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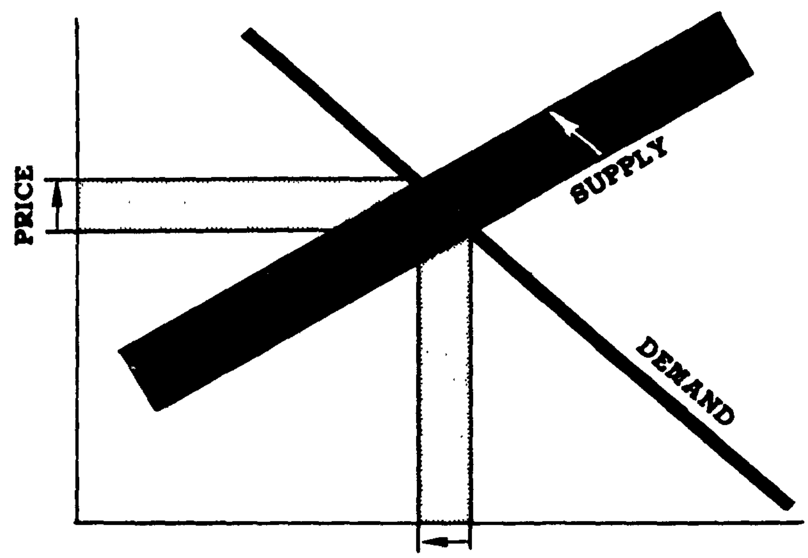
ECONOMIC ANALYSIS OF INTERIM FINAL EFFLUENT GUIDELINES FOR SELECTED SEGMENTS OF THE EXPLOSIVES INDUSTRY -- GROUP II



U.S. ENVIRONMENTAL PROTECTION AGENCY
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EPA 230/1-75-065a

ECONOMIC ANALYSIS OF INTERIM FINAL EFFLUENT GUIDELINES

FOR SELECTED SEGMENTS OF

THE EXPLOSIVES INDUSTRY – GROUP II

Contract No. 68-01-1541
Task Order No. 39

OFFICE OF WATER PLANNING AND STANDARDS
ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

February 1976

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1.0 EXECUTIVE SUMMARY

1.1 INTRODUCTION

This report is one of a series of reports to be prepared by Arthur D. Little, Inc. (ADL) for the Environmental Protection Agency (EPA) under Contract No. 68-01-1541, Task No. 39. The overall objective of this task is the determination of the economic impact that EPA-proposed interim final effluent limitations will have on eight point source categories. The EPA plans to name the following industries as point source categories:

Pharmaceuticals (SIC 2831, 2833, and 2834);

Gum and Wood Chemicals (SIC 2861);

Pesticides and Agricultural Chemicals (SIC 2879 and those establishments engaged in manufacturing agricultural pest-control chemicals covered under SIC 281 and 286);

Adhesives (SIC 2891);

Explosives (SIC 2892);

Carbon Black (SIC 2895);

Photographic Processing (SIC 7221, 7333, 7395, 7819); and

Hospitals (SIC 8062, 8063, and 8069).

This report on selected segments of the explosives industry (SIC 2892) is principally concerned with the civilian sector of the industry. A subsequent complete report will deal in greater detail with the military sector of the industry as well as the civilian sector.

The primary source of effluent treatment cost information is the Development Document for the Explosives Manufacturing Point Source Category, dated January 1976, by Roy F. Weston, Inc. The Development Document has broken the industry into the following subcategories:

A. *Manufacture of Explosives.* Examples of explosives are dynamite, nitroglycerin, cyclotrimethylenetrinitramine (RDX), cyclotetramethylenetetranitramine (HMX), trinitrotoluene (TNT), ammonium perchlorate and nitroguanidine.

B. *Manufacture of Propellants.* Examples of propellants are rolled powder, high-energy ball powder, and nitrocellulose (NC). Propellants can be single-based, double-based, or triple-based.

C. *Load, Assemble, and Pack Operations.* Includes plants which blend explosives and market a final product, and plants that fill shells and blasting caps. Examples of such installations would be plants manufacturing ammonium nitrate and fuel oil (ANFO), nitrocarbonitrate (NCN), slurries, water gels, and shells.

D. *Manufacture of Initiating Compounds.* Initiating compounds are highly-sensitive explosives used for detonation. Examples are pentaerythritol tetranitrate (PETN), lead styphnate, tetryl, mercury fulminate, lead azide, and nitromannite (HMN).

1.2 PURPOSE AND SCOPE

The purpose of this report is to assess the economic impact on the U.S. Explosives Industry (SIC 2892) of the cost of meeting EPA standards for pollution abatement applicable to the discharge of water effluents from point sources.

Compliance with the water pollution abatement standards may require the industry to install new physical facilities in its present operations, modify its current technical operations, or incorporate specialized facilities in new installations. Furthermore, the industry may have to install equipment and facilities capable of three levels of effluent water treatment such that:

- Level I – by 1977, for current industry installations, the best practicable control technology currently available (BPCTCA) is being used to control the pollutant content in the streams discharged by the industry;

- Level II – by 1983, for current industry installations, the best available technology that is economically achievable (BATEA) is being similarly used; and

- Level III – new source performance standards (NSPS) for new industry installations discharging directly in navigable waters to be constructed after the promulgation of applicable guidelines for water pollution abatement; facilities will be incorporated that will be capable of meeting these guidelines.

This report presents the results of a prescreening process and further technical and economic analyses applied to the Explosives Industry to determine the economic impact of the proposed effluent limitations.

1.3 STUDY APPROACH

1.3.1 Prescreening

In our October 1975 working draft report on selected segments of the eight industries studied under this contract, we developed methodologies to aid our industry experts in selecting those industry categories or subcategories that probably would not be significantly impacted by the Interim Final Effluent Guidelines.

ADL industry experts initiated the project by studying the Development Document, compiling prescreen information, and preparing statements on factors which they believed would have an economic impact on the industry. To aid them in preparing their comments, the team of ADL experts was supplied a table describing the information to be covered, and they were directed to complete the table with brief descriptions. In preparing their comments and completing the information table, the industry experts were also directed to use only their own personal knowledge, or information they could readily retrieve. This limitation was invoked to prevent an excessive use of available resources in conducting the prescreen exercise. The completed information tables and the accompanying industry expert comments are contained in the body of this report.

