JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
THE MINISTRY OF INDUSTRY AND TRADE
THE MINISTY OF GEOLOGY AND
PRESERVATION OF UNDERGROUND RESOURCES
THE REPUBLIC OF KAZAKHSTAN

No. 2

THE MASTER PLAN STUDY ON PROMOTION OF NON-FERROUS METALS INDUSTRY IN THE REPUBLIC OF KAZAKHSTAN

FINAL REPORT

SUMMARY

MARCH 1997

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MITSUI MINERAL DEVELOPMENT ENGINEERING CO.,LTD.
SUMIKO CONSULTANTS CO.,LTD.

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Preface

Two major site investigations have been carried out for the project "Master Plan Study on Promotion of the Non-ferrous Metals Industry (Copper, Lead, Zinc, and Associated Metals) in the Republic of Kazakhstan" since the project commenced in November, 1995. The results were consolidated into the Interim Report that was presented to the Steering Committee Meeting held on 23rd of October, 1996, at the venue of the Ministry of Industry and Trade in Almaty, Kazakhstan. The contents of the Interim Report were vigorously discussed between the members of the Kazakhstan side and the JICA Survey Team at the meeting.

The Final Report has been prepared on the basis of the results of the discussion, fully taking into account the requests indicated by the Kazakhstan side. The Report is divided into the main and the supplement reports; the main report includes the Master Plan for Promotion of the Non-ferrous Metals Industry based on the analysis of its present situation that is presented in the supplemental report.

This report summarizes the second part of the Final Report.

Finally, the JICA Survey Team wishes to express its sincere appreciation to the Kazakhstan counterpart ministries and the related institutions for their cooperation and assistance extended to the team in the course of the Master Plan Study. All the members of the Japanese Survey Team are very much obliged to staff members of the ministries institutions, combines, ministerial branches and local governments who cooperated and assisted them with their collection of information.

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Summary

Following the breakup of the Soviet Union in 1991 and the subsequent independence of the Republic of Kazakhstan, drastic changes have taken place in the republic's non-ferrous metal (copper・lead・zinc) industry. At present, this industrial base is being reconstructed, with the aim of building "an attractive industry", that will be independent and capable of moving forward in a market economy.

Although the international markets for base metals of copper・lead・zinc are mature markets, the demand for these metals is steadily increasing because they are important raw materials that support various industries. It is very important for Kazakhstan, a republic rich in natural resources, to economically develop these resources so that it can provide more value-added products in harmony with the environment. This will create an important pillar that will support the reconstruction of all its industries.

Problems facing the copper・lead・zinc industries of Kazakhstan:

・Development of stable markets (both domestic and overseas).

・Reconstruction of raw material base that is economical as an inland resource rich country

・Establishing independent production enterprise system for independent management.

(In order to solve the present problems)

① Huge debt

② Shortage of working capital

③ Superannuated production facilities

④ Lack of stable, continuous operations

(inconsistent product quality・rising costs・unreliable product delivery)

⑤ Cessation of new investments (including improvement・renewal)

・Measure for reliable supply of energy for these industries which tend to consume large amounts of energy

・Rationalizing raw material・product distribution

・Environmental protection・Establish pollution prevention measures

These problems cover all aspects of the industry.

In order to solve these problems and reconstruct Kazakhstan's industries so they contribute to the national wealth, the republic must: establish industrial reconstruction strategies based on resolute ideas and policies aimed at reconstruction and advancement. Both the public and private sectors must strive for advances in the industry by "planning, doing and observing." In other words, the republic must move forward as a whole and serve both as the focus of the movement forward and its impetus.

In this report, we make recommendations to be included in the master plan study on promotion of non-ferrous metal (copper, lead and zinc) industry in the Republic of Kazakhstan.

・Preparation and establishment of an industrial base in the target year of 2000.

・Stable industrial growth coupled with structural renovations, 2000 - 2005

・Activate the industrial structure and use high technology, 2005 -

These are our targets. Although we are taking a long-term view of this matter, the present proposals mostly emphasize short-term plans and measures. Our proposals are basic policies outlined below.

[Policy 1] Establish industry scale corresponding to the promotion.

Metal production amounts should be a yardstick for determining the size of the copper・lead・zinc industries in Kazakhstan.

・Forecasting market trends for metals, all of which are internationally marketable commodities.

・Future economic potential of natural resources of Kazakhstan, an inland nation in a market economy.

・Restrict these industries for environmental preservation.

After examining the above items, we set up the metal production on the following scale:

thousand tons/yr

	Production Estimate for 1996	Production Estimate for 2000	Production Estimate for 2001-2005	Production Estimate for 2006-2010
Electrolytic copper	320	360	380	380
Lead	90	120	130	130
Zinc	160	220	280	260

[Policy 2] Preparing production systems that are suitable for the size of the industry.

Current production enterprises are classified into three categories based on their present production capital potential (personnel・material・capital・information). The implementation of maintenance of the enterprise corresponds to its category・implement reform.

・Companies that have good potential (evaluated and classified as A).

Proceed with "privatization" based on the company's flexibility, efficiency and raising capital, all of which are qualities important to a private company's management, and in this manner build a sound capital enterprise.

・Companies that can be reconstructed and turned into companies with potential (evaluated and classified as B).

Depending on the special treatment of the accumulated debt, profitable assets and accumulation of capital, turn these companies into profitable companies.

・Companies that have no potential to continue in a market economy (evaluated and classified as C). If careful re-examination cannot find the company's future potential then close it down.

[Policy 3] Projects for investment in facilities:

Projects to accelerate the development of new mines having high potential and provide facility and equipment to prevent industrial pollution should be given the highest priority.

[Policy 4] Prepare an environmental protection system and aim at constructing industries that are environmentally friendly.

[Policy 5] Strengthen MIT's promotion support function

The MIT must take advantage of their public planning and authority in order to overcome the industry crisis caused by the sudden change in the base of the industry and create steady growth.

Establish policy and industry promotion toward related enterprises, supervision・inspection・strengthen the support function

[Policy 6] Provide promotion capital

① In principle, the companies themselves should be responsible for its supply of the necessary funds.

・Increase the internal finance

Retained profits - Items exempt from taxation

- Exempt reserve funds・Special depreciation

-Time limit for taxation・Exemption or limited reduction of tax

・Accelerate the smooth practical use of external funds.

As a means of direct financing: evaluate the company stock price and sell it・Introducing foreign capital.

As a means of indirect financing: Financing from export credit agency/multilateral agency

Project financing

Practical use of international financial institutions

National assistance to credit guarantee

② Cost supplement should be the basic rule for public corporation.

・Government's general accounting, investment and lending program.

・Two-step loan from international financial organizations

・Foreign aid

③ Basically, Kazakhstan should handle its own structural reforms, unprofitable businesses.

・The nation's special accounting (establishment of fund)

・Foreign aid

Summary of recommendations are as follows:

(1) Reform the constitution of the industry production organization to make it more profitable

1) Raw material bases should be restructured

- Develop new mines

Increase・decrease production at existing mines

- Withdraw from unprofitable businesses
- Modernize production lines

① Mine

・ Mining plan for potentially economical reserves in amount and quality
・ Renewal of equipment and facilities to improve productivity
・ Reduction of production costs
・ Investment plan

② Mineral dressing (Beneficiation)

・ Renewal and modernization of facilities
・ Improvement of concentrate quality
・ Reduction of costs of transporting concentrate
・ Treatment of waste and wastewater

2) Production of raw metals

- Corresponding to a stable supply of raw materials, readjust the facility capacity so that company will be able to stabilize their operations (Target: 2001)

① Copper

・ JSC "Zhezkazgantsvetmet"	Electrolytic copper: 200,000 tons/year, Own mine production
・ JSC "Balkhashmed"	Electrolytic copper: 150,000 tons/year, Own mine production and toll, Irtysh blister
・ JSC "UK Pb-Zn combinat"	(Blister: 70,000 tons/year, Domestic mine production) - (Irtysh Copper Smelter) Electrolytic copper: 30,000 tons/year, Irtysh Blister

② Lead

・ JSC "Leninogorsk PC"(Polymetal Combine):	40,000 tons/year, Battery scrap (Northern Kazakhstan area, Neighboring Russian areas)
・ JSC "UK Pb-Zn Combine":	60,000 tons/year, depending on lead concentrate from domestic mines
・ JSC "Shymkent Lead Plant":	50,000 tons/year Concentrate mainly from mines in ・ Uzbekistan ・ Tajikistan (Purchased concentrate ・ Toll) ・ Lead waste from copper smelter ・ Battery scrap (Southern Kazakhstan area, Neighboring CIS)

③ Zinc

- JSC "Leninogorsk PC": 100,000 tons/year, Polymetal mine in East Kazakh Province
- JSC" UK Pb-Zn Combine": 180,000 tons/year, Polymetal mine in East Kazakh Province

- Improvement of working environment conditions · improvement of pollution prevention facilities.
  In particular,SO_2 gas countermeasure in sulfuric acid production and exhaust gas desulfurization
- Stable product quality and quality certification · inspection · management
- Energy conservation measures

3) Processing industry

It is necessary to restructure the metal processing industry in order to reinforce competitiveness in terms of quality and price in the world market.

- Active market development in Kazakhstan · CIS, China and Southeast Asia countries

① Secondary processing of copper and its alloys

- Secure stable customers
- Completion of reconstruction and modernization of rolled metal production at JSC "Balkhashmed". Improvement of product quality.

② Manufacture lead batteries

- Accelerate construction work at the battery manufacturing plant in JSC "Shymkent Lead Plant".
- Affiliated companies involved in the recycling business.

③ Processing raw zinc metal

- Promote zinc galvanizing industries in cooperation with steel industries.
- Die-casting industries meeting the demands of the machinery industries in Kazakhstan and CIS.
- Manufacturing dry battery pellets

4) Restructure operation management system

Needless to say, each enterprise has a unified operation vision and will draft and develop an important operation strategy. The management of mining, beneficiation, smelting and processing companies should be separated into divisions. Each division should clarify its income and expenditures. Moreover, each enterprise makes and executes a short-term business plan (budget) then analyzes the difference between the goals and the actual results. Quick adjustments are necessary.

- Financial management

① Division of accounts for mining, beneficiation and smelting operations.

② Concentrate purchasing conditions

③ Understand the production costs regarding sales income for each product.

- Purchase management

① Withdraw from bartering and move toward purchasing with currency.

② Reasonable levels of inventories of raw and other materials and finished products.

③ Countermeasure for purchase of stable power and energy.

④ Rationalize distribution.

- Production Management

① Production plan under the condition of continuous operation and put it into practice.

② Facility maintenance and periodic repair plans

- Personnel Management

① Allocate workers according to the needs of the production process, quality rationalization and modernization

② Problem that part of the welfare costs should be borne by each individual worker and salary.

- Information Management

① Establish an enterprise database

② Share information within each enterprise and make good use of such information.

③ Secure and disclose secret information.

- Activation of organization

① Regarding the welfare division:

· Transfer this division to the provincial government.

· Make the division a separate enterprise.

· Establish the division as a enterprise in the third sector (semi-private company).

② Regarding the transportation division

· Make the division a separate company.

· Establish the division as a company in the third sector.

③ Make the engineering and repair division a separate company.

5) Important issues regarding the reform of the production system.

Classify the production enterprise according to its production capital potential. Specify important issues for reforming the production system. We recommend the following.

- East Kazakh Area (Polymetal)

① Developing new mines (increase the copper portion)

② Reinforce the copper smelter at Irtysh (70,000 tons/year)

③ Privatization, combining enterprises, strengthening cooperation among enterprises (building a network among enterprises)

① Businesses not related to the main business should be turned into separate companies.

- Lead smelter at Shymkent

① Accelerate realization of the lead battery manufacturing project.

② Custom smelter produces raw lead material mainly used for lead battery.

- Balkhash smelter

① Promote the development of its own mines. Close down unprofitable mines.

② Move forward the production project that uses the SX-EW process.

③ Proceed with the rationalization by changing the company's form.

(2) Market and market development

1) Perspective for base metal demand and world prices

- Increase according to the economic growth (note growth in Asia.)
- There will be no price change until 2000. Prices are expected to go up slowly after 2001.
- This market is mature. At present, there is an approximate balance between world supply and demand.
- The price of this product has poor elasticity, although prices may greatly fluctuate over the short term.

2) Market strategies for the Republic of Kazakhstan

- In order for the CIS market to recover, increase the number of customers and construct a good sales network.
- Participate in the growing Asian market (China and India)
- Establish product quality reliability and a stable supply.

3) Concrete strategic development

- Registration to LME

Stable production → Secure reliability of product quality・volume.

- Establish and nurture a Non-ferrous Metal Trading Firm.
- Establish a Trade Promotion Agency.

