Environmental Policy and Technology Project

Contract No. CCN-0003-Q-09-3165-00

UKRAINE
Waste Management Practices by Industries in Donetsk Oblast

Delivery Order #9, Task U-1, Subtask 2.1
August 1997

Prepared for:
U.S. Agency for International Development
Regional USAID Mission to Ukraine, Belarus & Moldova

Bureau for Europe & the New Independent States
Office of Environment, Energy & Urban Development
Environment & Natural Resources Division

Prepared by:
Ukraine, Belarus & Moldova Regional Office
Environmental Policy and Technology Project
For the New Independent States of the former Soviet Union

A USAID Project Consortium Led by CH2M HILL

PREFACE

Under the 1992 Freedom Support Act, the United States Congress initiated a program to provide various forms of assistance to new independent states (NIS) of the former Soviet Union Cooperative Agreements were signed between representatives of the U S government and each country in which assistance was to be undertaken The U S Agency for International Development (USAID) was given the responsibility to coordinate all U S government assistance to the NIS under the Act

Through competitive bidding, USAID awarded a multi-year contract to a team managed by CH2M HILL International Services, Inc (CH2M HILL) to support implementation of an environmental assistance program to republics of the former Soviet Union Under this contract, termed the Environmental Policy & Technology (EPT) Project, CH2M HILL is to assist USAID's missions in Moscow, Kyiv, and Almaty undertake a program to promote environmental improvements in the NIS The USAID mission in Kyiv supports environmental, and other, assistance programs to Ukraine, Belarus, and Moldova CH2M HILL established an office in Kyiv from which to perform services in these countries under the EPT Project

This report was prepared as a contractually required deliverable under a contract between USAID and CH2M HILL Although work on this report was conducted in cooperation with the assisted governments and USAID, the findings and recommendations are those of the CH2M HILL team They do not necessarily represent official positions of the governments of the assisted countries nor of the United States of America

The CH2M HILL team includes the following organizations

- Center for International Environmental Law
- Clark Atlanta University/HBCUMI Environmental Consortium
- Consortium for International Development
- Ecojuris
- Environmental Compliance, Inc
- Harvard Institute for International Development
- Hughes Technical Services Company
- International Programs Consortium
- International Resources Group, Ltd
- Interfax Newsagency
- K&M Engineering
- Ogden Environmental and Energy Services Company
- Price Waterhouse
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TABLE OF CONTENTS

ABBREVIATIONS, ACRONYMS & GLOSSARY

CH2M HILL	CH2M HILL International Services, Inc , which is a U S -based international environmental engineering consulting firm under contract to USAID to implement a large component of the EPT Project
DO	Delivery Order
EPT	Environmental Policy & Technology (Project) A USAID-funded program to provide environmental assistance to New Independent States of the former Soviet Union
MEPNS	Ministry for Environmental Protection & Nuclear Safety of Ukraine
MEPNS-DO	The Donetsk Oblast office of MEPNS
NIS	New Independent States (of the former Soviet Union)
oblast	A government territorial-administrative unit in the former Soviet Union that is still in use following Ukraine's independence A U.S analogue would be something between a state and a county
USAID	U.S Agency for International Development
USEPA	U S Environmental Protection Agency

Section 1

INTRODUCTION

As part of a United States government bilateral assistance program, the U S Agency for International Development (USAID) is supporting environmental management in Ukraine. Under direction from USAID, a consortium led by CH2M HILL International Services, Inc (CH2M HILL), is implementing part of USAID's Environmental Policy & Technology (EPT) Project by undertaking various tasks that have been agreed to by representatives of the governments of both countries

USAID authorized CH2M HILL to perform a series of tasks in Ukraine under Delivery Order (DO) No 9 Task U-1 (Donetsk Industrial Waste Management) included a requirement (Subtask 2 1)[1] for CH2M HILL to prepare a *Summary Report on Waste Management Practices* by major industrial enterprises in Donetsk oblast The report is to include the following