To determine which industry subcategories we would recommend for elimination from further economic impact study, we analyzed the information of the industry experts against four criteria. If an industry subcategory met any one (or a combination) of the following criteria, we considered its elimination. The criteria:

1. The industry subcategory was generating no wastewater.

2. The ratio of BPCTCA* plus BATEA** to selling price was less than 2% and/or the ratio of BPCTCA plus BATEA to profits was less than 15%.

3. Practically all of the plants in the subcategory were currently discharging into municipal sewage systems and would continue to do so with little or no pretreatment costs incurred.

4. The treatment facilities recommended in the Development Document had already been installed in practically all of the plants of the subcategory.

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*Best Practicable Control Technology Currently Available

**Best Available Technology Economically Achievable

1.4 CHARACTERIZATION OF THE CIVILIAN EXPLOSIVES INDUSTRY

Commercial explosives at present principally consist of "blasting agents" instead of "dynamites" which formerly dominated the market. Blasting Agent is a term now applied to explosives which consist principally of ammonium nitrate in admixture with a variety of nonexplosive sensitizing fuels (e.g., fuel oil, aluminum, dinitrotoluene). These explosives are more economical products having significantly less hazardous properties (lacking sensitiveness) than those of the dynamites.

For 1974 the U.S. Department of the Interior records the apparent consumption of industrial blasting agents and explosives in the United States to be as indicated in Table 1.4A.

TABLE 1.4A

APPARENT CONSUMPTION OF INDUSTRIAL BLASTING AGENTS AND EXPLOSIVES (U.S. 1974)

	Class	Pounds	Metric Tons
1.	Permissibles	42,331,000	19,200
2.	Other High Explosives	257,735,000	116,900
3.	Water Gels and Slurries	293,248,000	133,000
4.	Cylindrically Packaged Blasting Agents	301,261,000	136,600
5.	Other Processed Blasting Agents	1,867,715,000	847,000
	Totals	2,762,290,000	1,252,700

Source: U.S. Department of Interior, Mineral Industry Surveys.

Only two of the above classification – Classification 1 (Permissibles) and Classification 2 (Other High Explosives) – relate to Subcategory A of the Development Document. In these two classifications are included all the dynamites, gelatin dynamites and semi-gelatin dynamites of both the permissible and non-permissible species. Classification 2 (Other High Explosives) includes such explosive mixtures as ammonium nitrate and trinitrotoluene (TNT) packaged in (cylindrical) metal containers and would fall into Subcategory C (Load and Pack) of the Development Document. Classifications 3, 4, and 5 also fall into Subcategory C (Load and Pack) of the Development Document.

The dynamite industry is presently in a state of decline. Dynamite manufacturers are redirecting their efforts towards the development of slurry explosives and blasting agents. We estimate that dynamite will be essentially eliminated from the explosives market in the next five years. We expect that eventually only two types of explosive materials will dominate the explosives market. These two types are: 1) ammonium nitrate-fuel oil (ANFO) and other ANFO related types, and 2) explosives and blasting agents based on slurries or water gels.

In the commercial explosives industry, only nitroglycerin and the associated manufacture of dynamite are in Subcategory A (see Section 1.1) of the Development Document. All other materials listed in Subcategory A are in the military field. The military also uses a large number of propellants (Category B) but the commercial applications are principally for shells for shotguns, rifles and pistols used for sporting purposes.

The majority of commercial explosives industry operations belong in Subcategory C where materials made in Subcategories A, B, and D and/or materials from other industries are mixed, compounded and assembled into usable form.

Subcategory D includes primary explosives manufactured for use in making detonators, primers, boosters and other initiating devices used in civilian applications.

Product prices vary with the wide range of products produced in the industry and typical estimated prices by subcategory are shown in Table 1.4B.

TABLE 1.4B

ESTIMATED INDUSTRY PRODUCT PRICES BY SUBCATEGORY

Subcategory	Price Range Per Metric Ton
A	\$ 334 – \$ 667
B	\$ 1,800 – \$220,000
C	\$ 242 – \$ 8,500
D	\$22,000 – \$ 33,000

1.5 CONCLUSIONS AS TO THE ECONOMIC IMPACT ON THE COMMERCIAL SECTOR OF THE EXPLOSIVES INDUSTRY

Estimated treatment costs due to the Interim Final Effluent Guidelines are shown in Table 1.5 for the various subcategories.

TABLE 1.5

ESTIMATED BPCTCA PLUS BATEA COSTS AS A PERCENT OF SELLING PRICE FOR PRODUCTS OF THE EXPLOSIVES INDUSTRY

Subcategory	Treatment Cost As Percent of Sales
A	1.7 to 3.4
B	0.10 to 12.5
C	0.05 to 1.7
D	195.0 to 293.0

We do not expect that the Interim Final Effluent Guidelines will have a significant economic impact on Subcategory A -- Manufacture of Explosives – in the commercial sector. For other reasons, nitroglycerin dynamites are rapidly losing their share of the market. We expect that the companies still producing nitroglycerin dynamites will gradually shift to production of blasting agents based on slurries and water gels as well as ANFO products. Accordingly we see no significant effects of the Guidelines on price or production of explosives in Subcategory A. Effects on employment and communities would be insignificant.

The Development Document indicates a BPCTCA treatment for Subcategory C that costs $2.14 per metric ton. On the cheapest packaged ANFO products this treatment cost amounts to 0.9 percent of their sales prices. This cost is judged to be economically nonimpactive, especially since the cost appears to be overstated for the reasons given in Section 3.0 of this report.

The BATEA process presented in the Development Document was based on carbon absorption while the BATEA technology now recommended is based on multi-media filtration. Addition of the presently recommended BATEA process brings the total treatment costs to $4.05 per metric ton or a maximum of 1.7 percent of the selling price of the cheapest ANFO products. Under our criteria, the Interim Final Guidelines are not considered to be economically impactive.

Had the original carbon adsorption BATEA step been retained, the costs would have been $13.17 per metric ton or 5.4% of the ANFO sales price. Carbon adsorption may be reinstituted for Subcategory C, if data gathered before promulgation of the 1983 effluent limitations show that carbon adsorption provides effluent load reduction commensurate with the costs.

The importance of determining the appropriateness of the BATEA treatment costs attributed to ANFO and other NCN products is obvious when it is realized that products of this type make up almost 90% of the tonnage of civilian explosives products. If the higher BATEA treatment costs are necessary, the shift from off-site mixing to on-site mixing will be accelerated due to the fact that on-site mixing is not covered by the guidelines and will not incur the concomitant treatment costs.