(3) Promote execution of the promotion plan

1) Promotion policy

- Decide on promotion measures for policy and important non-ferrous metal industry reconstruction promotion (making rules and regulations・budgetary measures)
- Cooperation of every related ministry and approval based on the law
- MIT make plans, guidance, support ・management for promotion countermeasures

-With respect to MIT and metal industry system (public corporations・semi-private companies・private companies):

① Strengthening guidance and support (Require that management committees・duty to report management information)

② Entrust to metal promotion agency the work for management support of public enterprise (except during management entrustment).

2) Establishment of promotion policy support organization (example establishment and management of metal industry policy committee)

- Exploration Agency (jurisdiction of Ministry of Geology・public corporation)
- Non-ferrous Metal Promotion Agency (jurisdiction of MIT・public corporation)
- Non-ferrous Metal Trading Firm (jurisdiction of MIT・Semi-private company)
- Trade Promotion Agency (jurisdiction of MIT・public corporation)
- Society of Non-ferrous Metal Industry (voluntary group by members)

3) Roles of the provincial government

- Adjustment of employment
- Accept public welfare work (controlled by government or making semi-private company.)
- Establishment, investment ,management of semi-private enterprise for promotion of local industry company.
- Participate in Environmental Control Technology Center (・a public corporation).

4) Support through revision of laws

- Tax system: Establish a favorable tax law for industry promotion.
- Foreign capital law, provide incentive for participation to foreign capital.
- Company laws, Enterprise accounting laws

① Company inspection system (strengthen inspection・inspector from outside company)

② Adoption of exemption/depletion system

- Laws concerning privatization

① Make law for management contract system concerning time limit.

② Enact approval items to private company for underground resource industry.

- Financial countermeasures

① Project finance

② Introducing foreign capital

③ Examination for establishing Metal Industry Promotion Fund

① Special account

(4) Environmental protection

Combination of natural environment and implementation of environment protection as components for the maintenance and development of industry.

To protect the environment, prevention countermeasures must be done related by production enterprise-region-government

- Pollution control for production activity of enterprise
- Develop environmental standards and management standards
- Establishment of inspection and control system

1) Role of the Ministry of Environment

- Nationwide environmental protection
- Establishment of environmental standards

2) Environmental control and inspection by MIT

- Environmental protection to deal with manufacturing activities

3) Environmental control and inspection of each area

- Establish the Environmental Control Technology Center

4) Treatment and control of industrial waste

- Control standards
- Recovery of valuable material

5) Improving the working environment

(5) Industry information system

It is necessary to collect, sort and disclose accurate information for quick treatment for the change of enterprise management, environment condition · for introduction of foreign · promotion of foreign investment.

- Internal enterprise information system
- Foreign market information
- Establishment of industry information system and disclosure of information
- Industry statistics

(6) Aid from foreign countries

For the reconstruction and promotion of the Kazakhstan industry, technical cooperation from western countries is needed for the important issues of the industry for economical cooperation, for example foreign financial aid.

1) International cooperation organization

- Financial aid

- Development aid

2) Technical cooperation items

- Exploration for new mines
- Environmental protection (control center・training)
- Rationalization・modernization of production

① Make feasibility study

② Energy conservation measures

③ Control, inspection and guarantee of product quality

- Management control (dispatch qualified consultant・training)

Recommendations will be put into a plan which is listed as one idea of the action plan. The action plan consists of:

- Actual plan for metal production
- Actual plan of supporting countermeasures
- Possibility of foreign aid to each industrial issue
- Development plans to promote governmental industry promotion policies

Currency Exchange Rate in this Report

Year	TENGE/US$	TENGE/RUR
1994	35	16.0
1995	60	13.5
1996~	65	--

*Ref. 1.66 JY/Tenge in Fy 1995

(JY : JAPANESE YEN)

1. Concept of Master Plan

1. Concept of Master Plan

Since 1991, the non-ferrous metals industry of the Republic of Kazakhstan has been facing to the fundamental change due to the collapse of the former USSR system. Based on the new foundation, the non-ferrous metals industry needs to make an industry innovation development strategy and a plan to implement change at a high level.

(Past)

The Kazakhstan non-ferrous metals industry was a major base for production and supply of metals under the state planned economy of the former USSR.

(Present)

Kazakhstan is located in the CIS economic region. Under the market economy, the market has changed to a global market. The Non-ferrous Metals Industry produces valuable processed goods using underground mineral resources and produces and sells the profitable goods. The continuous development of the industry contributes to the national wealth.

(Future)

Based on the new foundation for industry, it must produce competitive goods for development and restoration. The competitive goods are as follows:

① The quality must be suitable to international standards and guaranteed.

② Be able to manage production costs that fluctuate with the international price.

③ Be able to supply stability for the client.

Establish industry organization for independent and continuous development and profitability.

Master plan for non-ferrous metal industry promotion (shown on Figure 1 (1))

Escape Crisis Situation	Establish Industry's Foundation	Industry Innovation	Industry Activity Changes to High Level

1-1 Ultimate Goal

The ultimate goal of the Master Plan is to reconstruct the presently troubled non-ferrous metals industry in the Republic of Kazakhstan so that the industry can substantially contribute to the national economy under market economy conditions. It is desirable that the industry provide its products necessary for social development at prices competitive on the world market. The industry should also be conscious of the global environment and human health and safety, and operate in harmony with the environment and society.

1-2 Objectives

1-2-1 Short Term Objectives (1996-2000)

(1) To rescue the industry from its present troubled state.

(2) To established an industrial base so that the industry becomes competitive under market economy conditions.

(3) To establish environmental conservation and monitoring systems.

(4) To establish systems for resource exploration and mine development.

1-2-2 Medium Term Objectives (2001-2005)

(1) To reform industrial fundamentals and production systems.

(2) To reform the industrial structure.

1-2-3 Long Term Objectives (2006 onward)

(1) To make the profitable operation sustainable.

(2) To establish the base of the industrial growth.

1-3 Basic Strategy for Promotion of the Non-ferrous Metals Industry

The non-ferrous metals (copper, lead, zinc and associated metals) industry of the Republic of Kazakhstan is facing crucial difficulties due to a huge amount of accumulated debt, lack of working capital, shortage of raw materials and other necessary supplies, increasing costs, obsolete facilities and equipment, and so forth. In order to restore the currently troubled Industry, effective measures have to be taken based on the following basic strategies;

(1) The Kazakhstan Government should place the restoration of the Industry in one of the most important items in its economic policy.

(2) The government should prepare an effective plan and provide a legislative background for implementation.

(3) The government should regulate and supervise the performances of enterprises (or combines) that have been privatized or transferred to foreign firms for their management .

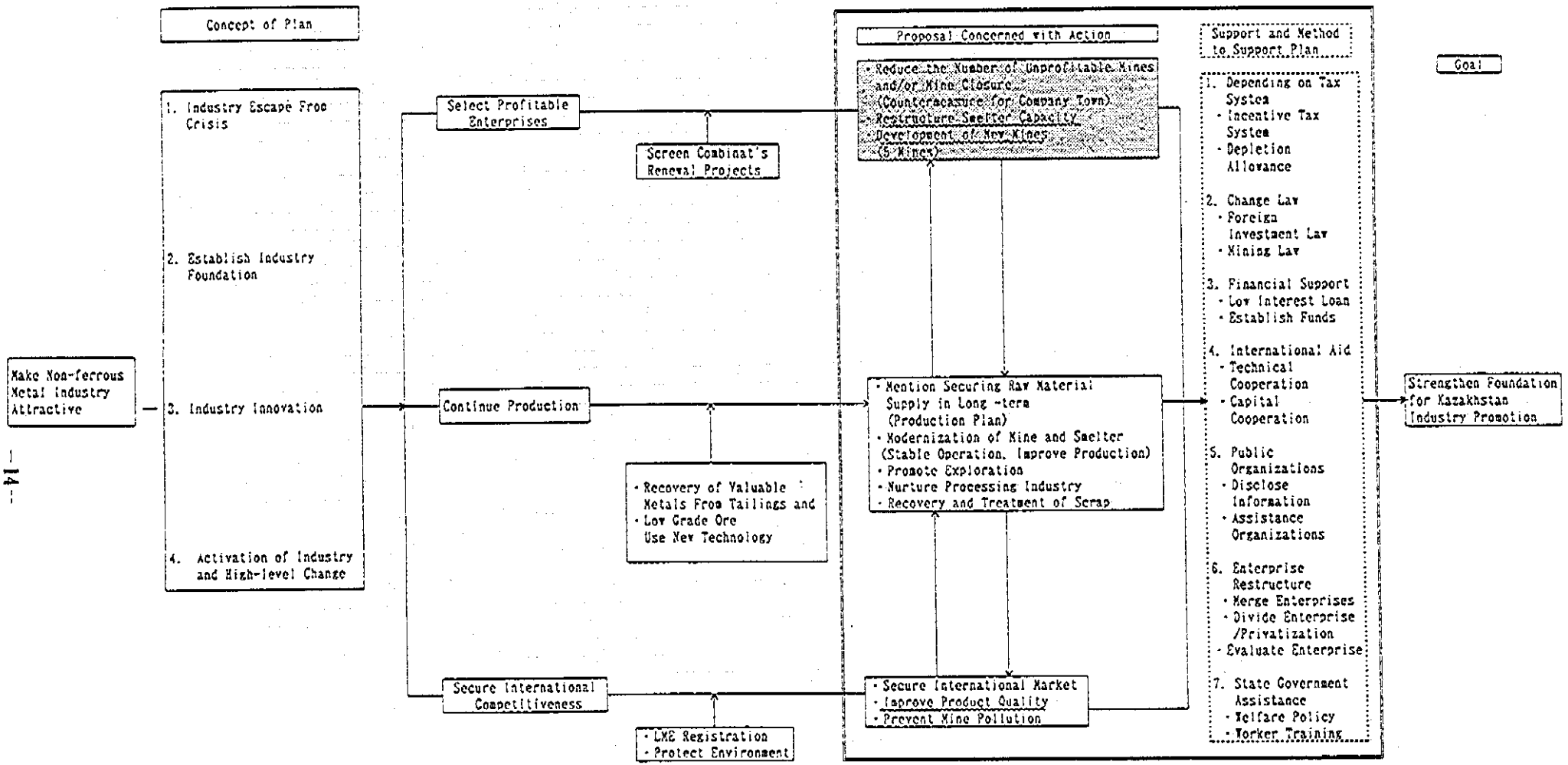
(4) The government should extend its assistance to an enterprise dealing with the most important projects of the Industry.

(5) The government should accelerate the programme to remove social welfare burden on enterprises.

(6) The government should found necessary organizations or institutions that take care of nonprofit activities associated with the Industry.

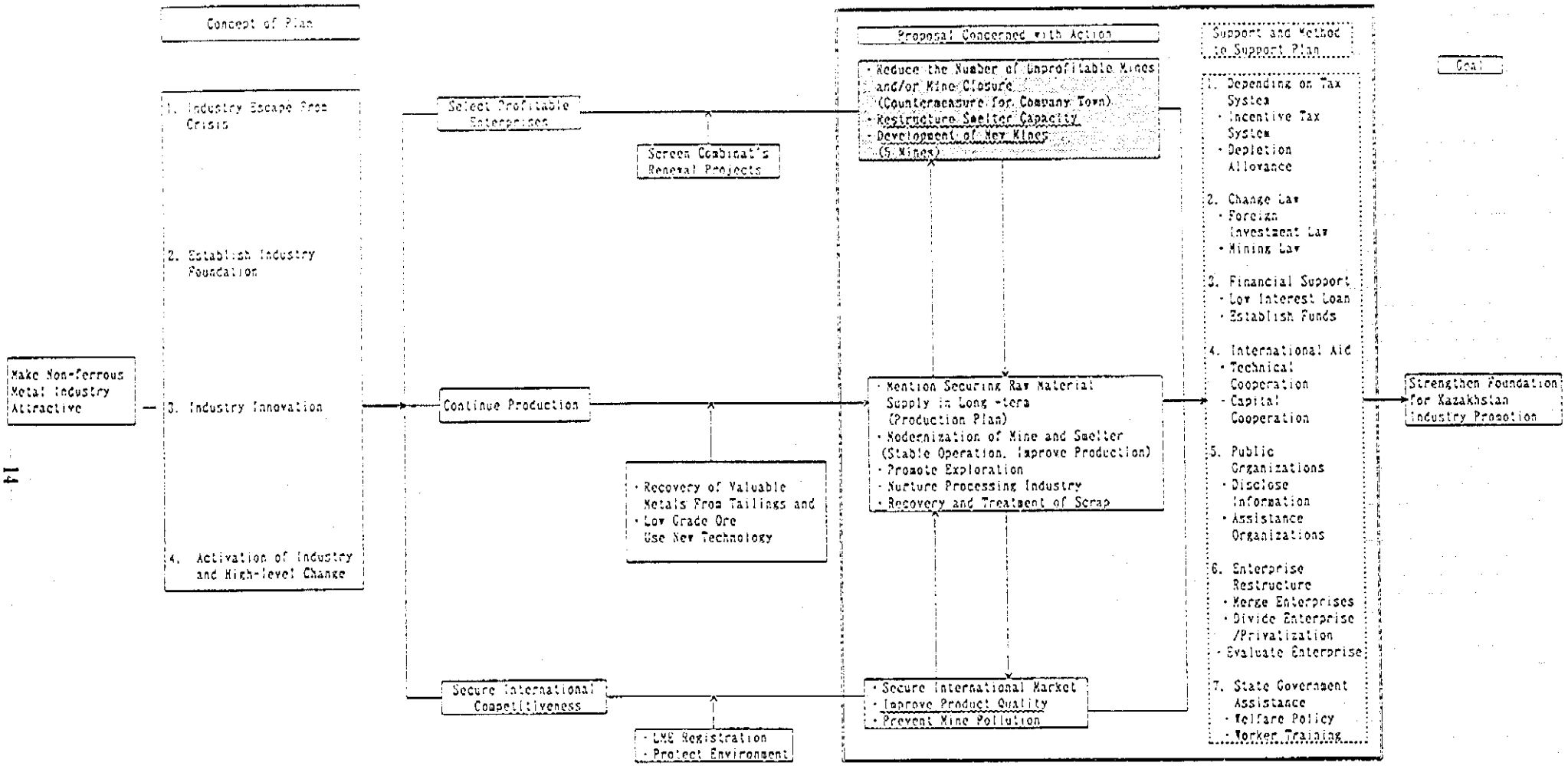
(7) The government should arrange financial assistance from available international funding agencies as required for the restoration.