- an outline of the system of hazardous waste classification, or criteria (this is presented in Section 2 herein)
- preliminary estimates of the volume of each major type of hazardous waste (this is addressed in Section 3 herein)
- the approximate number of hazardous waste generators (this is also addressed in Section 3 herein)
- types of treatment and/or disposal of hazardous industrial waste (this is addressed in Section 4 herein)

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[1] Subtask 2 1 of Delivery Order 9, Task U-1 states *Activity 2 1 Review [Waste] Management Practices -- The contractor shall conduct a review of the types of practices used in the Oblast to manage solid industrial waste which either exhibits or has the potential to exhibit hazardous characteristics The information compiled by the contractor shall be used to establish baseline information for future decision making. The contractor shall clearly identify the criteria, including but not limited to regulatory standards or criteria, it used to include waste types in the evaluation The term solid waste shall be broadly considered to include liquids that are not otherwise monitored or regulated specifically as liquid waste The contractor shall attempt to establish very preliminary estimates of the approximate volumes of each type of waste generated, the approximate number of generators and/or other types of waste handlers for each type of waste, and the treatment and/or type of disposal methods used for each type of waste This activity will depend mainly on review, summarization, and analysis of existing information and data. Where new data are required, the contractor will provide assistance to the [Donetsk] Oblast in identifying a strategy and procedure for collecting needed data The contractor shall prepare a brief report, including a translation in Ukrainian, regarding its findings*

In addition, the list of deliverables to be submitted to USAID as part of Task U-1 includes a *Summary report on Waste Management Practices*

This document is in response to USAID's requirement In keeping with the scope of work, the report was prepared from a document compiled by the Donetsk Oblast office of the Ministry for Environmental Protection and Nuclear Safety of Ukraine (MEPNS-DO), using readily available information The MEPNS-DO document was prepared in the Russian language, and is therefore viewed as fulfilling the scope of work requirement to provide " *a translation in Ukrainian* ", as Russian (not Ukrainian) is the predominant language spoken and read in Donetsk oblast, in view of its historical and geographical aspects

Section 2

HAZARDOUS WASTE MANAGEMENT CRITERIA USED IN DONETSK OBLAST

Hazardous industrial waste in Donetsk oblast, and throughout Ukraine, is managed largely on the basis of a waste classification and reporting system established by the Ministry of Health when Ukraine was part of the Soviet Union, and which has been continued following independence in 1991 This classification system, an English-language translation of which is presented in Appendix A, differs from approaches and definitions used by Western countries Classification is based on criteria that involves a complicated calculation method using information on waste composition, toxicity data from published sources, and volatility and solubility characteristics of individual chemical components within the waste Wastes are categorized according to four different classes of hazards (Hazard Class I, II, III and IV) The lower the hazard class number, the more toxic or hazardous is the waste (i.e. Class I is the most toxic). Local regulators generally consider the first three classes as hazardous

The scientific accuracy of this method is questionable Wastes appear to be categorized in part by the characteristics of some chemical constituents within it, instead of on the toxicity, volatility, and/or solubility of the entire material Further, the standards and classification methodologies do not appear to be readily comparable with methods typically used by commerce and regulatory agencies of other countries This system does not appear to be intended for practical, engineering management of hazardous industrial wastes.

The MEPNS-DO does not undertake any actual field testing or physical auditing of waste streams at industrial facilities Rather, the agency derives statistical waste information from data reported by industrial enterprises to other agencies, particularly the State Committee for Statistics. A major source of waste information are forms filled out by industries in conformance with the normative document *Provision Classifier of Toxic Industrial Waste and Recommendations on the Determination of Waste Toxicity* (approved by the USSR Ministry of Health and GKNT USSR 13. 05. 87, # 4286-87 -- see Appendix A) The determination of the hazard class is based on estimates of the percentage of the most toxic elements in the waste, taking into account the concentration, solubility and volatility of these elements.

The majority of industries in the oblast submit forms based on the *Provisional Classifier* without conducting any analytical testing to determine waste toxicity. Enterprises in the chemical, machine-building and other industries that have special laboratories may conduct waste composition analyses to determine the hazard class There are, however, no standardized test methods, and little or no reference is made to Western techniques or laboratory methodology, including quality control and quality assurance procedures.