Because of the wide range of treatment costs versus selling prices in Subcategories B and D, it is not possible to state that plants in these subcategories will not experience an economic impact from the Interim Final Effluent Guidelines. Certain plants in these subcategories will undoubtedly have very small impacts, but on an overall basis the subcategories will apparently be impacted. Further study of plants in Subcategories B and D will be required.

1.6 SUMMARY OF THE COSTS OF POLLUTION ABATEMENT FOR SUBCATEGORIES A AND C

The costs of pollution abatement for Subcategories A and C are summarized in Table 1.6. All treatment costs and investment costs were adjusted to 1975 levels by use of the Engineering News Record Construction Index (1972 = 1780, 1975 = 2276). Annual costs were calculated using treatment costs per metric ton and the estimated production in the subcategory. Total investment costs were calculated using costs given for the model plant in the Development Document multiplied by the number of such plants required to produce the estimated production of the subcategory.

The number of plants engaged in the manufacture of products falling into Subcategories A and C are preliminary estimates. The actual number of plants in Category C (especially for slurry and water gel production) is difficult to determine because of the changing status in the application of techniques used for blasting services. Some large producers of slurry blasting agents and water gel explosives have facilities captively committed to single large mining operations. We have included such sites in our estimate of the number of plants.

A complex facility producing a variety of products falling into Subcategory C (e.g., NCN's, boosters and water gels) is counted as one site for our estimate.

Most of the large "producers" of ANFO do not undertake the manufacture of this product at their complex facilities. Instead, companies like Hercules, DuPont and Atlas license distributors throughout the country to compound this product and to package it (or bulk produce it) under their respective company labels. We have not made any estimate of the number of distributor-manufacturers engaged in these operations.

TABLE 1.6

COST OF POLLUTION ABATEMENT FOR SELECTED SUBCATEGORIES OF THE EXPLOSIVES INDUSTRY[1]

Subcategories	Estimated Number of Plants	Estimated Production (metric tons)	Treatment Cost as a Percent of 1975 Selling Price		Annual Cost (in millions of dollars)		Total Investment (in millions of dollars)	
			BPCTCA	BPCTCA & BATEA	BPCTCA	BPCTCA & BATEA	BPCTCA	BPCTCA & BATEA
A	14	135,000	0.9 to 1.9	1.7 to 3.4	0.8	1.5	3.5	5.5
C	50	590,000	0.9[2]	1.7[2]	1.3	2.4	2.8	7 5
				Total Costs:	2.1	3.9	6.3	13.0

1. Treatment costs were obtained from the "Development Document" and adjusted to 1975 values by the use of the Engineering News Record Construction Index. 1972 = 1780. 1975 = 2276.

2. Calculated for ANFO only.

2.0 INDUSTRY CHARACTERIZATION

2.1 GENERAL INDUSTRY DESCRIPTION

The general industry description will deal with the major parts of the commercial explosives manufacture and load and pack operations (Subcategories A and C). These comprise the bulk of the commercial explosives industry. Propellant manufacture and initiator manufacture which comprise a much smaller part of the civilian explosives industry are discussed briefly in the appropriate section of this report. The government sponsored explosives industry is to be the subject of a future report; however, it is briefly discussed in the following sections where appropriate.

The principal explosives manufacturers (Subcategories A and C) in the United States are: DuPont, Hercules, Austin, Gulf, Atlas, Trojan, Dow and Ireco. With the exception of Ireco, Dow and Gulf, these companies have been traditional dynamite producers. Now they all produce a line of ammonium nitrate-fuel oil (ANFO) type blasting agents as well as bulk and packaged slurry and water gel explosives and slurry blasting agents. DuPont has, as of about a year ago, ceased the manufacture of nitroglycerin based explosives – dynamites and gelatin dynamites – and has committed itself to the production of small diameter, water gel type, specially sensitized products.

Commercial explosives in the United States may now be effectively characterized by the term "blasting agents" instead of "dynamites" which may have adequately described the industry as recently as 1960. In 1965 the consumption of dynamite type explosives – those based on nitroglycerin (N/G) sensitizer – was still approximately equivalent to the consumption of ammonium nitrate-fuel oil (ANFO) type blasting agents.

Blasting Agent is a term now applied to explosives which consist principally of ammonium nitrate in admixture with a variety of non-explosive sensitizing fuels (e.g., fuel oil, aluminum, dinitrotoluene). These explosives are more economical products having significantly less hazardous properties (lacking sensitiveness) than those of the dynamites. Within the category of blasting agents, two principal types of industrial explosives are recognized. These are:

1. The "dry" ammonium nitrate-fuel oil mixture (ANFO) – a nitrocarbonitrate species, and

2. The slurry blasting agents and water gels.

For 1974 the U.S. Department of the Interior records the apparent consumption of industrial blasting agents and explosives in the United States to be as follows:

TABLE 2.1

APPARENT CONSUMPTION OF INDUSTRIAL BLASTING AGENTS AND EXPLOSIVES (U.S. 1974)

	Class	Pounds	Metric Tons
1.	Permissibles	42,331,000	19,200
2.	Other High Explosives	257,735,000	116,900
3.	Water Gels and Slurries	293,248,000	133,000
4.	Cylindrically Packaged Blasting Agents	301,261,000	136,600
5.	Other Processed Blasting Agents	1,867,715,000	847,000
	Totals	2,762,290,000	1,252,700

Source: U.S. Department of Interior, Mineral Industry Surveys.

The five product classifications listed by the Mineral Industry Surveys bulletin now correspond to those used by the commercial manufacturers' organization, the Institute of Makers of Explosives. These classifications are described as follows:

1. Permissibles: Grades of high explosives approved by the Bureau of Mines for use in underground coal mines.

2. Other High Explosives: All high explosives except:

    a) permissibles and

    b) any water gels or slurries that would otherwise be classified as high explosives.

    Included in this classification are all formulations packaged in metal containers.

3. Packaged and Bulk Water Gels and Slurries: All such materials packaged or in bulk made by addition of more than 5% water to high explosives or blasting agents.

4. Cylindrically Packaged Blasting Agents: Ammonium nitrate and fuel mixtures packaged in cylindrical containers, trade name identified with a diameter and weight or length measurement and used for "down-the-hole" loading as distinguished from bulk loading.