Fig.1(1) indicates the procedure from the concept to the proposal for implementation of the Master Plan.



*Reference-Flow of Kazakhstan Non-ferrous Metal Industry Promotion Plan

Fig.1(1) Flow from Concept to Proposal



*Reference-Flow of Kazakhstan Non-ferrous Metal Industry Promotion Plan

Fig.1(1) Flow from Concept to Proposal

2. Industrial Plan

2. Industrial Plan

2-1 Raw Material Supply

2-1-1 Review of Present Situation

The problems with respect to the raw material supply to metal producing plants in Kazakhstan are summarized as follows;

(1) A number of mines and concentrators are now being operated in economically unjustifiable states. Ores are too low grades and costs are too high. Combines operating such mines and concentrators are making considerable losses (Table 2-1-1(1)) which have mounted to critical levels and have lead to a large amount of debt. Accordingly, these combines are placed financially in extremely difficult positions and are forced to reduce their production due to shortage or lack of working capital.

Table 2-1-1(1) Operation Result (1994)

(Thousand Tenge)

No.	Name of JSC	Value of Output	Production Cost	Sales Revenue	Profit from Sales	Profit from Other Sales	Profit from Non-Sales Operation	Operating Profit
1	Achpolymetal	276,941	603,090	207,051	-396,039	25,752	-4,315	-374,602
2	Zhezkent MCC (Mining-Concentrating Combine)	633,302	529,248	565,934	36,686	29,042	28,550	94278
3	Zyryanovsk Lead Combine	1,239,505	1,018,222	1,081,005	62,783	-33,609	-10,981	18193
4	Irtysh PC	92,593	182,272	85,448	-96,824	88	7,116	-89620
5	Karagaily MCC	75,099	89,415	44,339	-45,076	15,337	-22,377	-52116
6	Leninogorsk PC	2,526,658	2,137,991	3,031,324	893,333	3,096	-89,562	806867
7	Tekeli Pb-Zn Combine	245,925	259,392	229,342	-30,050	38,991	-229	8712
8	UK Pb-Zn Combine	7,244,581	4,359,108	5,533,604	1,174,496	100,922	-2,621,749	-1346331
9	Shymkent Lead Plant	1,283,671	1,358,254	1,114,294	-243,960	26,301	-7,660	-225319
10	Akshatau Ken-Baiytu Combinaty	289,584	282,486	244,601	-37,885	0	-45,909	-83794
11	Balkhashmed	8,548,752	5,869,443	9,702,891	3,833,448	1,990	-1,121,617	2713821
12	Zhezkazgantsvet-met	8,708,269	6,381,525	7,633,191	1,251,666	120,516	474,617	1846799

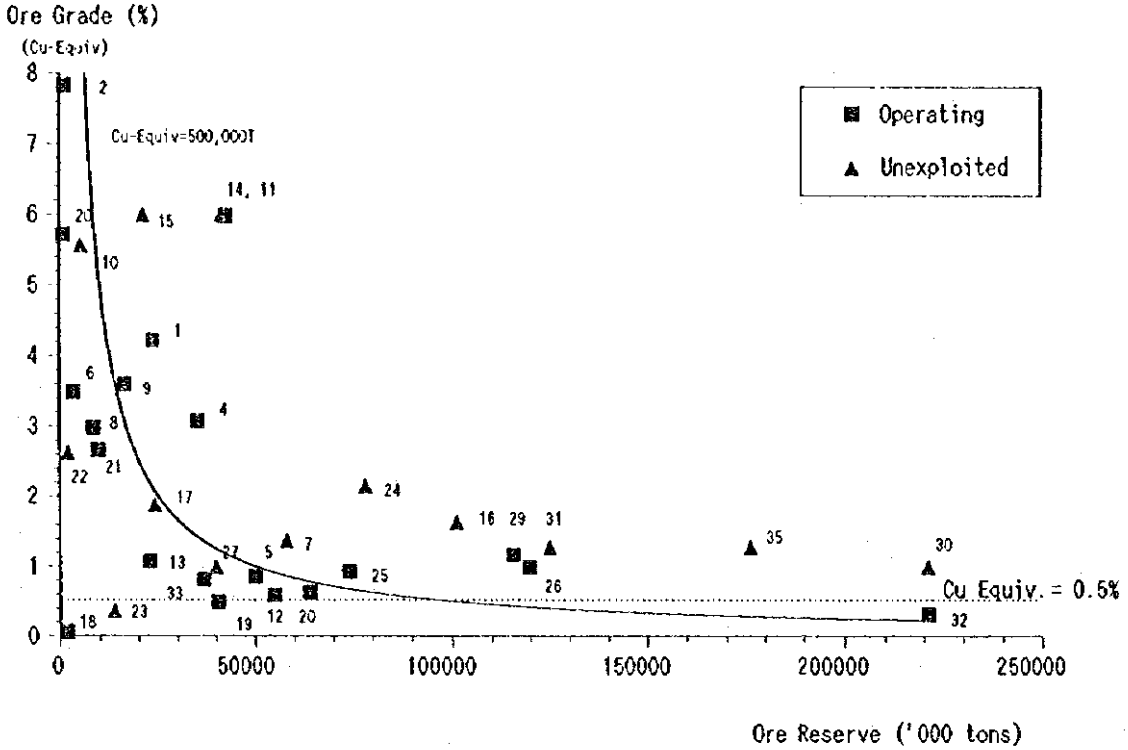
(2) Since the last stages of the collapse of the former USSR., exploration and development of new resources has been stalled mainly due to a shortage of funds. Despite the general belief, potentially economic resources which

are ready to be exploited, are scarce (Table 2-1-1(2)). The ore reserve-ore grade relation is one of the indications to understand the economic viability of ore deposits and is shown in Fig.2-1-1(1). A curve of 500,000 tons of contained equivalent copper is drawn in the figure and equals to a gross value of US$1.1 billion at the price of US$2,200. The gross value is equivalent to a gross operating cost of mining and dressing ores of 50 million tons at US$22 per ton of ores. In other words, the ore deposits that are plotted below the threshold curve are not economically viable unless their operating costs for a ton of ores are less than US$22 for the ore deposits with 50 million ton reserves. Normally, the larger the ore reserves are, the smaller the unit operating costs become with increasing unit outputs, and vice versa. It must be noted that ore dressing recoveries are not taken into account. A straight line of 0.5% copper-equivalent is also drawn in the figure and indicates a threshold of economic viability regardless of the mining or processing methods, locations or other factors unless ore reserves exceed the order of a billion tons. A number of operating mines are below this curve. Their economic viability is doubtful, taking account of mining extraction, ore dressing recoveries and smelting and refining charges, even assuming that all the capital costs have been written off. The Kounrad Mine has the reserves of 685,000 thousand tons of contained copper. However, its operation is unprofitable with the average grade far below the threshold line of 0.5% copper. For unexploited ore deposits, capital costs for development of mines and construction of concentrators must be taken into account in addition to operating costs. Therefore, they should be plotted far above the threshold curve to make up for their capital costs. Among the deposits in development or pre development stages, the Maleevskoye and Artemyevskoye are superior in their tonnages and grades, and are located in the proximity of smelters. Small but high grade deposits, such as the Yubileyno-Snegirihinskoye, may be commercially exploited. Other unexploited deposits that are plotted above the threshold curve require elaborated feasibility studies according to individual conditions and parameters.

(3) There are two major smelters that are facing extreme difficulty in raw material supplies, namely the JSC Shymkent and Balkhash Smelters. The former has been built to treat lead ores mainly from the Almalik Combine, that is located in Uzbekistan, now to the south of the international border. The latter is relying upon more than one third of its raw materials from foreign sources which are at extremely remote locations, in Mongolia (Erdenet) and Chile (Escondida and Chiquiquamata).

Table 2-1-1(2) Major Deposits, Operating, Development, Pre-development

No.	Name of Combine	Name of Mine	Location	Ore Reserve	Ore Grade (%)				Present Status	Remarks
				T.T.	Cu	Pb	Zn	Cu-Eq.		
1	JSC "EKCChC"	Nicolaevskoye	E. Kazakh.	23,643	2.45	0.48	3.65	4.22	Operating, O/P 500 T.T./Yr	Max. Plan 1,000 T.T./Yr
2		Shemonaihinskoye		1,238	3.74	1.30	8.31	7.83	Operating, O/P 200 T.T./Yr	Mine Out 2002
3		Artemyevskoye		21,473	1.96	1.96	6.89	5.59	Development, U/G	Max. Plan 1,000 T.T./Yr in 2001
4	JSC "Leninogorsk PC"	Tishinskoye	E. Kazakh.	35,293	0.52	0.85	5.17	3.08	Operating U/G 970 T.T./Yr	Max. Plan 1,200 T.T./Yr in 1999
5		Ridder-Sokolnoye		50,059	0.37	0.35	0.88	0.86	Operating U/G 2240 T.T./Yr	Max. Plan 2,500 T.T./Yr in 1997
6		Shubinskoye		3,316	1.85	0.47	3.37	3.49	Operating U/G 80 T.T./Yr	Max. Plan 200 T.T./Yr in 1997
7		Chekmar		57,992	0.21	0.78	2.10	1.37	Development Suspended	Max. Plan 3,000 T.T./Yr in 2005, O/P
8	JSC "Irtysh PC"	Belousovskoye	E. Kazakh.	8,359	1.00	0.94	3.83	2.98	Operating U/G 200 T.T./Yr	Mine Out 2003
9		Irtishkoye		16,235	1.55	0.64	4.18	3.60	Operating U/G 340 T.T./Yr	Max. Plan 700 T.T./Yr in 2000
10		Yubileynoe		5,216	3.41	0.67	4.40	5.57	F/S Completed	Max. Plan 300 T.T./Yr in 2001, U/G
11	JSC "Zhezkent MCC"	Orlovskoye	Semipala.	42,374	4.22	0.95	3.33	5.98	Operating U/G 900 T.T./Yr	Max. Plan.1,200 T.T./ Yr in 1999
12	JSC "Zyryanovsk Lead Combine"	Zyryanovskoye	E. Kazakh.	54,856	0.10	0.42	0.84	0.59	Operating U/G 680 T.T./Yr	Closed in 1999, too low grade
13		Grehovskoye		22,927	0.44	0.36	1.20	1.08	Operating U/G 430 T.T./Yr	
14		Maleevskoye		41,319	2.42	1.11	7.29	6.00	Development U/G 500 T.T./Yr	Max. Plan 1,500 T.T./Yr in 2002
15		Maleev. Yar		21,075	2.42	1.11	7.29	6.00	Detailed Exploration	Max. Plan 1,000 T.T./Yr in 2009 U/G
16	JSC "Achpolymetal"	Shalkiya	Kzyl-Orda	101,047		0.67	3.23	1.63	Development Plan	No Concentrator
17		Talap		24,175		1.64	3.20	1.88	Development Plan	No Concentrator
18		Mirgalimsai		1,860		0.09	0.07	0.06	Operating U/G 41 T.T./Yr	Barite
19		Glubokiy		40,600		0.90	0.55	0.49	Operating U/G 40 T.T./Yr	
20		Achisai		813			12.70	5.72	Operating U/G 7 T.T./Yr	
21	JSC "Tekeli Pb-Zn Combine"	Tekeli	T-Kulgan	9,580		2.89	4.17	2.66	Operating U/G 400 T.T./Yr	
22		W. Tekeli		2,006		2.67	4.21	2.62		
23		Tuyuk		13,635		1.35		0.36		
24	JSC "Sary-Arkapolymetal"	Zhairem	Zhezkaz.	78,122	0.15	2.00	3.24	2.15	Opration Suspended	No Concentrator
25	JSC "Zhezkazgantsvetmet"	E. Zhezkazgan	Zhezkaz.	73,981	0.93			0.93	Operating U/G 6,000 T.T./Yr	Mine-Out in 2008
26		S. Zhezkazgan		119,758	0.99			0.99	Operating U/G 7,6001 T.T./Yr	
27		W. Zhezkazgan		36,733	0.81			0.81	Operating U/G 3,280T.T./Yr	Mine-out in 2005
28		N. Zhezkazgan		64,009	0.63			0.63	Operating O/P 3,700 T.T./Yr	Max. Plan 4,000 T.T./Yr in 1997
29		Annensky		115,441	1.16			1.16	Operating U/G 2,350 T.T./Yr	Max. Plan 4,000 T.T./Yr in 1998
30		Akchi-Spassky		220,899	0.99			0.99	Development U/G	Start Mining in 2001, 1500 T.T./Yr
31		Zhilandinskaya		124,903	1.27			1.27	Development Plan	Start Mining in 2006, 2500 T.T./Yr
32	JSC "Balkhashmed"	Kounrad	Zhezkaz.	221,118	0.31			0.31	Operating O/P, 7,800TT./Yr	Reduce Output 4,000 T.T./Yr in 2000
33		Sayak		11,717	0.69			0.69	Operating O/P, 2,000 TT./Yr	Mine-Out in 2001
34		Koktau	Akchu.	40,000	1.82			1.82	Development Suspended	Max. Plan 2,300 T.T./ Yr in 2003, O/P
35		Boshekul	Pavlodar	176,000	0.65			0.65	Development Suspended	Max. Plan 7,000 T.T./Yr in 2001, O/P
36		Aktogay	Semipala.	1,430,000	0.37			0.37	Developementn Plan	Start Mining in 2006, 9000 T.T./Yr, O/P