There is a registration system for reporting existing waste inventories, however it appears to be ambiguous, inaccurate, and rarely enforced. There is no common form for recording hazardous waste inventories at facilities that generate, treat, store, or dispose of hazardous waste Enterprises are required to report to the government twice a year their waste

generation and re-use, according to the Form #14-MTP -- *The Account of Secondary Raw Materials and Industrial Waste Generation, Utilization and Delivery* However, these forms are not submitted to environmental regulatory agencies, and only require reporting of very specific wastes Since 1992, new state statistic registration Form # 1 has been used *The Account of Toxic Waste Generation, Utilization and Disposal*, which is to be returned to local environmental regulatory organizations Industrial facilities use their own interpretations as to what they should and should not report on this form Consequently there are many wastes, e g coal-mining waste, overburden rock and ash, which are not reported.

Section 3

HAZARDOUS WASTE GENERATION BY MAJOR INDUSTRIES IN DONETSK OBLAST

The MEPNS-DO has identified 61 major industrial waste generators within Donetsk oblast, these are listed in Appendix B by location and again by enterprise type Information presented below should be considered in the context of data completeness and quality issues outlined in Section 2

According to MEPNS-DO information, Donetsk oblast has some 3.5 billion tons of industrial solid waste that occupy an area of about 10,000 hectares (the total oblast territory is about 26,500 square kilometers) Based on the waste classification system outlined in Appendix A, the MEPNS-DO believes that more than 1,000,000 tons of waste fall within the first three (hazardous) classes, about one-half of which is not treated or stabilized The leading industries contributing to the solid waste (defined to include solids, semi-solids, and sludges) problem are mining, iron and steel plants, non-ore materials mining, and electric power generation Mining enterprises are estimated to have contributed more than 2 billion tons to the overall waste, iron and steel plants more than 600 million tons, and thermoelectric power stations more than 130 million tons.

Although the annual production of industrial wastes has decreased due to the severe decline in industrial output, there is still a large volume of hazardous waste disposal in the oblast. The 1994 and 1995 estimates of annual solid hazardous waste discharges (around 60 million tons per year) can be compared against the 100 million tons reported in 1990 Of the 1995 levels, roughly 10 million tons of waste were recycled or treated for product recovery purposes

levels of nickel, lead, zinc, ammonium, and barium-containing elements, and are improperly stored

4.4 NON-FERROUS MINERALS MINING AND PROCESSING WASTES

Open mining techniques are generally used for the extraction of fire-clay, carbonate metallurgical raw materials, brick-earth, marl for the concrete industry, and sand for building and other materials The waste includes overburden rock and off-grade materials of breaking, sorting, and cleaning This waste occupies a territory of about three hectares, which is a small compared to the volume of other industrial wastes generated within the oblast; furthermore, this waste is also relatively less toxic.

More than 100 enterprises in the oblast generate wastes with high concentrations of non-ferrous heavy metals. Many of these are in the form of galvano-sludges, which are discharged directly to the city's sewage system Existing wastewater treatment plants are not adequately equipped to deal with these materials, thereby polluting receiving waters.

4.5 WASTES FROM MANUFACTURING FACILITIES

One of the major waste management issues in Donetsk oblast is the treatment and utilization or disposal of machine-building industry waste These wastes include slags, spent sand, solvents, paint and solvent wastes, spent lubricants and coolants, emulsions, and others. There are no few proper storage and disposal facilities for these wastes, and very often they are deposited directly onto the back lots of the operating plant.

