and processes for Cr-6 which can be competitive as listed above in the Alternatives and Advantages. There are proven alternatives and processes for Cyanide also. Many in the industry are unaware, do not have access to this information or are reluctant to chance a new process or technology. DTSC has an opportunity to demonstrate that alternative technologies and/or P2 options are viable options to business owners. Through various workshops, DTSC can disseminate this information to inspectors, trade associations, and businesses, including site visits, as with the VSR project. DTSC can also help address their concerns over occupational health and safety, waste treatment costs, regulatory compliance requirements, and potential liability.

Working together with new innovative technologies, business owners, technicians, inspectors, and industry organizations, additional P2 alternatives can be created and become available. Additional case studies can be developed; demonstrating to companies that acceptance of P2 will help them become more competitive, obtain a better working relationship with their respective communities, and relieve some of the regulatory burden while increasing profits.

As new and proven technologies surface and become available they will be added and introduced into the Metal Finishing and Plating (MFP) program. Similar to the VSR project, the MFP can also produce and/or introduce Video Tapes, Toolkits, brochures, posters, and a "Model Shop" program though-out the MFP industry.

By limiting the project to the top eleven (11) percent (16 generators that generate 73 percent of the Cr-6 waste) and the top seven (7) percent (16 generators that generate 63 percent of the cyanide waste), a manageable strategy can be developed to the specific needs of each facility.

Also by limiting the universe to 31 facilities (one facility has both waste streams in the top 16) project would be easier to manage, help implement P2 options and measure reduction amounts of Cr-6 and Cyanide wastes and air emissions.

List of Sources

Sources used in this report as listed in Table V. The majority of information gathered for this report came from the Internet reports, case studies, and DTSC's Hazardous Waste Tracking System (HWTS). Additional information gathered for this report came from Federal, State, trade organizations, and businesses.

<Table IV>

Title	Format	Date	Website	Author
P2 Techniques for Metal Finishing Facilities	presentation	Jan 2001		Tetra Tech EM Inc.
Modifying Tank Layouts To Improve Process Efficiency	Report and case studies	July 1998		Merit Partnership P2 Project for Metal Finishers
Finding and Alt to Solvent Degreasing – Ultrasonic Aqueous Cleaning	Report and case studies	Dec 1997		Merit Partnership P2 Project for Metal Finishers
City of Los Angeles Pretreatment Program Compliance Guide	Compliance Guide			Environ Affairs Department and Bureau of Sanitation, Industrial Waste Mngt Div
Pollution Prevention in Metal Finishing: Plating	Report	1995	http://www.pprc.org/pprc/sbap/metalfin/rt_rept.html	Pacific Northwest P2 Research Center
Effluent Guidelines Metal Products and Machinery	Report on proposed regulations	2003	http://www.epa.gov/waterscience/guide/mpm/background.html	U.S. EPA
Metal Finishing P2 Opportunities Checklist	Checklist		EnviroSense website http://es.epa.gov/techinfo/facts/cheklst3.html	CH2MHill and Co Sanitation Districts of LA County
Benchmarking Metal Finishing	Analysis Tool	2003	http://www.nmfrc.org/benchm.cfm	National Metal Finishing Resource Center
Resource Center News	On-line Industry News	2003	http://www.nmfrc.org	National Metal Finishing Resource Center
Pollution Prevention at Specific Plating Company	Case Study Report	Aug 1996		City of Palo Alto
Guide to Pollution Prevention Practices	On-line P2 guide	2003		National Metal Finishing Strategic Goals Program
The Metal Plating Industry: Improvement of Resource Efficiency and Environmental Performance	On-line P2 information and links	Last update 12/6/2000	http://www.cleanerproduction.com	Cleaner Production.com
Technology Demo Project-Hard Chrome P2 Demo Project Interim Report	On-line report	2003	http://www.iti.org/ee/eem/techdemo/chromep2/index.html	MMTC and CAMP
Chrome Plating	Fact Sheet		http://www.arb.ca.gov/toxics/chrome/fact.pdf	CARB, Air Toxics Program
Toxic Air Contaminant Control Program CR-6 Regulatory History	On-line information	Updated 3/4/2003	http://www.arb.ca.gov/toxics/chrome/history.htm	CARB, Air Toxics Program
Multi-media Chrome Plating Project	Report	Dec, 2000	http://www.arb.ca.gov/toxics/chrome/chromeplating.doc	Principal author Hardip Judge, CARB
Cr-6 Airborne Toxic Control Measure for Chrome Plating & Chromic Acid Anodizing Operations	Regulations	Updated 3/4/2003		
Chrome Plating Rule Effectiveness Study	Report	July 2002	http://www.arb.ca.gov/toxics/chrome/ruleeffect.pdf	CARB/SSD
Evaluation of the Cr-6 Airborne Toxic Control Measure for Chrome Plating and Chromic Acid Anodizing Operations	Stakeholder Workgroup Presentation	1/29/2002	http://www.arb.ca.gov/toxics/chrome/workmtgs/hexpres.pdf	CARB
Permit by Rule for Onsite Treatment of Aq Wastes Containing Cyanides; discussion with author	DTSC Draft Issue Memo	5/2/2002 4/30/2003		Mike Horner, DTSC HWMP