Cu-Equiv = Cu(%)+0.27 Pb(%)+0.45 Zn(%)

Fig 2-1-1(1) Cu Ore Reserve vs Ore Grade

2-1-2 Mine-Concentrator Production Plan

A raw material supply plan has been drawn up as shown in attached Tables 2-1-2(1) and 2-1-2(2). Although economic parameters have not been taken into account, it is assumed that some mines and concentrators which are considered economically unjustifiable, remain in operation by absorbing their losses within the entire operation of the relevant combines. The reason is that sudden closure of these mines and concentrators will create a critical shortage of raw materials at smelters and social and labour unrest in the short term. The plan involves the establishment of economically sound bases for the operations in the first 5 years, to reform their systems for profitability in the second 5 years and to make the profitable operation sustainable in the third 5 years.

Table 2-1-2(1) Mine-Concentrator Production Plan (JSC "Zhezkazgantsvetment" and JSC "Balkhashmed")

Combine	Mine Name	Ore Reserves (Kt, 1996) Grade	Mining	Dil. (%)	Re. (%)	Minable Ore Reserves (Kt, 1996) Grade	Metal Recovery in each Conc. (%)	Production & Metal Content (Kt/year) 1995	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2012	2014	2016	2018	2020	Total Production (Kt) (until 2035)	Remaining Reserves (Kt) (in 2035)
JSC "Zhez-kazgantsvet-ment"	East Zhezkazgan	86,003 Cu(%) 1.00 Pb(%) Zn(%) Ag(g/t)	U/G	7	80	73,981 0.93	82	5,830 44	6,000 46	6,000 46	6,000 46	6,000 46	4,700 36	4,700 36	3,350 26	3,350 26	3,350 26	3,350 26	3,350 26	3,350 26	0 0	0 0	0 0	0 0	0 0	0 0	0 0	59,330 452	14,651 20%
	South Zhezkazgan	139,219 Cu(%) 1.07 Pb(%) Zn(%) Ag(g/t)	U/G	7	80	119,758 0.99	82	7,620 62	7,600 62	7,600 62	7,600 62	7,600 62	7,600 62	7,600 62	5,300 43	5,300 43	5,300 43	5,300 43	3,800 31	3,800 31	3,800 31	3,800 31	3,800 31	0 0	0 0	0 0	0 0	97,220 793	22,538 19%
	West Zhezkazgan	42,102 Cu(%) 0.88 Pb(%) Zn(%) Ag(g/t)	U/G	7	80	36,733 0.81	82	3,280 22	3,280 22	3,280 22	3,280 22	3,280 22	3,280 22	3,280 22	2,350 16	2,350 16	2,350 16	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	30,010 201	6,723 18%
	North Zhezkazgan	62,009 Cu(%) 0.68 Pb(%) Zn(%) Ag(g/t)	O/P	7	96	64,009 0.63	82	3,700 19	4,000 21	4,000 21	4,000 21	4,000 21	4,000 21	4,000 21	2,800 15	2,800 15	2,800 15	2,800 15	2,000 10	2,000 10	2,000 19	2,000 10	2,000 10	0 0	0 0	0 0	0 0	50,900 264	13,109 20%
	Annensky	134,200 Cu(%) 1.25 Pb(%) Zn(%) Ag(g/t)	U/G	7	80	115,441 1.16	82	2,350 22	2,350 22	4,000 38	4,000 38	4,000 38	4,000 38	4,000 38	4,000 38	4,000 38	4,000 38	4,000 38	4,000 38	2,800 27	2,800 27	2,800 27	2,800 27	2,800 27	2,800 27	2,000 19	2,000 19	91,900 816	23,540 20%
	Akchi-spassky	220,899 Cu(%) 1.06 Pb(%) Zn(%) Ag(g/t)	U/G	7	80	190,020 0.99	82	0 0	0 0	0 0	0 0	0 0	1,500 12	1,500 12	3,000 24	3,000 24	3,000 24	3,000 24	4,500 35	4,500 36	4,500 36	4,500 36	6,000 49	6,000 49	6,000 49	6,000 49	6,000 49	139,800 1,130	50,220 26%
	Zhitlandin-skaya	121,000 Cu(%) 1.37 Pb(%) Zn(%) Ag(g/t)	O/P	7	96	124,903 1.27	82	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	2,500 26	2,500 26	5,000 52	5,000 52	5,000 52	5,000 52	5,000 52	3,500 37	3,500 37	99,500 1,040	25,403 20%
	Total	Production Metal Content Grade						22,780 169 0.90	23,230 172 0.90	24,880 189 0.93	24,880 189 0.93	24,880 189 0.93	25,080 191 0.93	22,780 191 1.02	20,800 162 0.95	20,800 162 0.95	20,800 162 0.95	20,950 172 1.00	20,150 167 1.01	21,450 182 1.03	18,100 156 1.05	18,100 156 1.05	19,600 169 1.05	13,800 128 1.13	13,800 128 1.13	11,500 105 1.11	11,500 105 1.11	568,660	
JSC "Balk-hashmed"	Kounrao	212,000 Cu(%) 0.33 Mo(%) 0.005 Au(g/t) 0.015 Ag(g/t) 0.62	O/P	7	97	221,118 0.31 0.005	75	1,800 18	8,000 18	8,000 18	8,000 18	4,000 9	4,000 9	4,000 9	4,000 9	4,000 9	4,000 9	4,000 9	4,000 9	4,000 9	4,000 9	5,600 13	5,600 13	4,000 9	4,000 9	4,000 9	4,000 9	176,600 405	44,518 20%
	Sayak	7,400 Cu(%) 1.15 Mo(%) 0.004 Au(g/t) 0.40 Ag(g/t) 6.0	O/P	40	95	11,717 0.69 0.002	75	2,000 10	2,000 10	2,000 10	1,400 7	1,000 5	1,000 5	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	9,400 49	2,317 20%
	Total	Production Metal Content Grade						9,800 28 0.35	10,000 28 0.34	10,000 28 0.34	9,400 25 0.32	5,000 14 0.34	5,000 14 0.34	4,000 9 0.27	4,000 9 0.27	4,000 9 0.27	4,000 9 0.27	4,000 9 0.27	4,000 9 0.27	4,000 9 0.27	4,000 9 0.27	5,600 13 0.28	5,600 13 0.28	4,000 9 0.27	4,000 9 0.24	4,000 9 0.27	4,000 9 0.27		
	Koktau	40,000 Cu(%) 1.82 Mo(%) Au(g/t) 0.2 Ag(g/t)	O/P			40,000 1.82 0.2	83	0 0	0 0	180 2	1,003 11	1,000 11	1,000 11	1,000 11	2,300 27	2,300 34	2,300 36	2,300 35	1,150 17	1,150 17	1,150 17	1,150 17	1,150 17	1,150 17	1,150 17	1,150 17	1,150 17	31,180 416	8,220 21%
	Boshekul	116,000 Cu(%) 0.65 Mo(%) Au(g/t) Ag(g/t)	O/P			116,000 0.65	86	0 0	0 0	0 0	3,500 20	3,500 20	7,000 39	7,000 39	7,000 39	7,000 39	7,000 39	7,000 39	4,900 27	4,900 27	4,900 27	4,900 27	4,900 27	3,500 20	3,500 20	3,500 20	3,500 20	139,300 779	36,100 21%
	Actogay	1,445,018 Cu(%) 0.384 Mo(%) 0.008 Au(g/t) 0.030 Ag(g/t)	O/P	4	95	1,430,000 0.37 0.008 0.029	90 51	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	9,000 34	9,000 34	18,000 75	18,000 75	18,000 76	18,000 76	27,000 102	27,000 102	36,000 136	36,000 120	828,000 2,873	602,000 42%

Metal contents in concentrate :

Cu Total	196	201	219	249	234	255	250	238	244	248	289	254	310	284	289	302	276	276	281	271							
JSC "Zhezkazgantsvetment"	169	172	189	189	189	191	191	162	162	162	172	167	182	156	156	169	128	128	105	105							
JSC "Balkhashmed"	29	29	30	56	45	64	59	75	82	84	117	86	128	128	133	133	148	148	176	166							