5. Other Processed Blasting Agents and Unprocessed Ammonium Nitrate (AN):

   a) AN and fuel mixtures sold in bulk or packed in paper, plastic or burlap bags designed for bulk loading and

   b) Prilled or grained ammonium nitrate.

Explosives in the above list differ from Blasting Agents in the degree of potential hazard associated with these materials during transportation, as well as in their sensitivity to initiation by a blasting cap. Explosives can be initiated by a blasting cap while blasting agents require high strength explosive priming.

Only two of the above classifications – Classification 1 (Permissibles) and Classification 2 (Other High Explosives) – relate to Subcategory A of the Development Document. In these two classifications are included all the dynamites, gelatin dynamites and semi-gelatin dynamites of both the permissible and non-permissible species. Classification 2 (Other High Explosives) includes such explosive mixtures as ammonium nitrate and trinitrotoluene (TNT) packaged in (cylindrical) metal containers and would fall into Subcategory C (Load and Pack) of the Development Document. Classifications 3, 4, and 5 also fall into Subcategory C (Load and Pack) of the Development Document.

The dynamite industry is presently in a state of decline. Dynamite manufacturers are redirecting their efforts towards the development of slurry explosives and blasting agents. We estimate that dynamite will be essentially eliminated from the explosives market in the next five years. We expect that eventually only two types of explosive materials will dominate the explosives market. These two types are: 1) ammonium nitrate-fuel oil (ANFO) and other ANFO related types, and 2) explosives and blasting agents based on slurries or water gels.

2.2 DESCRIPTION OF SUBCATEGORIES OF THE INDUSTRY

2.2.1 Subcategory A – Manufacture of Explosives

Examples of explosives given in the Development Document are dynamite, nitroglycerin, cyclotrimethylenetrinitramine (RDX), cyclotetramethylenetetranitramine (HMX), trinitrotoluene (TNT), ammonium perchlorate and nitroguanidine.

There is a fairly strict division between the explosives in this subcategory that are manufactured for military purposes and those produced for commercial purposes. Traditionally, commercial explosives have been or are now characterized by such compositional and component terms as:

Dynamite
Nitroglycerin (N/G)
Nitrocarbonitrate (NCN)
Ammonium Nitrate-Fuel Oil (ANFO)
Slurry Blasting Agent (SBA)
Slurry High Explosive (SHE)
Water Gels

In the above list of terms, only dynamite and nitroglycerin fall into Subcategory A. Nitroglycerin is an integral part of dynamites and its manufacture for explosive purposes is almost exclusively for its use in dynamite compositions. Nitroglycerin may, of course, be manufactured also on a commercial basis for incorporation into propellants.

The military sector is not involved in the production of dynamite, nor does it manufacture nitroglycerin for explosive purposes. The military is largely concerned with the manufacture of the three essential explosives listed in Subcategory A of the Document. These are:

Trinitrotoluene (TNT)
Cyclotrimethylenetrinitramine (RDX)
Cyclotetramethylenetetranitramine (HMX)

These three molecular explosives are largely used for incorporation into cyclotols (RDX/TNT) and octols (HMX/TNT) for use in bomb fillings and projectile bursting charges.

TNT, the large volume "work horse" explosive, was for a long time manufactured at both military plants and at a very few commercial plants, but its production on a commercial basis was terminated in 1971. It is now only produced at Government-owned facilities.

RDX and HMX, of which the former is produced in greater volume, are produced on a large scale only at one Government-owned facility (Holston) and, to our knowledge, are not manufactured in significant quantities at any privately owned facility.

Nitroguanidine, listed in Subcategory A of the Development Document, is not used as an explosive compound, principally because it is too difficult to detonate. However, it is used as a military propellant ingredient (Subcategory B).

Nitroguanidine, as far as we know, has not been manufactured by either the military or commercial sectors but has always been imported from Canadian producers. This non-domestic source has now terminated its production and plans are under way to erect a facility in the U.S. under military auspices scheduled to be on-stream in late 1979.

Ammonium perchlorate (AP) is manufactured in the commercial sector and like ammonium nitrate is regarded as non-explosive and should not be included in this subcategory. Ammonium perchlorate is covered by the Effluent Guidelines for the Industrial Organic Chemicals (NEC) under SIC 2819.

2.2.2 Subcategory B – Manufacture of Propellants

Examples of propellants are rolled powder, high energy ball powder and nitrocellulose (N/C). Propellants can be single-based, double-based or triple-based. Single-based powders contain colloided nitrocellulose but do not contain nitroglycerin. Nitrocellulose and nitroglycerin are the principal explosive ingredients in double-based powders. Triple-based powders contain three explosive ingredients, nitrocellulose, nitroglycerin and nitroguanidine.

All the propellants listed above are based on nitrocellulose in association with various property-modifying ingredients such as nitroguanidine, ammonium perchlorate and aluminum. The propellants listed are all used extensively by the military for propulsion of missiles and rockets The civilian commercial applications are confined largely to the powders used in shotgun shells and rifle and pistol ammunition; these are predominantly single-based powders, although double-based powders are also employed.

In the commercial sector, companies such as Atlantic Research, Hercules, Olin, Aerojet General, DuPont and Thiokol are involved in a variety of propellant manufacturing processes. The diversity of finished products is extremely great and processes for manufacture are often complex in order to obtain the desired combustion properties for specific applications.

The majority of the plants manufacturing military propellants are government-owned plants which are often operated by companies such as those previously listed, but other government plants may be government operated. In some instances the propellants for special military application are manufactured in company-owned plants.

2.2.3 Subcategory C – Load, Assemble and Pack Operations

Load, assemble and pack operations take materials that are manufactured in operations defined in Subcategories A, B, and D and/or materials derived from other industries and mix, compound, and assemble them into a usable form. Often it is impossible to distinguish between the load and pack operations of Subcategory C and the manufacturing operations of Subcategories A, B, and D. One example of this difficulty occurs in the manufacture of propellants at large, integrated plants. In these plants the materials making up the propellant are continuously mixed together and loaded into the finished units.

Examples of companies engaged in load, assemble and pack operations are Ireco, DuPont, Hercules, Olin and Aerojet General. In some instances, a company in the explosives industry may not be engaged in the manufacture of any material in Subcategory A. For example, a slurry blasting agent producer brings together a large variety of components prepared by other producers to formulate these into a wide spectrum of slurry type explosives and blasting agents.