4.6 EFFLUENT FROM WASTEWATER TREATMENT PLANTS

These facilities are generally designed to treat wastewaters generated by domestic households. Some industrial enterprises discharge liquid wastes from their facility directly into sewers leading to the treatment plants, without first pre-treating their effluent This effluent is then concentrated into a single point of discharge to receiving waters, causing pollution downstream

4.7 COAL-FIRED POWER PLANT WASTES

Seven thermoelectric power stations operate in the oblast, all of which rely on coal. Ash from air quality control equipment is mixed with slag from the bottom of the coal burners, and is removed to dumps. The annual production of this waste is about 4.4 million tons, and the total estimated amount currently in storage is 130 million tons. Some 15-20% of these wastes are re-used, primarily by ferro-concrete technologies.

Appendix A

CLASSIFICATION SYSTEM FOR HAZARDOUS INDUSTRIAL WASTE IN UKRAINE

THE MINISTRY OF HEALTH OF THE USSR
THE STATE COMMITTEE OF THE USSR ON SCIENCE AND TECHNOLOGY

PROVISIONAL CLASSIFIER OF TOXIC INDUSTRIAL WASTES

AND

RECOMMENDATIONS ON THE DETERMINATION OF WASTE TOXICITY

Moscow, 1987

THE MINISTRY OF HEALTH OF THE USSR
THE STATE COMMITTEE OF THE USSR ON SCIENCE AND TECHNOLOGY

APPROVED
The Chief Sanitary Inspector of the USSR

G N Khliabich [Signature]

The 13th of May 1987

APPROVED
First Deputy Head of
the State Committee of the USSR on science and technology

L N Jefriemov [Signature]

The 15th of May 1987

 # 4286-87

Provisional classifier of toxic industrial wastes and recommendations on the determination of waste toxicity

Moscow, 1987

The Classifier is effective for 5 years and after this term it is to be revised.

Taking into consideration the practice of the Provisional Classifier application, an improved and updated Classifier of toxic industrial wastes having all-Union jurisdiction shall be developed It shall be consistent with the principles of the Unified System of classification and codification of technical and economic information which is a component of automatic systems of inventory control of national economy

Methods of assessment of a toxicity class of industrial wastes

1. General principles

To assign industrial wastes to the particular class of toxicity, a calculation method is used. It provides:

1 1 probabilistic principle to assess feasible impact of industrial wastes on the environment;

1 2 sanitary regulations and toxicometric parameters as the most important indicators for the assessment of feasible impact of industrial wastes,

1 3 assessment of a toxicity class of complex industrial wastes according to the content of toxic chemical compounds,

1 4 optimal combination of sanitary, toxicology, physical and chemical parameters easy to detect which enables to assess feasible impact of toxic matters on the environment,

1.5. interchangeability principle for some of the parameters.

2. Toxicity class assessment

2 1 Determination of the toxicity class according to the admissible concentrations (AC) of foreign chemical compounds in the soil:

2.1.1. The toxicity index (K_i) is calculated with the following formula:

$$(1)\quad K_i = \frac{AC}{(S + C_b)\, i}$$

AC -- admissible concentration of a toxic waste component in the soil;
S -- water solubility factor for a component; non-dimensional value,
C_b -- content of a component in the overall waste amount, tons per ton,
i -- ordinal number of a component

K_i shall be rounded off to the first sign after the division point.

2 1 2 After K_i calculated for all waste components, from 1 to 3 components with minimal K_i value are to be chosen Following conditions are to be taken into consideration (a) $K_i < K_{i+1} < K_{i+2}$, and (b) $2 K_i \geq K_{i+2}$

Then, total toxicity index (K_Σ) is defined with the formula

$$(2)\quad K_\Sigma = 1/n^2 \sum K_i,$$

where $n \leq 3$ After then, toxicity class is defined according to the Table 1

Table 1. Classification of soil foreign chemical matters according to the environmental danger

Calculated K_i	Toxicity class	Degree of danger
less than 2	I	extremely dangerous
from 2 to 16	II	highly dangerous
from 16 1 to 30	III	generally dangerous
more than 30	IV	slightly dangerous

2 2 Assessment of toxicity class in case of undefined AC for the soil

2.2 1 The toxicity index (K_i) is to be calculated for each toxic waste component separately with the formula (3) using component's DL_{50} value

$$(3)\ K_i = \frac{\lg LD_{50}}{(S + 0.1F + C_b)i}$$

F -- fugacity coefficient of a component;
For the rest of the symbols, see (1).