Table 2-1-2(2) Long term production plan of polymetallic ore

JSC	Mine Name		Ore Reserve (1000t, 1995) grade(%)	Mining	dil. (%)	Re. (%)	Minable Ore Reserves (1000t, 1995) grade(%)	Metal recovery in each conc. (%)	Production & Metal Content (1000 tons/year) 1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2012	2014	2016	2018	2020	Total Production (until 2035)	Remaining Reserves (at 2035)
EKCChC	Nikiforovskoye		23,402	O.P.	3	98	23,643		500	600	800	1,000	1,000	1,000	1,000	1,000	1,000	1,000	700	700	700	700	700	700	500	500	500	500	19,050	4,593
		Cu(*a)	2.54				2.46	75	9	11	15	18	18	18	18	18	18	18	13	13	13	13	13	13	9	9	9	9	352	19*a
		Pb(*a)	0.49				0.48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Zn(*a)	3.76				3.65	60	11	13	18	22	22	22	22	22	22	22	15	15	15	15	15	15	11	11	11	11	417	
	Shemonaikhinskoye		1,238	O.P.	3	98	1,251		200	200	200	140	100	100	50	0	0	0	0	0	0	0	0	0	0	0	0	0	990	261
		Cu(*a)	3.86				3.74	85	6	6	6	4	3	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	32	23*a
		Pb(*a)	1.31				1.30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Zn(*a)	8.57				8.31	75	12	12	12	9	6	6	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Artemyevskoye		19,923	C&F	10	93	21,413		0	0	0	0	200	500	1,000	1,000	1,000	1,000	1,000	1,000	1,000	700	700	700	500	500	500	500	16,550	4,523
		Cu(*a)	2.18				1.96	72	0	0	0	0	3	7	15	15	15	15	15	15	15	10	10	10	7	7	7	7	246	21*a
		Pb(*a)	2.18				1.96	73	0	0	0	0	3	7	14	14	14	14	14	14	14	10	10	10	7	7	7	7	243	
		Zn(*a)	7.66				6.89	82	0	0	0	11	28	57	57	57	57	57	57	57	57	40	40	40	28	28	28	28	958	
Leninogorsk PC	Tishinskoye		31,578	SLS	15	95	35,293		970	1,000	1,000	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	840	840	840	840	840	600	600	28,230	7,063
		Cu(*a)	0.63				0.52	72	4	4	4	4	4	4	4	4	4	4	4	4	3	3	3	3	3	3	2	2	105	20*a
		Pb(*a)	1.00				0.85	60	5	5	5	6	6	6	6	6	6	6	6	6	4	4	4	4	3	3	3	3	144	
		Zn(*a)	6.08				5.17	88	44	45	45	55	55	55	55	55	55	55	55	55	38	38	38	38	38	27	27	27	1,281	
	Ridder-Sokolnoye		41,716	SLC	25	90	50,059		2,240	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	1,750	1,750	1,750	1,750	1,750	1,750	1,250	1,250	1,250	1,250	0	39,590	10,469
	40 Years Lenin	Cu(*a)	0.49				0.37	72	6	7	7	7	7	7	7	7	7	5	5	5	5	5	3	3	3	3	3	0	93	21*a
		Pb(*a)	0.43				0.35	60	5	5	5	5	5	5	5	5	5	4	4	4	4	4	3	3	3	3	3	0	84	
		Zn(*a)	1.17				0.88	88	17	19	19	19	19	19	10	10	10	14	14	14	14	14	10	10	10	10	10	0	336	
	Shubinskoye		2,962	SLS	15	95	3,316		80	200	200	200	200	200	200	200	200	140	140	140	100	100	100	100	50	0	0	0	2,690	626
		Cu(*a)	2.18				1.85	72	1	3	3	3	3	3	3	3	3	2	2	2	2	1	1	1	1	1	0	0	36	19*a
		Pb(*a)	0.55				0.47	60	0	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	8	
		Zn(*a)	3.92				3.37	88	2	6	6	6	6	6	6	6	6	4	4	4	3	3	3	3	1	0	0	0	80	
Irtysh PC	Belousovskoye		6,463	SLS, C&F	25	93	8,355		200	200	200	200	200	200	200	200	100	0	0	0	0	0	0	0	0	0	0	0	1,500	6,855
		Cu(*a)	1.33				1.00	50	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	7	82*a
		Pb(*a)	1.25				0.94	60	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	8	
		Zn(*a)	5.81				3.83	70	5	5	5	5	5	5	5	5	0	0	0	0	0	0	0	0	0	0	0	0	40	
	Irtyshskoye		12,553	SLS, C&F	25	93	15,235		340	300	300	500	700	700	700	700	700	700	700	490	490	490	490	490	350	350	350	350	13,320	3,115
		Cu(*a)	2.66				1.55	70	7	7	7	9	9	9	9	9	9	9	9	6	6	6	6	6	4	4	4	4	142	19*a
		Pb(*a)	0.85				0.62	55	1	1	1	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	46	
		Zn(*a)	3.57				2.18	72	10	9	9	15	21	21	21	21	21	21	21	15	15	15	15	15	11	11	11	11	395	
	Yubileyno-Snegirikhinskoye		4,033	SLS, C&F	25	93	5,216		0	0	0	0	100	200	300	300	300	300	300	210	210	210	210	150	150	150	80	0	4,130	1,086
		Cu(*a)	4.55				3.41	69	0	0	0	0	2	5	7	7	7	7	7	5	5	5	5	4	4	4	2	0	97	21*a
		Pb(*a)	0.89				0.67	65	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	18	
		Zn(*a)	5.87				4.40	76	0	0	0	3	7	10	10	10	10	10	10	7	7	7	7	5	5	5	3	0	118	
Zhezkazgan SICC	Orlovskoye		41,482	C&F	7	95	42,374		900	900	1,000	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	840	840	840	840	840	33,700	8,674
		Cu(*a)	4.54				4.22	80	30	30	34	41	41	41	41	41	41	41	41	41	41	41	41	28	28	28	28	28	1,138	20*a
		Pb(*a)	1.02				0.95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Zn(*a)	3.58				3.33	45	13	13	15	18	18	18	18	18	18	18	18	18	18	18	18	13	13	13	13	13	505	
Zyryanovsk Lead Combine	Zyryanovskoye		37,932	SLS, SLC	35	94	54,856		680	500	300	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,580	53,276
		Cu(*a)	0.56				0.10	68	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	97*a
		Pb(*a)	0.64				0.42	89	2	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	
		Zn(*a)	1.29				0.84	89	3	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	
	Grebnevskoye		18,867	SLC	21	96	22,927		430	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	280	13,910	9,017
		Cu(*a)	0.56				0.44	68	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	42	39*a
		Pb(*a)	0.46				0.36	89	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	40	
		Zn(*a)	1.52				1.20	89	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	3	134	
	Malokrasnogorskoye		39,211	SLS, C&F	7	98	41,319		500	550	600	650	1,000	1,200	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,000	1,000	1,000	1,000	750	750	33,100	8,219
		Cu(*a)	2.60				2.42	70	8	9	10	10	17	20	25	25	25	25	25	25	25	25	17	17	17	17	13	13	560	20*a
		Pb(*a)	1.16				1.11	60	3	4	4	4	7	8	10	10	10	10	10	10	10	10	7	7	7	7	5	5	220	
		Zn(*a)	7.84				7.29	89	29	32	35	35	58	70	87	87	87	87	87	87	87	87	58	58	58	58	41	41	1,931	
	A		57,400		3	98	57,992		0	0	0	0	0	0	500	1,000	2,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	2,100	2,100	2,100	1,500	46,500	11,492
	(Glubokoye)	Cu(*a)	0.22				0.21	41	0	0	0	0	0	0	0	1	2	3	3	3	3	3	3	3	2	2	1	1	41	20*a
		Pb(*a)	0.80				0.78	65	0	0	0	0	0	0	0	3	5	10	15	15	15	15	15	15	11	11	8	8	235	
		Zn(*a)	2.12				2.10	89	0	0	0	0	0	0	8	17	34	51	51	51	51	51	51	51	35	35	25	25	783	
	B		20,000		7	98	21,035		0	0	0	0	0	0	0	0	0	0	0	200	400	800	1,000	1,000	1,000	1,000	1,000	700	700	700	16,800	4,235
	(Malaye Yar)	Cu(*a)	2.60				2.42	70	0	0	0	0	0	0	0	0	0	0	0	3	7	14	17	17	17	17	12	12	281	20*a
		Pb(*a)	1.19				1.11	60	0	0	0	0	0	0	0	0	0	0	0	1	3	5	7	7	7	7	5	5	111	
		Zn(*a)	7.84				7.29	89	0	0	0	0	0	0	0	0	0	0	0	12	23	47	58	58	58	58	41	41	930	

Metal contents in concentrate :

Cu	72	74	84	100	115	128	132	130	127	128	126	125	130	129	119	105	96	90	80	78						
Pb	19	20	19	22	21	40	45	47	50	55	56	56	57	54	49	45	41	35	30	29						
Zn	154	163	171	203	249	293	316	318	325	342	347	349	355	350	316	293	272	254	206	202						

2-1-3 Profit-Loss Estimation of Planned Production

Profit-loss estimation has been made for planned production of each mine and concentrator, and is summarized in Table 2-1-3(1) and (2) (Copper-1 to -5 and Polymetal-1 and -2).

Among copper mines and concentrators, the Balkhashmed (Kounrad and Sayak Mines) and the Aktogai will make operating losses through the estimation period. In particular, the losses of the mine-concentrator operation at the JSC "Balkhashmed" is considerable due to low grade ores, low recovery rates at the concentrator and long haulage of Sayak ores. These are the fundamental disadvantages of the Balkhashmed operation and are unsolvable. The mine-concentrator operation at the JSC "Balkhashmed" should be ceased as early as possible from the economic point of view. The production plan of the Aktogai deposits has been made based on the feasibility report published in early 1995. The result of its economic analysis, assuming a copper price at US$2,200 per ton, indicates that the project will be operated at a loss even without writing off any capital expenditures. A detailed review of the feasibility report will be necessary and may be able to draw an alternative plan that will lead to a profitable operation. The Koktau-Chilisai and Boshekul operations are expected to make operating profits. However, the estimation does not include capital expenditures. Their feasibility should be reviewed particularly for their capital requirements. The development and construction for these operations are in considerably advanced stages, though suspended at the present time. The economic review should be made urgently, from the view point of raw material supply to the Balkhashmed Smelter.

Among polymetal mines, the Tishinskoye, Shubinskoye, Belousovskoye, Irtyshskoye, Zyryanovskoye and Grehovskoye will make operating losses through the estimation period due mainly to high mining costs and overheads. The Orlovskoye, Maleevskoye and Artemyevskoye are regarded as the most profitable of all. However, the Maleevskoye output is still limited and the Artemyevskoye is yet to be developed. Although its ore reserves are not large, the Yubileynoe-Snegirihinskoye is also expected to become a profitable mine once developed. Development of these three mines should be accelerated in order to economically restore all the operations, including smelters and refineries, in the East Kazakhstan Region.

The JSC "Achpolymetal", JSC "Tekeli Pb-Zn Combine" and JSC "Akshatau Ken-Baiytu Combinaty" have been excluded from the production plan. The reasons are that they (1) are making considerable losses by mining economically unjustifiable ores, (2) are remotely located from either lead or zinc smelters and (3) are considered small in their contribution to smelters as raw material sources. Development of the Zhairem and Shalkiya deposits also have not been taken into account in the production plan for the same reasons as(2)and (3) above.

Table 2-1-3(1) Mine-Concentrator Profit-Loss Estimation (Copper-1)

The Philippines

			1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2012	2014	2016	2018	2020
Mine Output	T.T.		22,785	23,230	24,880	24,880	24,880	25,080	22,780	20,800	20,800	20,800	20,950	20,150	21,450	18,100	18,100	19,600	13,800	13,800	11,500	11,500
Ore Grade	Cu (%)		0.90	0.90	0.93	0.93	0.93	0.93	1.02	0.95	0.95	0.95	1.00	1.01	1.03	1.05	1.05	1.05	1.13	1.13	1.11	1.11
	Pb (%)																					
	Zn (%)																					
	Au (g/t)																					
	Ag (g/t)																					
Conc. Cu Conc.	T.T.		354	463	513	513	513	517	515	438	438	438	464	451	490	421	421	456	346	346	283	283
Conc. Grade	Cu (%)		37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37
	Pb (%)																					
	Zn (%)																					
	Au (g/t)																					
	Ag (g/t)	630	630	630	630	630	630	630	630	630	630	630	630	630	630	630	630	630	630	630	630	630
Metal Content	Cu (T.T.)		168	171	190	190	190	191	191	162	162	162	172	167	181	156	156	169	128	128	105	105
	Pb (T.T.)																					
	Zn (T.T.)																					
	Au (kg)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Ag (kg)		286	292	323	323	323	326	324	276	276	276	293	284	308	265	265	287	218	218	178	178
Recovery	Cu (%)		82	82	82	82	82	82	82	82	82	82	82	82	82	82	82	82	82	82	82	82
Moisture	(%)																					
Total Value (T.US$)			410,795	418,873	463,580	463,580	463,580	467,306	465,527	395,893	395,893	395,893	419,735	407,744	442,645	380,767	380,767	412,322	312,427	312,427	255,748	255,748
Cu (US$/lb)	1.2204.6		370,662	377,951	418,290	418,290	418,290	421,652	420,047	357,216	357,216	357,216	378,728	367,909	399,400	343,567	343,567	372,039	281,904	281,904	230,762	230,762
Pb																						
Zn																						
Au (less 1g/t)			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ag			40,133	40,923	45,290	45,290	45,290	45,654	45,480	38,677	38,677	38,677	41,007	39,835	43,245	37,200	37,200	40,283	30,523	30,523	24,986	24,986
Sales Cost Total (T.US$)			65,944	67,243	74,417	74,417	74,417	75,015	74,730	63,552	63,552	63,552	67,379	65,454	71,057	61,123	61,123	66,189	50,153	50,153	41,054	41,054
Freight (US$/WMT)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T.C (US$/DMT)	80	36,353	37,068	41,024	41,024	41,024	41,354	41,196	35,034	35,034	35,034	37,144	36,083	39,171	33,695	33,695	36,489	27,648	27,648	22,632	22,632
R.C. (US$/Cu lb)	0.08	176	29,591	30,175	33,393	33,393	33,393	33,662	33,534	28,518	28,518	28,518	30,235	29,371	31,885	27,428	27,428	29,701	22,505	22,505	18,422	18,422
Penalty																						
Sales Revenue (T.US$)			344,852	351,633	389,163	389,163	389,163	392,291	390,905	332,342	332,342	332,342	352,356	342,290	371,589	319,643	319,643	346,133	262,274	262,274	214,693	214,693
Cost Mine US$/T	5.50	125,301	127,765	136,840	136,840	136,840	137,940	125,290	114,400	114,400	114,400	115,225	110,825	117,975	99,550	99,550	107,800	75,900	75,900	63,250	63,250
Conc. US$/T	2.40	54,677	55,752	59,712	59,712	59,712	60,192	54,672	49,920	49,920	49,920	50,280	48,360	51,480	43,440	43,440	47,040	33,120	33,120	27,600	27,600
Overhead US$/T	0.70	15,947	16,261	17,416	17,416	17,416	17,556	15,946	14,560	14,560	14,560	14,665	14,105	15,015	12,670	12,670	13,720	9,660	9,660	8,050	8,050
Total			195,925	199,778	213,968	213,968	213,968	215,688	195,908	178,880	178,880	178,880	180,170	173,290	184,470	155,660	155,660	168,560	118,680	118,680	98,900	98,900
Operating Profit (T.US$)			148,926	151,855	175,195	175,195	175,195	176,603	194,889	153,462	153,462	153,462	172,186	169,000	187,119	163,983	163,983	177,573	143,594	143,594	115,793	115,793