Analogously in some Government-owned-Government-operated plants, materials are not manufactured but are obtained from outside suppliers (civilian, foreign and other military suppliers) and formulated into the desired munitions items. For example, at some U.S. Naval Ammunition Depots, TNT, and/or cyclotols are brought in and formulated with other additives into a variety of cast explosives for filling projectiles and bombs.

The civilian market in Subcategory C type explosives has grown or declined at the following rates for the years indicated:

TABLE 2.2.3

CHANGES IN U.S. CIVILIAN MARKETS FOR EXPLOSIVES IN SUBCATEGORY C

Explosive or Blasting Agent	Percent Change From 1972 to 1973	Percent Change From 1973 to 1974
Permissibles	− 4.1	− 4.4
Other High Explosives	− 2.4	− 1.8
Water Gels/Slurries	+16.5	+11.0
Processed Blasting Agents and Unprocessed AN	+ 2.0	− 2.0
Cylindrically Packaged Blasting Agents	+ 4.7	+ 8.0
Total Apparent Consumption of Industrial Explosives and Blasting Agents in the United States	+ 3.2	+ 0.3

Source: U.S. Department of Interior, Mineral Industry Surveys.

Another kind of load, assemble and pack operation performed in the civilian sector of explosive manufacturing involves the remelting and recasting of cyclotols and octols (RDX/TNT and HMX/TNT respectively). Such plants do not synthesize the component explosives of such mixtures but acquire these (in flake or pellet form for example) from non-domestic sources or from domestic military surpluses and by "melt and pour" techniques cast the explosives into boosters and primers for use in initiating charges of blasting agents.

RDX in homogeneous admixture with wax may also be hydraulically pressed at such plants into shaped charge configuration for use as jet tappers (perforators) in the steel industry.

2.2.4 Subcategory D – Manufacture of Initiating Compounds

This subcategory includes initiating compounds and a large variety of small-volume compounds which are usually classified as primary explosives, such as those used in the preparation of detonators, primers, boosters, detonating cord, and other initiating devices. Examples of highly sensitive explosives used for detonation include PETN, lead styphnate, tetryl, mercury fulminate, lead azide, and nitromannite (HMN). The subcategory does not include the loading of these compounds into specially designed containers for use as initiating devices.

Examples of companies who make initiating compounds are Hercules, Commercial Solvents, and DuPont. As far as we know, no initiating compounds are presently made at Government-owned-Government-operated facilities.

As noted in the Development Document, this subcategory is characterized by high waste loads per unit of product, probably due to batch processing of small quantities. The preparation of initiating compounds also requires the use of large quantities of water to thoroughly stabilize these sensitive products. The water is used to wash away trace impurities which contribute to the hazardous sensitization of these products during storage. Another significant contribution to the effluent waste load is made by the necessity for thorough cleanup procedures for equipment after each run. Generally such cleanup often requires the use of strong oxidizing or reducing agents, or caustic solutions, to effect rapid decomposition of solid waste materials.

The diversity of compounds in this subcategory makes it difficult to provide a framework which will assure uniformity of treatment methodology. The economic impact of effluent treatment costs will vary widely among the groups of firms engaged in these operations; single plants that manufacture a spectrum of such compounds will likely be heavily impacted by the need for separate treatment technologies.

Lead styphnate can be used as an example of the complexity of assessing the economic impact of wastewater treatment on a subcategory. For the waste material derived from cleanup and scrap collection procedures of this compound, there are at least three current and near future treatment processes (apart from detonation and combustion). These treatments handle such wastewater pollutants as trinitroresorcinol, sodium hydroxide, sodium dichromate, sodium carbonate, sodium aluminate, and sodium aminoresorcinol. Dissolved lead salts (and, more rarely, suspended solids) are also present in amounts determined by the efficacy of treatment. With PETN manufacture, a totally different and simpler array of wastewater pollutants is derived from the processing and cleanup operations associated with its manufacture.

2.3 INDUSTRY PRODUCT PRICES BY SUBCATEGORY

Because of the diversity of products produced in the explosives industry, individual manufacturing plants may have product prices that differ drastically from those of other plants. Estimated price ranges for products in the various subcategories of the industry are shown in the following table.

TABLE 2.3

ESTIMATED INDUSTRY PRODUCT PRICES BY SUBCATEGORY

Subcategory	Price Range Per Metric Ton
A	\$ 334 – \$ 677
B	\$ 1,800 – \$220,000
C	\$ 242 – \$ 8,500
D	\$22,000 – \$ 33,000

The extreme range in price of products in Subcategory B is due to the price of simple nitrocellulose at the low end of the range and by the price of specially formed high energy propellants (often requiring costly catalyst components) at high end of the range.

Subcategory C has a range which includes the prices of ANFO at the lower extreme and electric blasting caps at the higher extreme.

3.0 PROPOSED TREATMENT TECHNOLOGY AND ASSOCIATED COSTS

For this report, we have accepted the information on hydraulic loads, treatment technologies and associated costs contained in the Development Document. We have adjusted the effluent treatment costs from the 1972 level used in the Development Document to the 1975 level using the respective values of the Engineering News Record Construction Cost Index (1972 = 1780, 1975 = 2276) to allow comparison of treatment costs versus selling prices of explosives.

The Development Document presents treatment technologies and treatment costs for typical plants in each industry subcategory as shown in Tables 3.0A and 3.0B. It is obvious that some actual plants may have costs higher than the typical models while others may have extremely low costs. Wastewater treatment costs based on a model plant that covers an entire subcategory can become apparently economically impactive on a plant that is producing a low cost item in the subcategory. The wastewater volumes and treatment costs given in the Development Document appear to be logical for Subcategory A – Manufacture of Explosives. However, we would like to comment on corresponding data for Subcategory C – Load, Assemble and Pack Operations.

As will be described in the next section of this report, the production of ANFO blasting agents makes up a major portion of Subcategory C. The normal cleanup procedure in ANFO plants consists of dry cleanup techniques employing shovels, brooms and vacuum pickup. Very little water is used in cleaning ANFO plants so the 26,000 liters (6,810 gallons) per day figure given for a Subcategory C plant in the Development Document is far in excess of normal usage. We estimate that actual process contact wastewater in ANFO plants will only be from one to four percent of the Development Document estimate. Therefore any economic impact calculations will overstate the apparent cost of meeting Interim Effluent Guidelines, so the actual costs charged against the low priced ANFO product will be even less than indicated per unit of production.