K_i shall be rounded off to the first sign after the division point.

2 2.2 After calculation of K_i for each toxic waste component, several (no more than 3) dominating components with lowest K_i values are to be taken. Following conditions shall be met· (a) $K_i < K_{i+1} < K_{i+2}$ and (b) $2K_i \geq K_{i+2}$.

Then, total toxicity index (K_Σ) shall be calculated for two or three dominating components with the formula (2) Toxicity class of this mixture is to be defined with the Table 2.

Table 2. Classification of chemical matters according to DL_{50}

Calculated K_I	Toxicity class	Degree of danger
less than 1 3	I	extremely dangerous
from 1 3 to 3 3	II	highly dangerous
from 3 4 to 10	III	generally dangerous
more than 10	IV	slightly dangerous

2 3 Assessment of a toxicity class in case of unidentified AC for the soil and unknown DL_{50}

When AC is unidentified and DL_{50} is unknown, but toxicity class values are detected for the air of operating zone then conditional LD_{50} values, calculated approximately according to toxicity class indexes for the air of operating zone given in the Table 3 shall be used in the equation (3).

Table 3. Toxicity classes for the air of operating zone and corresponding conditional LD_{50} values

Toxicity class for the air of operating zone	LD_{50} equivalent, mg/kg
I	15
II	150
III	5000
IV	more than 5000

3. Calculation of the toxic matters concentration limits in the overall mass of toxic wastes

The toxic matter concentration limit (C_I) in waste mass is calculated with the formula:

$$(4)\ C_I = \frac{\lg(DL_{50})_I \sum ai}{n^2 \overline{K}_{III}} - (S_I + 0.1F_I),$$

$\lg(LD_{50})_I$ -- LD_{50} logarithm for the component K_I of which defined with (3) is minimal.

$\sum ai$ -- the sum of K_I, K_{I+1}, K_{I+2} ratio to the minimal K_I value, that is:

$$\sum ai = 1 + \frac{K_{I+1}}{K_I} + \frac{K_{I+2}}{K_I}$$

S_I -- water solubility coefficient for the I component;

F_I -- fugacity coefficient of the I component,

K_{III} -- III class toxicity index

4. Calculation of AC for the soil, LD_{50}, coefficients of solubility in water and fugacity from the equations (1) and (3)

4 1 Admissible concentration and LD_{50} values can be taken from special reference books In case there are several LD_{50} values listed in the reference literature, the minimal LD_{50} value shall be taken for the calculation of toxicity index for different warm-blooded species

4 2. The technique to calculate S is following: standard solubility value of the particular chemical matter or compound in water in grams per 100 ml of water measured under 25 ^{0}C (see special reference literature) shall be divided into 100

The value of calculated non-dimensional coefficient S as usual belongs to the interval from 0 to 1.

4 3 The technique to calculate F is following: standard value of saturated steam pressure of the particular components (for those having boiling point not higher than 80 ^{0}C under the pressure of 760 mm of mercury column) in millimeters of mercury column under 25 ^{0}C shall be divided into 760 millimeters of mercury column

The value of calculated non-dimensional coefficient F as usual belongs to the interval from 0 to 1

5. Danger index calculation examples

Assume that 10 tons contain 8 tons of CCl_4 and 2 tons of $HgCl_2$.

5.1. CCl_4: boiling point = 76.5 ^{0}C; solubility in water = 0.08 grams per 100 grams of water. That is S comes to 0.0008.
Standard value of saturated steam pressure = 112.2 mm of mercury column. That is F comes to 0.15.
Then, according to the reference literature LD_{50} is (a) 9000 mg/kg for mice; (b) 5200 mg/kg for rats; and (c) 5760 mg/kg for rabbits and guinea-pigs.