Table 2-1-3(1) Mine-Concentrator Profit-Loss Estimation (Copper-2)

Balkhash

				1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2012	2014	2016	2018	2020
Mine	Output	T.T.		9,800	10,000	10,000	9,400	5,000	5,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	5,600	5,600	4,000	4,000	4,000	4,000
	Ore Grade	Cu (%)		0.38	0.37	0.37	0.35	0.37	0.37	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.33	0.33	0.30	0.30	0.30	0.30
		Pb (%)																					
		Zn (%)																					
		Au (g/t)																					
		Ag (g/t)																					
Conc.	Cu Conc.	T.T.		200	198	198	176	99	99	64	64	64	64	64	64	64	64	99	99	64	64	64	64
	Conc. Grade	Cu (%)		14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
		Pb (%)																					
		Zn (%)																					
		Au (g/t)	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
		Ag (g/t)																					
	Metal Content	Cu (T.T.)		28	28	28	25	14	14	9	9	9	9	9	9	9	9	14	14	9	9	9	9
		Pb (T.T.)																					
		Zn (T.T.)																					
		Au (kg)		599	595	595	529	297	297	193	193	193	193	193	193	193	193	297	297	193	193	193	193
		Ag (kg)																					
	Recovery	Cu (%)		75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75
	Moisture	(%)																					
Total Value (T.US$)				66,719	66,289	66,289	58,944	33,145	33,145	21,499	21,499	21,499	21,499	21,499	21,499	21,499	21,499	33,109	33,109	21,499	21,499	21,499	21,499
	Cu (US$/lb)	1	2204.6	61,574	61,178	61,178	54,399	30,589	30,589	19,841	19,841	19,841	19,841	19,841	19,841	19,841	19,841	30,556	30,556	19,841	19,841	19,841	19,841
	Pb																						
	Zn																						
	Au (ozs.1g/t)	401	25.8	5,145	5,112	5,112	4,545	2,556	2,556	1,658	1,658	1,658	1,658	1,658	1,658	1,658	1,658	2,553	2,553	1,658	1,658	1,658	1,658
	Ag		0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sales Cost Total (T.US$)				20,876	20,741	20,741	18,443	10,371	10,371	6,727	6,727	6,727	6,727	6,727	6,727	6,727	6,727	10,359	10,359	6,727	6,727	6,727	6,727
	Freight (US$/WMT)																						
	T.C (US$/DMT)		80	15,960	15,857	15,857	14,100	7,929	7,929	5,143	5,143	5,143	5,143	5,143	5,143	5,143	5,143	7,920	7,920	5,143	5,143	5,143	5,143
	R.C. (US$/Cu lb)	0.08	176	4,916	4,884	4,884	4,343	2,442	2,442	1,584	1,584	1,584	1,584	1,584	1,584	1,584	1,584	2,439	2,439	1,584	1,584	1,584	1,584
	Penalty																						
Sales Revenue (T.US$)				45,843	45,548	45,548	40,501	22,774	22,774	14,772	14,772	14,772	14,772	14,772	14,772	14,772	14,772	22,749	22,749	14,772	14,772	14,772	14,772
Cost	Mine US$/T		7.53	73,794	75,300	75,300	70,782	37,650	37,650	30,120	30,120	30,120	30,120	30,120	30,120	30,120	30,120	42,168	42,168	30,120	30,120	30,120	30,120
	Conc. US$/T		1.85	18,130	18,500	18,500	17,390	9,250	9,250	7,400	7,400	7,400	7,400	7,400	7,400	7,400	7,400	10,360	10,360	7,400	7,400	7,400	7,400
	Overhead US$/T		1.13	11,074	11,300	11,300	10,622	5,650	5,650	4,520	4,520	4,520	4,520	4,520	4,520	4,520	4,520	6,328	6,328	4,520	4,520	4,520	4,520
Total				102,998	105,100	105,100	98,794	52,550	52,550	42,040	42,040	42,040	42,040	42,040	42,040	42,040	42,040	58,856	58,856	42,040	42,040	42,040	42,040
Operating Profit (T.US$)				-57,155	-59,552	-59,552	-58,293	-29,776	-29,776	-27,268	-27,268	-27,268	-27,268	-27,268	-27,268	-27,268	-27,268	-36,107	-36,107	-27,268	-27,268	-27,268	-27,268

Table 2-1-3(1) Mine-Concentrator Profit-Loss Estimation (Copper-3)

Notice

			1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2012	2014	2016	2018	2020
Mine Output	T.T		0	0	180	1,000	1,000	1,000	1,000	2,300	2,300	2,300	2,300	1,150	1,150	1,150	1,150	1,150	1,150	1,150	1,150	1,150
Ore Grade	Cu (%)		0.00	0.00	1.82	1.82	1.82	1.82	1.82	1.82	1.82	1.82	1.82	1.82	1.82	1.82	1.82	1.82	1.82	1.82	1.82	1.82
	Pb (%)																					
	Zn (%)																					
	Au (g/t)																					
	Ag (g/t)																					
Conc. Cu Conc	T.T		0	0	14	76	76	76	76	174	174	174	174	87	87	87	87	87	87	87	87	87
Conc. Grade	Cu (%)		20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
	Pb (%)																					
	Zn (%)																					
	Au (g/t)	1.35	0	0	1.35	1.35	1.35	1.35	1.35	1.35	1.35	1.35	1.35	1.35	1.35	1.35	1.35	1.35	1.35	1.35	1.35	1.35
	Ag (g/t)		0	0	0	0	0	0	0	0	0	0	23.7	23.7	23.7	23.7	23.7	23.7	23.7	23.7	23.7	23.7
Metal Content	Cu (T.T.)		0	0	3	15	15	15	15	35	35	35	35	17	17	17	17	17	17	17	17	17
	Pb (T.T.)																					
	Zn (T.T.)																					
	Au (kg)		0	0	15	102	102	102	102	235	235	235	235	117	117	117	117	117	117	117	117	117
	Ag (kg)																					
Recovery	Cu (%)		83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83
Moisture	(%)																					
Total Value (T.US$)			0	0	6,056	33,644	33,644	33,644	33,644	77,380	77,380	77,380	77,380	38,690	38,690	38,690	38,690	38,690	38,690	38,690	38,690	38,690
Cu (US$/lb)	1	2204.6	0	0	5,994	33,303	33,303	33,303	33,303	76,596	76,596	76,596	76,596	38,298	38,298	38,298	38,298	38,298	38,298	38,298	38,298	38,298
Pb																						
Zn																						
Au (less 1g/t)	a01	4.5	0	0	61	341	341	341	341	784	784	784	784	392	392	392	392	392	392	392	392	392
Ag		0.01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sales Cost Total (T.US$)			0	0	1,933	10,740	10,740	10,740	10,740	24,703	24,703	24,703	24,703	12,351	12,351	12,351	12,351	12,351	12,351	12,351	12,351	12,351
Freight (US$/WMT)		23	0	0	367	2039	2039	2039	2039	4690	4690	4690	4690	2345	2345	2345	2345	2345	2345	2345	2345	2345
T.C (US$/DMT)		80	0	0	1,088	6,042	6,042	6,042	6,042	13,898	13,898	13,898	13,898	6,949	6,949	6,949	6,949	6,949	6,949	6,949	6,949	6,949
R.C. (US$/Cu lb)	0.06	176	0	0	479	2,659	2,659	2,659	2,659	6,115	6,115	6,115	6,115	3,057	3,057	3,057	3,057	3,057	3,057	3,057	3,057	3,057
Penalty																						
Sales Revenue (T.US$)			0	0	4,123	22,903	22,903	22,903	22,903	52,677	52,677	52,677	52,677	26,339	26,339	26,339	26,339	26,339	26,339	26,339	26,339	26,339
Cost Mine US$/T		5.50	0	0	990	5,500	5,500	5,500	5,500	12,650	12,650	12,650	12,650	6,325	6,325	6,325	6,325	6,325	6,325	6,325	6,325	6,325
Conc. US$/T		2.40	0	0	432	2,400	2,400	2,400	2,400	5,520	5,520	5,520	5,520	2,760	2,760	2,760	2,760	2,760	2,760	2,760	2,760	2,760
Overhead US$/T		0.70	0	0	126	700	700	700	700	1,610	1,610	1,610	1,610	805	805	805	805	805	805	805	805	805
Total			0	0	1,548	8,600	8,600	8,600	8,600	19,780	19,780	19,780	19,780	9,890	9,890	9,890	9,890	9,890	9,890	9,890	9,890	9,890
Operating Profit (T.US$)			0	0	2,575	14,303	14,303	14,303	14,303	32,897	32,897	32,897	32,897	16,449	16,449	16,449	16,449	16,449	16,449	16,449	16,449	16,449

Table 2-1-3(1) Mine-Concentrator Profit-Loss Estimation (Copper-4)

Beneficial

				1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2012	2014	2016	2018	2020
Mine Output	T.T.			0	0	0	3,500	3,500	7,000	7,000	7,000	7,000	7,000	7,000	4,900	4,900	4,900	4,900	4,900	3,500	3,500	3,500	3,500
Ore Grade	Cu (%)			0.00	0.00	0.00	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65
	Pb (%)																						
	Zn (%)																						
	Au (g/t)						0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22
	Ag (g/t)						7.18	7.18	7.18	7.18	7.18	7.18	7.18	7.18	7.18	7.18	7.18	7.18	7.18	7.18	7.18	7.18	7.18
Conc. Cu Conc.	T.T.			0	0	0	93	93	186	186	186	186	186	186	130	130	130	130	130	93	93	93	93
Cons. Grade	Cu (%)			21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21
	Pb (%)																						
	Zn (%)																						
	Au (g/t)	6.3		0	0	0	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3
	Ag (g/t)	257		0	0	0	257	257	257	257	257	257	257	257	257	257	257	257	257	257	257	257	257
Metal Content	Cu (T.T.)			0	0	0	20	20	39	39	39	39	39	39	27	27	27	27	27	20	20	20	20
	Pb (T.T.)																						
	Zn (T.T.)																						
	Au (kg)			0	0	0	587	587	1174	1174	1174	1174	1174	1174	822	822	822	822	822	587	587	587	587
	Ag (kg)			0	0	0	24	24	48	48	48	48	48	48	34	34	34	34	34	24	24	24	24
Recovery	Cu (%)			0	0	0	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86
Moisture	(%)																						
Total Value (T.US$)				0	0	0	52,724	52,724	105,448	105,448	105,448	105,448	105,448	105,448	73,814	73,814	73,814	73,814	73,814	52,724	52,724	52,724	52,724
Cu (US$/lb)		1	2204.6	0	0	0	43,133	43,133	86,266	86,266	86,266	86,266	86,266	86,266	60,386	60,386	60,386	60,386	60,386	43,133	43,133	43,133	43,133
Pb																							
Zn																							
Au (ton 1g/t)		401	68.3	0	0	0	6,367	6,367	12,734	12,734	12,734	12,734	12,734	12,734	8,914	8,914	8,914	8,914	8,914	6,367	6,367	6,367	6,367
Ag				0	0	0	3,224	3,224	6,449	6,449	6,449	6,449	6,449	6,449	4,514	4,514	4,514	4,514	4,514	3,224	3,224	3,224	3,224
Sales Cost Total (T.US$)				0	0	0	13,412	13,412	26,825	26,825	26,825	26,825	26,825	26,825	18,777	18,777	18,777	18,777	18,777	13,412	13,412	13,412	13,412
Freight (US$/WMT)			25	0	0	0	2516	2516	5031	5031	5031	5031	5031	5031	3522	3522	3522	3522	3522	2516	2516	2516	2516
T.C (US$/DMT)			80	0	0	0	7,453	7,453	14,907	14,907	14,907	14,907	14,907	14,907	10,435	10,435	10,435	10,435	10,435	7,453	7,453	7,453	7,453
R.C (US$/Cu lb)		0.08	176	0	0	0	3,443	3,443	6,887	6,887	6,887	6,887	6,887	6,887	4,821	4,821	4,821	4,821	4,821	3,443	3,443	3,443	3,443
Penalty																							
Sales Revenue (T.US$)				0	0	0	39,312	39,312	78,624	78,624	78,624	78,624	78,624	78,624	55,037	55,037	55,037	55,037	55,037	39,312	39,312	39,312	39,312
Cost Mine US$/T			1.70	0	0	0	5,950	5,950	11,900	11,900	11,900	11,900	11,900	11,900	8,330	8,330	8,330	8,330	8,330	5,950	5,950	5,950	5,950
Conc. US$/T			2.89	0	0	0	10,115	10,115	20,230	20,230	20,230	20,230	20,230	20,230	14,161	14,161	14,161	14,161	14,161	10,115	10,115	10,115	10,115
Overhead US$/T			0.64	0	0	0	2,240	2,240	4,480	4,480	4,480	4,480	4,480	4,480	3,136	3,136	3,136	3,136	3,136	2,240	2,240	2,240	2,240
Total				0	0	0	18,305	18,305	36,610	36,610	36,610	36,610	36,610	36,610	25,627	25,627	25,627	25,627	25,627	18,305	18,305	18,305	18,305
Operating Profit (T.US$)				0	0	0	21,007	21,007	42,014	42,014	42,014	42,014	42,014	42,014	29,410	29,410	29,410	29,410	29,410	21,007	21,007	21,007	21,007