While wastewater production of other types of plants in Subcategory C is larger than for ANFO plants, the volumes and costs appear to be large enough to cover other plants in this subcategory.

The January 1976 version of the Development Document includes multimedia filtration as the final process in the BATEA system for the model plant of Subcategory C. Originally this treatment technology included carbon adsorption as a final step, which caused the incremental annual cost of achieving the BATEA level to be $33,200 for the Subcategory C model plant. The incremental investment cost for carbon adsorption was $117,000. Carbon adsorption may be reinstituted for Subcategory C, if data gathered before promulgation of the 1983 effluent limitations show that carbon adsorption provides effluent load reduction commensurate with these costs. However, the present cost analyses have been done for Subcategory C by substituting the costs presented under BADCT for those shown under BATEA in Table 3.0B.

TABLE 3.0A

WASTEWATER TREATMENT COSTS FOR BPCTCA, BADCT AND BATEA EFFLUENT LIMITATIONS
(ENR 1780 – August, 1972 Costs)

Explosive Industry – Subcategory A

	RWL	Technology Level: BPCTCA	BADCT[2]	BATEA[2]
Average Production 36.2 x 10^3 kg/day (79.6 x 10^3 lbs/day)				
Production Days 260				
Wastewater Flow – kL/day 61 (gpd) (16,000)				
kL, 1,000 kg Product	1.68			
(gal/1,000 lbs)	(201)			
BOD Effluent Limitation – kg BOD/1,000 kg product[3]	1.46	0.10	0.092	0.028
mg/L	871	61	55	17
COD Effluent Limitation – kg COD/1,000 kg product[3]	3.87	1.08	0.94	0.23
mg/L	2,310	647	560	137
Total Capital Costs		**$192,000**	**$35,200**	**$108,000**
Annual Costs				
Capital Recovery plus return at 10% at 10 years		$ 31,400	$ 5,800	$ 31,600
Operating + Maintenance		11,400	2,000	6,400
Energy + Power		3,000	–	–
Total Annual Cost		$ 45,800	$ 7,800	$ 38,400
Cost[1] $/1,000 kg Product		4.87	0.83	4.04
($/1,000 lbs Product)		(2.21)	(0.38)	(1.84)

1. Cost based on total annual cost
2. Incremental cost over BPCTCA cost
3. kg/kkg product is equivalent to lbs/1,000 lbs product

Source: Development Document, January 1976

TABLE 3.0B

WASTEWATER TREATMENT COSTS FOR BPCTCA, BADCT AND BATEA EFFLUENT LIMITATIONS
(ENR 1780 – August, 1972 Costs)

Explosive Industry – Subcategory C

	RWL	Technology Level: BPCTCA	BADCT[2]	BATEA[2]
Average Production 14.8 x 10^3 kg/day				
(32.6 x 10^3 lbs/day)				
Production Days 260				
Wastewater Flow – kL/day 26				
(gpd) (6,810)				
kL/1,000 kg Product	1.76			
(gal/1,000 lbs)	(211)			
BOD Effluent Limitation – kg BOD/1,000 kg product[3]	0.0005	**	**	0.00014
mg/L	less than 1	**	**	less than 1
COD Effluent Limitation – kg COD/1,000 kg product[3]	0.08	**	**	0.017
mg/L	45	**	**	10
TSS Effluent Limitation – kg TSS/1,000 kg product[3]	0.92			
mg/L	523	50 mg/L	20 mg/L	10 mg/L
Total Capital Costs		**$14,300**	**$24,100**	**$117,000**
Annual Costs				
Capital Recovery plus return at 10% at 10 years		$ 2,350	$ 3,910	$ 19,100
Operating + Maintenance		$ 3,360	$ 1,250	$ 14,100
Energy + Power		700	550	–
Total Annual Cost		$ 6,410	$ 5,710	$ 33,200
Cost[1] $/1,000 kg Product		1.67	1.49	8.63
($/1,000 lbs Product)		(0.76)	(0.67)	(3.92)

1. Cost based on total annual cost
2. Incremental cost over BPCTCA cost
3. kg/kkg product is equivalent to lbs/1,000 lbs product

Source: Development Document, January 1976

TABLE 3.0B

WASTEWATER TREATMENT COSTS FOR BPCTCA, BADCT AND BATEA EFFLUENT LIMITATIONS
(ENR 1780 – August, 1972 Costs)

Explosive Industry – Subcategory C

			Technology Level		
		RWL	BPCTCA	BADCT[2]	BATEA[2]
Average Production	14.8 x 10^3 kg/day (32.6 x 10^3 lbs/day)				
Production Days	260				
Wastewater Flow –	kL/day 26 (gpd) (6,810)				
	kL/1,000 kg Product	1.76			
	(gal/1,000 lbs)	(211)			
BOD Effluent Limitation –	kg BOD/1,000 kg product[3]	0.0005	**	**	0.00014
	mg/L	less than 1	**	**	less than 1
COD Effluent Limitation –	kg COD/1,000 kg product[3]	0.08	**	**	0.017
	mg/L	45	**	**	10
TSS Effluent Limitation –	kg TSS/1,000 kg product[3]	0.92			
	mg/L	523	50 mg/L	20 mg/L	10 mg/L
Total Capital Costs			**$14,300**	**$24,100**	**$117,000**
Annual Costs					
Capital Recovery plus return at 10% at 10 years			$ 2,350	$ 3,910	$ 19,100
Operating + Maintenance			$ 3,360	$ 1,250	$ 14,100
Energy + Power			700	550	–
Total Annual Cost			$ 6,410	$ 5,710	$ 33,200
Cost[1] $/1,000 kg Product			1.67	1.49	8.63
($/1,000 lbs Product)			(0.76)	(0.67)	(3.92)

1. Cost based on total annual cost
2. Incremental cost over BPCTCA cost
3. kg/kkg product is equivalent to lbs/1,000 lbs product

Source: Development Document, January 1976

4.0 PRESCREEN OF ECONOMIC IMPACT OF EFFLUENT GUIDELINES

4.1 PRESCREENING METHODOLOGY

The objective of the prescreen was to provide EPA with sufficient information to permit it to choose which industry subcategories it could eliminate from further study by ADL. Of course, eliminating some of the subcategories would permit a more cost-effective utilization of the available resources for studying the economic impact of the proposed effluent guidelines.