Thus, $K_I = \dfrac{\lg(5760)}{0\,008 + 0\,015 + 0\,8} = 4.6$

5 2 $HgCl_2$ solubility in water = 6 59 grams per 100 grams of water, i e S = 0 01659

Minimal LD_{50} = 17 5 mg/kg (for mice), thus

$$K_2 = \frac{lg(17\ 5)}{0\ 01659} = 5\ 7$$

5 3 $$K_{\Sigma} = 0\ 25(4\ 6 + 5\ 7) = 2\ 3,$$

that is II class of danger

Appendix B

MAJOR HAZARDOUS WASTE GENERATORS IN DONETSK OBLAST

MAJOR HAZARDOUS WASTE GENERATORS IN DONETSK OBLAST

The Donetsk Oblast office of the Ministry for Environmental Protection & Nuclear Safety of Ukraine has listed 61 enterprises as being major waste generators within the oblast These are listed below by location, and by industrial category

B1 WASTE GENERATORS BY LOCATION

city Donetsk:

1 Donetsk Plant of Chemical Reagents
2. Donetsk Metallurgical Plant
3 Donetsk Coke Chemical Plant
4 Joint venture "Donkavamet" Metallurgical Plant
5 Production Amalgamation "Donetsk Coal"

city Mariupol:

6 Mariupol Metallurgical Plant, named after Illyich
7 Mariupol Metallurgical Plant "Azovstal"
8 Mariupol Coke Chemical Plant
9 Mariupol City Wastewater Treatment Plant
10 Mariupol Concern "Azovmash"

city Horlovka:

11 Horlovka Coke Plant
12. Horlovka Chemical Plant
13 Horlovka Concern "Stirol" Chemical Plant
14 Nikitovka Dolomite Combinat
15 Nikitovka Mercury Combinat
16 Production Amalgamation "Artem Coal"

city Yenakievo:

17. Yenakievo Metallurgical Combinat
18. Yenakievo Coke Chemical Combinat
19. Production Amalgamation "Orjonikidze Coal"

city Makeyevka:

20. Makeyevka Metallurgical Combinat
21. Makeyevka Coke Chemical Plant
22. Yassinovka Coke Chemical Plant
23 Makeyevka Pipe Casting Plant
24 Production Amalgamation "Makeyevka Coal"

city Kramatorsk:

25 Kramatorsk Thermal Power Plant
26 Kramatorsk Metallurgical Plant
27 Novokramatorsk Metallurgical Plant
28 Kramatorsk "Energomashspetzstal"
29 Kramatorsk Cement & Slate Plant

city Konstantinovka:

30 Konstantinovka Plant "Ukrzink"
31 Konstantinovka Metallurgical Plant, named after Frunze
32 Konstantinovka Chemical Plant

city Slavyansk:

33 Slavyansk Raion Power Plant
34 Slavyansk Production Amalgamation "Chemical Production"

city Artemovsk and surrounds:

35 Artemovsk Plant for Processing Non-ferrous Metals
36 Artemovsk Wastewater Treatment Plant
37 Chasov-Yarski Fire-Proof Materials Plant
38 Severski Dolomite Combinat

city Dzerzinsk:

39. Dzerzinsk Phenol Plant
40. Production Amalgamation "Dzerzinsk Coal"

city Debaltzevo:

41 Uglegory Raion Power Plant
42. Mironovka Raion Power Plant

city Druzhkovka:

43. Druzhkovka Machine-Building Plant

city Dobropolie:

44 Dobropolie Wastewater Treatment Plant
45. Production Amalgamation "Dobropolie Coal"

city Khartsizk:

46 Khartsizk Pipe & Cable Manufacturing Plant
47 Zuyevka Raion Power Plant

city Avdeyevka:

48 Avdeyevka Coke Chemical Combinat

city Yasinovataya:

49 Yasinovataya Machine-Building Plant

city Amvrosievka:

50 Amvrosievka Cement Combinat

city Dokuchayevsk:

51 Dokuchayevsk Flux-Dolomite Combinat

Volkhnovakha raion:

52 Donetsk Chemical-Metallurgical Plant (Donskoye Plant)
53 Velikoanadol Fire-Proof Materials Combinat

Maryino raion:

54 Kurakhovka Raion Power Plant

Starobeshevska raion:

55 Starobeshevska Raion Power Plant
56. Production Amalgamation "Donetsk Coal Preparation"
57. Production Amalgamation "Oktyabrsk Coal"
58. Production Amalgamation "Selydov Coal"
59 Production Amalgamation "Torez Anthracite"
60 Production Amalgamation "Krasnoarmeisk Coal"
61. Production Amalgamation "Shakhtersk Coal"

B2 WASTE GENERATORS BY INDUSTRIAL TYPE

The 61 major waste generators can be grouped according to industrial categories, as follows:

Coal Mining and Preparation Activities:

5 Production Amalgamation "Donetsk Coal"
16 Production Amalgamation "Artem Coal"
19 Production Amalgamation "Orjonikidze Coal"
24 Production Amalgamation "Makeyevka Coal"
40 Production Amalgamation "Dzerzinsk Coal"
45 Production Amalgamation "Dobropolie Coal"
56 Production Amalgamation "Donetsk Coal Preparation"
57 Production Amalgamation "Oktyabrsk Coal"
58 Production Amalgamation "Selydov Coal"
59 Production Amalgamation "Torez Anthracite"
60 Production Amalgamation "Krasnoarmeisk Coal"
61. Production Amalgamation "Shakhtersk Coal"

Metallurgical Plants:

2. Donetsk Metallurgical Plant
4 Joint venture "Donkavamet" Metallurgical Plant
6 Mariupol Metallurgical Plant, named after Illyich
7 Mariupol Metallurgical Plant "Azovstal"
17 Yenakievo Metallurgical Combinat
20 Makeyevka Metallurgical Combinat
26. Kramatorsk Metallurgical Plant
27 Novokramatorsk Metallurgical Plant
30 Konstantinovka Plant "Ukrzink"
31 Konstantinovka Metallurgical Plant, named after Frunze

Coke and Chemical Plants:

1. Donetsk Plant of Chemical Reagents
3 Donetsk Coke Chemical Plant
8 Mariupol Coke Chemical Plant
11 Horlovka Coke Plant
12 Horlovka Chemical Plant
13. Horlovka Concern "Stirol" Chemical Plant
18. Yenakievo Coke Chemical Combinat
21. Makeyevka Coke Chemical Plant
22 Yassinovka Coke Chemical Plant
32. Konstantinovka Chemical Plant
34 Slavyansk Production Amalgamation "Chemical Production"
39. Dzerzinsk Phenol Plant
48 Avdeyevka Coke Chemical Combinat
52. Donetsk Chemical-Metallurgical Plant (Donskoye Plant)

Non-Ferrous Minerals Mining and Processing:

14 Nikitovka Dolomite Combinat
15 Nikitovka Mercury Combinat
29 Kramatorsk Cement & Slate Plant
35 Artemovsk Plant for Processing Non-ferrous Metals
37 Chasov-Yarski Fire-Proof Materials Plant
38 Severski Dolomite Combinat
50 Amvrosievka Cement Combinat
51 Dokuchayevsk Flux-Dolomite Combinat
53 Velikoanadol Fire-Proof Materials Combinat

Manufacturing Facilities:

10 Mariupol Concern "Azovmash"
23 Makeyevka Pipe Casting Plant
28 Kramatorsk "Energomashspetzstal"
43 Druzhkovka Machine-Building Plant
46 Khartsizk Pipe & Cable Manufacturing Plant
49 Yasinovataya Machine-Building Plant

Wastewater Treatment Plants:

9 Mariupol City Wastewater Treatment Plant
36. Artemovsk Wastewater Treatment Plant
44 Dobropolie Wastewater Treatment Plant

Coal-fired Power Plants:

25 Kramatorsk Thermal Power Plant
33. Slavyansk Raion Power Plant
41. Uglegory Raion Power Plant
42. Mironovka Raion Power Plant
47. Zuyevka Raion Power Plant
54 Kurakhovka Raion Power Plant
55. Starobeshevska Raion Power Plant