Table 2-1-3(1) Mine-Concentrator Profit-Loss Estimation (Copper-3)

Acmgay

				1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2012	2014	2016	2018	2020
Mine	Output	T.T		0	0	0	0	0	0	0	0	0	0	9,000	9,000	18,000	18,000	18,000	27,000	36,000	36,000	36,000	36,000
	Ore Grade	Cu(%)		0.000	0.000	0.000	0.000	0.00	0.00	0.000	0.000	0.000	0.000	0.42	0.42	0.46	0.46	0.42	0.42	0.42	0.37	0.37	0.37
		Pb(%)																					
		Zn(%)																					
		Au(g/t)												0.029	0.029	0.029	0.029	0.029	0.029	0.029	0.029	0.029	0.029
		Ag(g/t)																					
Conc.	Cu Conc	T.T		0	0	0	0	0	0	0	0	0	0	227	227	497	497	508	680	907	909	677	909
	Conc. Grade	Cu(%)		15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15
		Pb(%)																					
		Zn(%)																					
		Au(g/t)	0	0	0	0	0	0	0	0	0	0	0	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68
		Ag(g/t)		0	0	0	0	0	0	0	0	0	0	23.7	23.7	23.7	23.7	23.7	23.7	23.7	23.7	23.7	23.7
	Metal Content	Cu(T.T.)		0	0	0	0	0	0	0	0	0	0	34	34	75	75	76	102	136	120	87	120
		Pb(T.T.)																					
		Zn(T.T.)																					
		Au(kg)		0	0	0	0	0	0	0	0	0	0	154	154	338	338	345	463	617	543	392	543
		Ag(kg)																					
	Recovery	Cu(%)		90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90
	Moisture	(%)																					
Total Value (T.US$)				0	0	0	0	0	0	0	0	0	0	75,000	75,000	164,287	164,287	167,858	225,001	300,002	264,287	190,874	264,287
	Cu (US$/lb)	1	2204.6	0	0	0	0	0	0	0	0	0	0	75,000	75,000	164,287	164,287	167,858	225,001	300,002	264,287	190,874	264,287
	Pb																						
	Zn																						
	Au (less 1g/t)	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Ag		0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sales Cost Total (T.US$)				0	0	0	0	0	0	0	0	0	0	25,111	25,111	55,006	55,006	56,201	75,334	100,445	88,487	63,908	88,487
	Freight (US$/WA/T)		40	0	0	0	0	0	0	0	0	0	0	980	980	2146	2146	2193	2939	3919	3453	2494	3453
	T.C (US$/DMT)		80	0	0	0	0	0	0	0	0	0	0	18,144	18,144	39,744	39,744	40,608	54,432	72,576	63,936	46,176	63,936
	R.C. (US$/Cu lb)	0.09	176	0	0	0	0	0	0	0	0	0	0	5,988	5,988	13,116	13,116	13,401	17,963	23,950	21,099	15,238	21,099
	Penalty																						
Sales Revenue (T.US$)				0	0	0	0	0	0	0	0	0	0	49,889	49,889	109,281	109,281	111,657	149,668	199,557	175,800	126,967	175,800
Cost	Mine US$/T		5.50	0	0	0	0	0	0	0	0	0	0	49,500	49,500	99,000	99,000	99,000	148,500	198,000	198,000	143,000	198,000
	Conc. US$/T		2.40	0	0	0	0	0	0	0	0	0	0	21,600	21,600	43,200	43,200	43,200	64,800	86,400	86,400	62,400	86,400
	Overhead US$/T		0.70	0	0	0	0	0	0	0	0	0	0	6,300	6,300	12,600	12,600	12,600	18,900	25,200	25,200	18,200	25,200
Total				0	0	0	0	0	0	0	0	0	0	77,400	77,400	154,800	154,800	154,800	232,200	309,600	309,600	223,600	309,600
Operating Profit (T.US$)				0	0	0	0	0	0	0	0	0	0	-27,511	-27,511	-45,519	-45,519	-43,143	-82,532	-110,043	-133,800	-96,633	-133,800

Table 2-1-3(2) Profit Summary of Each Mines (polymetal-1)

	unit	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	TOTAL	DESCRIPTION
Nicolaevskoye																		
Income/orent	US$/t	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	
Cu Conc.	DMT	41,932	50,318	67,091	83,864	83,864	83,864	83,864	83,864	83,864	83,864	83,864	83,864	58,705	58,705	58,705	1,090,232	
Pb Conc.	DMT																	
Zn Conc.	DMT	25,253	30,303	40,405	50,506	50,506	50,506	50,506	50,506	50,506	50,506	50,506	50,506	35,354	35,354	35,354	656,577	
Income	'000US$	19,519	23,423	31,231	39,039	39,039	39,039	39,039	39,039	39,039	39,039	39,039	39,039	27,327	27,327	27,327	507,501	
Operating Cost	'000US$	18,335	22,002	29,336	36,670	36,670	36,670	36,670	36,670	36,670	36,670	36,670	36,670	25,669	25,669	25,669	476,710	
Profit after Tax	'000US$	688	450	476	501	251	251	251	280	452	544	636	853	477	526	592	7,735	
Investment	'000US$	3,000	2,000	2,000	2,000				1,000	1,000	1,000						12,000	
Shemonaihinskoye																		
Income/orent	US$/t	67	67	67	67	67	67										67	
Cu Conc.	DMT	30,241	30,241	30,241	21,168	15,120	15,120										142,131	
Pb Conc.	DMT																	
Zn Conc.	DMT	26,542	26,542	26,542	18,579	13,271	13,271										121,747	
Income	'000US$	13,477	13,477	13,477	9,434	6,739	6,739										63,344	
Operating Cost	'000US$	5,236	5,236	5,236	3,665	3,118	3,118										25,909	
Profit after Tax	'000US$	5,650	5,650	5,650	3,745	2,475	2,475										25,644	
Investment	'000US$																	
Artemyevskoye																		
Income/orent	US$/t				60	60	60	60	60	60	60	60	60	60	60	60	60	
Cu Conc.	DMT				13,350	33,374	66,748	66,748	66,748	66,748	66,748	66,748	66,748	46,724	46,724	46,724	674,156	
Pb Conc.	DMT				5,829	14,572	29,145	29,145	29,145	29,145	29,145	29,145	29,145	20,401	20,401	20,401	294,363	
Zn Conc.	DMT				22,140	55,349	110,698	110,698	110,698	110,698	110,698	110,698	110,698	77,489	77,489	77,489	1,118,051	
Income	'000US$				12,067	30,168	60,337	60,337	60,337	60,337	60,337	60,337	60,337	42,236	42,236	42,236	609,404	
Operating Cost	'000US$	1,000	1,000	1,000	8,106	20,265	40,530	40,530	40,530	40,530	40,530	40,530	40,530	28,371	28,371	28,371	412,353	
Profit after Tax	'000US$	-1,000	-2,786	-6,462	-5,379	-3,194	4,531	4,716	4,829	5,304	6,780	8,880	10,980	11,280	7,609	8,055	58,144	
Investment	'000US$	10,000	20,000	20,000	20,000				5,000	5,000							80,000	
Tishinskoye																		
Income/orent	US$/t	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	
Cu Conc.	DMT	14,644	15,097	15,097	15,097	18,116	18,116	18,116	18,116	18,116	18,116	18,116	18,116	12,681	12,681	12,681	242,906	
Pb Conc.	DMT	7,564	7,798	7,798	7,798	9,358	9,358	9,358	9,358	9,358	9,358	9,358	9,358	6,550	6,550	6,550	125,472	
Zn Conc.	DMT	80,385	82,871	82,871	82,871	99,445	99,445	99,445	99,445	99,445	99,445	99,445	99,445	69,611	69,611	69,611	1,333,391	
Income	'000US$	27,166	28,006	28,006	28,006	33,607	33,607	33,607	33,607	33,607	33,607	33,607	33,607	23,525	23,525	23,525	450,620	
Operating Cost	'000US$	32,699	33,710	33,710	33,710	40,452	40,452	40,452	40,452	40,452	40,452	40,452	40,452	28,316	28,316	28,316	542,394	
Profit after Tax	'000US$	-5,840	-6,787	-8,137	-8,643	-10,390	-11,054	-11,769	-12,545	-13,296	-10,724	-14,682	-15,707	-14,636	-15,664	-30,373	-193,247	
Investment	'000US$	2,000	5,000						1,000	1,000							9,000	
Shubinskoye																		
Income/orent	US$/t	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	
Cu Conc.	DMT	4,297	10,742	10,742	10,742	10,742	10,742	10,742	10,742	7,519	7,519	7,519	7,519	5,371	5,371	5,371	125,680	
Pb Conc.	DMT	345	862	862	862	862	862	862	862	604	604	604	604	431	431	431	10,088	
Zn Conc.	DMT	4,321	10,804	10,804	10,804	10,804	10,804	10,804	10,804	7,563	7,563	7,563	7,563	5,402	5,402	5,402	126,407	
Income	'000US$	2,864	7,159	7,159	7,159	7,159	7,159	7,159	7,159	5,012	5,012	5,012	5,012	3,580	3,580	3,580	83,769	
Operating Cost	'000US$	2,731	6,828	6,828	6,828	6,828	6,828	6,828	6,828	4,780	4,780	4,780	4,780	3,414	3,414	3,414	79,888	
Profit after Tax	'000US$	74	-271	-271	-271	-271	-271	-435	-599	-285	-294	-303	-316	-388	-283	-567	-4,733	
Investment	'000US$	3,000					1,000	1,000									5,000	
Belousovskoye																		
Income/orent	US$/t	24	24	24	24	24	24	24	24								24	
Cu Conc.	DMT	4,444	4,444	4,444	4,444	4,444	4,444	4,444	2,222								33,330	
Pb Conc.	DMT	3,133	3,133	3,133	3,133	3,133	3,133	3,133	1,567								23,498	
Zn Conc.	DMT	11,811	11,811	11,811	11,811	11,811	11,811	11,811	5,905								88,582	
Income	'000US$	4,771	4,771	4,771	4,771	4,771	4,771	4,771	2,388								35,786	
Operating Cost	'000US$	6,830	6,830	6,830	6,830	6,830	6,830	6,830	3,415								51,225	
Profit after Tax	'000US$	-2,117	-2,265	-2,423	-2,593	-2,775	-2,969	-3,177	-2,340	-1,446							-22,105	
Investment	'000US$																	
Irtyshskoye																		
Income/orent	US$/t	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	
Cu Conc.	DMT	17,567	15,500	15,500	25,833	36,167	36,167	36,167	36,167	36,167	36,167	36,167	25,317	25,317	25,317	25,317	428,837	
Pb Conc.	DMT	3,627	3,200	3,200	5,333	7,467	7,467	7,467	7,467	7,467	7,467	7,467	5,227	5,227	5,227	5,227	88,537	
Zn Conc.	DMT	24,077	21,244	21,244	35,407	49,570	49,570	49,570	49,570	49,570	49,570	49,570	34,699	34,699	34,699	34,699	587,758	
Income	'000US$	11,304	9,975	9,975	16,623	23,273	23,273	23,273	23,273	23,273	23,273	23,273	16,292	16,292	16,292	16,292	275,957	
Operating Cost	'000US$	13,410	11,832	11,832	19,720	27,608	27,608	27,608	27,608	27,608	27,608	27,608	19,326	19,326	19,326	19,326	327,352	
Profit after Tax	'000US$	-2,242	-2,491	-3,005	-4,199	-6,095	-6,564	-7,268	-7,731	-7,970	-8,422	-9,175	-8,412	-8,852	-9,332	-17,771	-104,929	