For any prescreen process to be effective, it must:

- Exclude only those subcategories for which there is strong evidence readily available that the economic impact would be insignificant; and

- Not consume a large amount of the available resources.

Initiating the study, ADL interviewed its own experts for each industry category to develop information which characterized the industry, its markets, its pollution control practices, and any consideration the industry expert felt EPA should know about respective industry subcategories. To guide the experts on the kind of information they should provide, we developed an outline in tubular form of the information needed.

The experts were instructed to prepare their comments utilizing only personal knowledge or information that was immediately available to them in completing the information table for their respective industry subcategories. In many instances, there were areas in the information table on which no comment was possible, either because the expert did not have the requisite information immediately available to him, or because the answer was too complex for answering at the prescreen level.

The information contained in the experts' comments and on the information table not only provided the basis for our recommendations concerning the categories EPA should consider eliminating, but also generalized the condition of the industry with respect to the proposed regulations.

In developing our recommendations, we wanted to have a high degree of certainty that any category we recommended for elimination could not, on further study, be shown to be seriously impacted. Thus, we developed four criteria, any one of which, if met by an industry subcategory, would be enough to give a tentative classification as a subcategory for elimination. Before we recommended that EPA consider elimination of a subcategory from further study, we made an overall assessment involving other data known to the industry expert. The criteria are as follows:

(1) The industry subcategory is generating no wastewater.

(2) The ratio of BPCTCA plus BATEA to selling price is less than 2% and/or the ratio of BPCTCA plus BATEA to profits is less than 15%.

(3) Most of the plants in the subcategory are currently discharging into municipal sewage systems and may continue to do so with little or no pretreatment costs incurred.

(4) Most of the recommended treatment facilities have already been installed in most of the plants in the subcategory.

Criterion (1) obviously represents the strongest reason for eliminating an industry from further study. If the industry does not discharge wastewater, water pollution regulations will have no impact upon the industry.

Criterion (2) is based on discussions with ADL economic experts. We decided that, if this criterion were met, the proposed standards would likely not result in a significant economic impact. Often, our experts had no profit margin information available. In those instances, when the ratio of treatment cost to selling price was less than 2%, we still recommended that EPA consider removing the subcategory from further study. However, this recommendation is not so strong as the recommendations made using profit information.

In considering treatment cost/selling price and treatment cost/profit margin ratios, it is important to realize that the treatment costs presented in the Development Document are for a total treatment system and represent the costs incurred by a plant having no wastewater treatment already in place. Most facilities within the eight industries studied under this contract have some form of wastewater treatment already installed.

Criterion (3) also represents a very strong reason for eliminating a subcategory from further study. If the wastewater treatment practice within a subcategory consists mainly of discharging to municipal sewage systems, the cost of that treatment is already being incurred via sewer charges. If the subcategory can continue this practice, be consistent with the pretreatment standards set forth in the Development Document, and yet incur little or no pretreatment cost, then the incremental economic impact to that subcategory will be nil. Since the Development Document does not provide pretreatment costs, Criterion (3) was used to eliminate a category only when it was very clear that pretreatment would be either unnecessary or minimal.

Criterion (4) represents a reason for eliminating an industry from further study on the basis that, should the industry meet Criterion (4), it will not have to expend as much money as the Development Document indicates to meet the proposed standards.

The wastewater treatment already installed to meet other Federal or State regulations may be adequate to meet the requirements of the proposed guidelines. Therefore, the incremental treatment costs attributable to the guidelines may be zero for many facilities. In any event, the treatment costs in the Development Document represent maximum costs, so that for plants with treatment facilities in place we expect that actual costs will be less than indicated by the Development Document and the 2 percent or 15 percent criteria used in the prescreen process are therefore conservative.

4.2 ECONOMIC AND TECHNOLOGICAL FACTORS

Economic and technological information is presented in Table 4.2. In Subcategory A, the only commercial explosive is nitroglycerin and the associated production of dynamite. The total of BPCTCA plus BATEA unit treatment costs is estimated to be 1.7 to 3.4% of estimated selling prices. The corresponding figures for BPCTCA alone are 0.9 to 1.9% of selling price. These estimated costs are low enough so that we do not judge them to be economically impactive. As mentioned in Section 2.1, we expect that the nitroglycerin dynamites will essentially disappear from the market in the next five years so that only the BPCTCA cost is likely to be felt by the industry.

BPCTCA plus BATEA treatment costs versus selling prices vary from 0.10 to 12.5% for Subcategory B, from 0.05% to 1.7% for Subcategory C and from 195 to 293% for Subcategory D.

The Development Document indicates a BPCTCA treatment for Subcategory C that costs $2.14 per metric ton. On the cheapest packaged ANFO products this treatment cost amounts to 0.9 percent of their sales prices. This cost is judged to be economically nonimpactive, especially since the cost appears to be overstated for the reasons given in Section 3.0 of this report.

The BATEA process presented in the Development Document was based on carbon adsorption while the BATEA technology now recommended is based on multi-media filtration. Addition of the presently recommended BATEA process brings the total treatment costs to $4.05 per metric ton or a maximum of 1.7 percent of the selling price of the cheapest ANFO products. Had the original carbon adsorption step been retained, the costs would have been $13.17 per metric ton or 5.4% of the ANFO sales price. Since ammonium nitrate is the

TABLE 4.2

INFORMATION TABLE – COMMERCIAL EXPLOSIVES INDUSTRY

Industry Data	A. Manufacture of Explosives	B. Manufacture of Propellants	C. Load and Pack Plants	D. Manufacture of Initiating Compounds
	Subcategories			
1. Annual Production (units/yr)	See Section 2.1	Not Determined	See Section 2.1	Not Determined
2. Production Value ($MM sales)		Not Determined		Not Determined
3. Representative Range of Unit Selling Price,* ($/metric ton)	$334-677	$1800-220,000	$242-8500	$22,000-$33,000
4. Estimated Profit Margin (% of selling price)	15%	Not Determined	7-15%	Not Determined
5. BPCTCA (1977) Treatment Cost** ($/metric ton)	$6.22	$162	$2.14	$47,180
6. BATEA (1983) Treatment Cost** ($/metric ton)	$5.17	$62.1	$1.91	$17,260
Technical and Economic Factors Pertinent to Economic Impact Analysis				
Technical Factors				
7. Possibility of drastically reducing or totally eliminating wastewater flow rate, compared to Development Document.	Low	Low	High	Low
8. Possibility of substantially reducing cost of end-of-pipe treatment via in-plant changes and/or process modifications.	Low	High	Low	Low
9. Fraction of plants with substantial wastewater treatment facilities in place.	Low	Low	Low	Low
10. Fraction of plants presently discharging into municipal wastewater treatment facilities.	Low	Low	Low	Low
11. Frequency or likelihood of plants sharing waste treatment facilities. with other manufacturing operations	Low	Low	Low	Low
12. Degree to which proposed treatment departs from currently employed treatment.	High	High	High	High
13. Seriousness of other pending environmental control problems (including OSHA).	High	High	Probably Low	Probably Low
Economic Factors				
14. BPCTCA plus BATEA unit treatment cost as percent of unit selling price.	1.7%-3.4%	0.10%-12.5%	0.05-1.7%	195%-293%
15. BPCTCA plus BATEA unit treatment cost as percent of unit profit margin.	11.3%-22.7%	–	0.3-24%	–
16 Would the demand for the industry's product be significantly affected by a 10% increase in price?	No	No	No	No

*Selling prices are based on 1975 estimates.

**BPCTCA and BATEA treatment costs have been adjusted from 1972 to the 1975 level using the Engineering News Record Construction Cost Index (1972 = 1780, 1975 = 2276).

principal ingredient in wastewaters from the civilian sector Subcategory C plants, it is doubtful that a carbon adsorption process would be cost effective. Nevertheless, carbon adsorption may be reinstituted for Subcategory C, if data gathered before promulgation of the 1983 effluent limitations show that carbon adsorption provides effluent load reduction commensurate with the costs.

The importance of determining the appropriateness of the BATEA treatment costs attributed to ANFO and other NCN products is obvious when it is realized that products of this type make up almost 90% of the tonnage of civilian explosives products. If the higher BATEA treatment costs are necessary, the shift from off-site mixing to on-site mixing will be accelerated due to the fact that on-site mixing is not covered by the guidelines and will not incur the concomitant treatment costs.

Because of the wide range of treatment costs versus selling prices in Subcategories B and D, it is not possible to state that plants in these subcategories will not experience an economic impact from the Interim Final Effluent Guidelines. Certain plants in these subcategories will undoubtedly have very small impacts, but on an overall basis the subcategories will apparently be impacted. Further study of plants in Subcategories B and D will be required.

5.0 ECONOMIC IMPACT OF THE INTERIM FINAL EFFLUENT GUIDELINES ON THE CIVILIAN EXPLOSIVES INDUSTRY

As stated in Section 4.2, we do not expect that the Interim Final Effluent Guidelines will have a significant economic impact on the civilian sector of Subcategory A, Manufacture of Explosives. The BPCTCA costs amount to 0.9 to 1.9% of the selling prices of products in this subcategory. The total of BPCTCA plus BATEA unit treatment costs is estimated to be 1.7 to 3.4% of estimated selling prices. These costs are low enough so we do not judge them to be economically impactive. As mentioned in Section 2.1, the dynamite industry is presently in a state of decline. In 1960 dynamites based on nitroglycerin were the major commercial explosives in the United States. Even as recently as 1965 the consumption of dynamite type explosives (based on nitroglycerin) was still approximately equal to the consumption of ammonium nitrate-fuel oil (ANFO) blasting agents. At the present time, blasting agents based on ammonium nitrate in admixture with a variety of nonexplosive sensitizing fuels have taken over approximately 90% of the civilian explosives market. We estimate that dynamite will be essentially eliminated from the explosives market in the next five years. (Manufacture of nitroglycerin for propellants in Subcategory B will continue.)

Because of the above-mentioned industry sales trends as well as increased costs to meet OSHA regulations, we expect that companies still producing nitroglycerin dynamites will gradually shift to production of blasting agents based on slurries or water gels as well as ANFO products. Therefore we do not expect this industry to see the effect of the Subcategory A BATEA costs because the industry would be converted into the Subcategory C classification by 1983. Because the plants would be expected to remain in the same locations, effects on employment and communities would be insignificant.

The BPCTCA treatment costs for Subcategory C (Load, Assemble and Pack Operations) will only amount to 0.9% of sales prices of the cheapest ANFO products. The presently contemplated BATEA process would give a combined cost for BPCTCA and BATEA that would be 1.7% of the ANFO selling price. Under our criteria neither the BPCTCA cost nor the combined costs are judged to be economically impactive.

As was discussed in Section 3.0 of this report, the typical ANFO plants will not have the volume of wastewater indicated in the model plant of the Development Document. Therefore, the costs will be even lower than calculated above. Other plants in this subcategory producing water gels and slurries may approach the water usage of the model plant. Prices for water gels and slurries are higher than for ANFO so we are confident that all Subcategory C plants will show no significant economic impact from the Interim Final Effluent Guidelines.

Within relatively wide limits, the demand for blasting agents is price inelastic. Our contacts with several distributors indicated that the 15% rise in prices for blasting agents in 1975 due to rises in ingredient costs had no apparent effect on sales volume. Therefore we expect that the added costs of treatment would be passed on directly to consumers in the form of modest price increases. We do not believe that these relatively small treatment costs of 0.9 to 1.7% would be taken from company profits nor would they cause significant shifts in modes of operation in the industry. On the other hand, if large increases in costs due to effluent controls were imposed, the prevailing shift from off-site mixing to on-site mixing of ANFO at mines would accelerate because on-site mixing is not covered by the guidelines. A corresponding shift from off-site to on-site mixing of packaged water gels and slurries is not envisioned because of the greater difficulty of processing these materials at a mine site. The large business in on-site mixing of slurries and water gels for direct addition to bore holes is expected to continue. These operations are conducted by the companies that have patents on blasting agent compositions or by their licensees working on a royalty basis.

Subcategory C plants have few pressing OSHA problems and plants in this subcategory should be able to accomodate the costs of meeting the Interim Final Effluent Guidelines with a minimum of difficulty. Therefore, we anticipate no significant effects on employment or on communities. Because of the highly competitive conditions in areas that use large amounts of blasting agents, the price changes should be minimal and will probably consist of a simple pass through of the minor treatment costs to be borne.