Table 2-1-3(2) Profit Summary of Each Mines (polymetal-2)

	unit	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	TOTAL	DESCRIPTION
Yubileynoe-Snegir'kinskoye																		
Income/ore-t	US$/t				55	55	55	55	55	55	55	55	55	55	55	55	55	
Cu Conc.	DMT				13,307	26,615	39,922	39,922	39,922	39,922	39,922	39,922	27,945	27,945	27,945	27,945	391,234	
Pb Conc.	DMT																	
Zn Conc.	DMT				8,324	16,649	24,973	24,973	24,973	24,973	24,973	24,973	17,481	17,481	17,481	17,481	244,735	
Income	'000US$				5,494	10,988	16,481	16,481	16,481	16,481	16,481	16,481	11,537	11,537	11,537	11,537	161,512	
Operating Cost	'000US$	1,500	1,500	1,500	4,359	6,718	10,077	10,077	10,077	10,077	10,077	10,077	7,054	7,054	7,054	7,054	104,255	
Profit after Tax	'000US$	-1,500	-3,246	-5,176	-2,789	186	1,635	1,805	1,955	2,929	3,653	3,477	2,247	2,321	2,395	2,375	12,228	
Investment	'000US$	10,000	10,000							2,000	2,000						24,000	
Orlovskoye																		
Income/ore-t	US$/t	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	
Cu Conc.	DMT	146,854	146,854	163,171	195,805	195,805	195,805	195,805	195,805	195,805	195,805	195,805	195,805	195,805	195,805	195,805	2,806,539	
Pb Conc.	DMT																	
Zn Conc.	DMT	33,007	33,007	36,674	44,009	44,009	44,009	44,009	44,009	44,009	44,009	44,009	44,009	44,009	44,009	44,009	630,796	
Income	'000US$	51,331	51,331	57,035	68,442	68,442	68,442	68,442	68,442	68,442	68,442	68,442	68,442	68,442	68,442	68,442	981,000	
Operating Cost	'000US$	34,389	34,389	38,210	45,852	45,852	45,852	45,852	45,852	45,852	45,852	45,852	45,852	45,852	45,852	45,852	657,212	
Profit after Tax	'000US$	11,482	11,232	12,257	14,424	14,434	14,434	14,441	14,081	13,914	14,122	14,420	14,448	14,502	14,591	14,950	207,744	
Investment	'000US$	2,000	2,000	3,000				3,000	3,000								13,000	
Zyryanovskoye																		
Income/ore-t	US$/t	7	7	7	7												7	
Cu Conc.	DMT	1,962	1,443	866	289												4,560	
Pb Conc.	DMT	3,527	2,593	1,556	519												8,195	
Zn Conc.	DMT	4,758	3,440	1,864	1,288												20,350	
Income	'000US$	4,473	3,290	1,974	669												10,396	
Operating Cost	'000US$	18,333	13,480	8,088	2,696												42,597	
Profit after Tax	'000US$	-13,902	-11,195	-7,890	-4,352	-2,614											-39,953	
Investment	'000US$																	
Kruhovskoye																		
Income/ore-t	US$/t	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	
Cu Conc.	DMT	5,459	5,154	5,154	5,154	5,154	5,154	5,154	5,154	5,154	5,154	5,154	5,154	5,154	5,154	5,154	77,615	
Pb Conc.	DMT	1,912	1,745	1,745	1,745	1,745	1,745	1,745	1,745	1,745	1,745	1,745	1,745	1,745	1,745	1,745	26,342	
Zn Conc.	DMT	7,912	7,314	7,314	7,314	7,314	7,314	7,314	7,314	7,314	7,314	7,314	7,314	7,314	7,314	7,314	110,308	
Income	'000US$	5,560	5,191	5,191	5,191	5,191	5,191	5,191	5,191	5,191	5,191	5,191	5,191	5,191	5,191	5,191	78,228	
Operating Cost	'000US$	9,525	8,860	8,860	8,860	8,860	8,860	8,860	8,860	8,860	8,860	8,860	8,860	8,860	8,860	8,860	133,565	
Profit after Tax	'000US$	-4,010	-3,993	-4,277	-4,571	-5,248	-5,956	-6,336	-6,743	-7,179	-7,652	-8,164	-8,454	-8,783	-9,410	-17,703	-108,474	
Investment	'000US$				2,000	2,000											4,000	
Nareevskoye																		
Income/ore-t	US$/t	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	
Cu Conc.	DMT	36,043	39,647	43,251	43,251	72,085	72,085	108,128	108,128	108,128	108,128	108,128	108,128	108,128	108,128	72,085	1,243,471	
Pb Conc.	DMT	5,741	6,316	6,890	6,890	11,483	11,483	17,224	17,224	17,224	17,224	17,224	17,224	17,224	17,224	11,483	198,078	
Zn Conc.	DMT	58,320	64,152	69,984	69,984	116,640	116,640	174,960	174,960	174,960	174,960	174,960	174,960	174,960	174,960	116,640	2,012,040	
Income	'000US$	29,603	32,564	35,524	35,524	59,206	59,206	88,809	88,809	88,809	88,809	88,809	88,809	88,809	88,809	59,206	1,021,310	
Operating Cost	'000US$	20,740	22,814	24,888	22,488	37,480	37,480	56,220	56,220	56,220	56,220	56,220	56,220	56,220	56,220	37,480	652,530	
Profit after Tax	'000US$	5,994	4,234	1,223	123	6,038	6,038	13,502	13,064	14,513	17,487	19,581	19,835	20,153	20,529	13,962	176,256	
Investment	'000US$	20,000	20,000	20,000				5,000	5,000								90,000	

TOTAL

	unit	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	TOTAL	DESCRIPTION
Cu Conc.	DMT	303,443	319,440	355,557	432,304	501,488	549,167	569,090	566,868	561,423	561,423	561,423	539,596	505,854	485,830	449,787	7,260,691	
Pb Conc.	DMT	25,849	25,647	25,184	32,109	48,620	61,193	68,934	67,388	65,643	65,643	65,643	63,303	60,322	51,528	45,837	774,573	
Zn Conc.	DMT	290,386	294,488	311,513	363,037	475,368	539,041	584,090	578,184	569,038	569,038	569,038	546,675	499,528	466,319	407,999	7,053,742	
Income	'000US$	170,070	179,188	194,343	232,409	288,585	324,246	347,110	344,725	340,191	340,191	340,191	328,265	305,040	286,938	257,335	4,278,828	
Operating Cost	'000US$	164,727	168,281	175,918	200,084	240,681	264,305	279,927	276,512	271,049	271,049	271,049	259,743	235,241	223,082	204,342	3,505,989	
Profit after Tax	'000US$	-6,723	-11,508	-18,031	-14,295	-7,202	2,451	5,741	4,250	6,934	12,493	14,650	15,474	16,075	10,961	-26,459	4,810	
Investment	'000US$	52,000	71,000	45,000	24,000	3,000	2,000	9,000	15,000	10,000	4,000						235,000	

2-1-4 Exploration and Development

As aforementioned, assumed resources which are potentially economic, are limited. Exploration and development of new resources must be accelerated in order to make up for depletion of resources by production. A substantial amount of new resources will be required to be placed into production for sustaining the production level of the year 2005. A technical cooperation scheme can be sought for exploration and development projects.

The territory of Kazakhstan was extensively explored for mineral resources during the era of the former USSR. An enormous amount of data are now stored in the archive of the Ministry of Geology and Underground Resources Preservation. It is necessary to assess the past exploration data and prioritize individual ore deposits for further detailed exploration in accordance with their economic potential. Accelerated exploration and economic assessment programmes should be prepared for selected targets on the basis of their priorities.

In addition to the unexploited deposits included in Table 2-1-1(2), a number of ore deposits are still in an advanced exploration stage and are listed in Table 2-1-4(1). In terms of the total amount of contained metals, the Novo-Leninogorsk, Kosmurun, Zhaman-Aibat, Samarskoe, Chatrykul and Koksay deposits are important resources with their metal contents exceeding one million tons on copper equivalent basis. The Kosmurun deposit seems to be the most promising of these as far as its copper and gold grades concern, and will become a major raw material source for copper and zinc.

The Zhaman-Aibat and Samarskoe deposits are now being actively explored and have a good potential to be exploited depending upon the results of the present exploration works. Although their metal grades are as low as 1.87% and 1.54% respectively on copper equivalent basis, low cost mining method, such as room-and-pillar, open-pit or block-caving, are likely to be applicable.

The Chatrykul deposit, together with the Zhaisan which is located in the vicinity, appears to be economically interesting for its appreciably high copper grade. These two deposits, the Chatrykul and Zhaisan, are being explored by a joint venture between Kazakhstan and Canadian firms.

The Novo-Leninogorsk deposit is an important lead and zinc raw material source, containing more than 1.5 million tons of each of these metals. However, its grade of 2.83% on copper equivalent basis appears to be economically marginal for an underground exploitation, taking account the top of the ore body is 600 meters below the surface. The average copper grade of 0.49% for the Koksay deposit appears to be also economically marginal, although it is believe that the deposit can be mined by open pit. It is reported that the exploration and feasibility studies have been completed for these deposits. A detailed review of their economic feasibilities will be necessary.

The Akbastau deposit, though its size is relatively small, is important as a copper, lead and zinc raw material source. The Dolinnoe and Mizek deposits are principally gold deposits in terms of the proportion of gold to the total ore values. However, the zinc content of the Dolinnoe and the copper content of the Mizek cannot be disregarded as raw material sources for these metals. The economic potential of these three deposits is interesting and worthwhile for a detailed study.

Among small deposits with their reserves of less than 5 million tons, those that indicate copper equivalent grade of 5% or better may be economically exploited and are worth for further studies.

Table 2-1-4(1) Major Ore Deposits in Advanced Exploration Stage

No.	Name of Ore Deposits	Location	Reserves (Million T)	Grade						Metal Content				Remarks
				Cu (%)	Pb (%)	Zn (%)	Au (g/t)	Ag (g/t)	Cu Equiv. (%)	Cu (T.T)	Pb (T.T)	Zn (T.T)	Cu Equiv. (T.T)	
1	Novo-Leninogorsk	E.kazakh.	51.1	0.17	1.21	3.55		27.4	2.83	87	1,640	1,814	1,446	Deep sheeted U/G
2	Krasnoyarskoe		2.0	1.45	1.70	9.98	0.21	165	7.68	29	34	200	154	U/G
3	Anisimov Kluch		3.5	3.04	0.71	5.18	0.28	35.7	5.98	115	25	181	209	No Power Lines U/G
4	Rulikhinskoe		2.2	1.95	1.32	2.62	0.55	59.7	4.23	43	29	58	85	U/G
5	Obruchevskoye		3.7	1.16	3.08	8.59	0.46	22.2	6.28	43	114	318	232	U/G
6	Dolinnoe		7.2	0.24	0.81	2.74	7.63	82.3	6.77	17	58	197	487	U/G
7	Strezhanskoe		4.8	1.77	0.79	4.40	0.54	55.8	4.67	85	38	211	224	U/G
8	Vavilonskoe		9.1	1.46					1.46	133			133	O/P
9	Karchiginskoe		5.1	2.78		0.39	1.01	5.5	3.59	142		20	183	O/P
10	Nikitinskoe		1.4	0.90	2.26	2.63			2.69	13	32	37	38	
11	Akbastau	Semipala	12.5	1.76	0.81	5.42	0.69	14.8	4.93	220	101	678	616	O/P and U/G
12	Kosmurun		21.0	3.33		0.75	14.60	20.0	12.42	699		158	2,608	O/P and U/G
13	Mizek		6.8	1.11		0.34	5.38	4.3	4.47	76		23	304	O/P and U/G
14	Rodnikovoye	Zhambyl	22.7		6.59	1.97		17.6	2.79		1,500	447	633	O/P and U/G
15	Irisu	Shymkent	250.0	0.30			0.13	1.2	0.39	750			975	? O/P
16	Borly	Dzhekaz.	94.4	3.34			0.03	3.4	0.38	321			359	Mo: 0.01% O/P
17	Karatasskaya		82.4	0.33			0.01	6.5	0.38	272			313	Mo: 0.04% O/P
18	Zhaman-Aibat		217.0	1.66	0.23			20.8	1.87	3,602	499		4,058	U/G, (R/P)
19	Akzhal		31.0		1.07	4.83	0.14	38.7	2.82	1,389	331	1,498	874	O/P
20	Samarskoe	Karaganda	112.0	1.24			0.48	2.5	1.54				1,725	U/G, (B/C)
21	Zhaisan	Zhambyl	9.9	3.03			0.12	4.1	3.13	943			310	U/G
22	Chatyrkul		27.1	3.48			0.79	7.2	4.00	30			1,084	U/G
23	Mayskoe	E.Kazakh.	22.9	0.13	0.75	1.96	0.28	32.9	1.61	89	172	449	369	U/G
24	Novo-Beryozov		4.2	2.11	0.14	4.65	0.39	15.8	4.58		6	195	192	U/G
25	Yablonovoye	T.Kurgan	3.0		3.22	5.03		56.8	3.53		97	151	106	? U/G
26	Koksay		608.0	0.49			0.12		0.56	2,974			3,405	O/P

Note 1. Cu Equiv. (%) = Cu % + 0.27 Pb (%) + 0.45 Zn (%) + 0.59 Au (g/t) + 0.007 Ag (g/t)

2. Cu Equiv. Metal Content = Reserves × Cu Equiv. (%)

3. Reserves: Category C2 and higher (A+B+C1+C2)

4. U/G: Underground, O/P: Open Pit, R/P: Room and Dillar, B/C: Block Caving

2-2 Metal Production

2-2-1 Raw Materials

Raw material supplies from foreign sources are partially secured for the Balkhash Smelter until 1999. However, a shortage of raw materials at the Smelter is apparent and critical in short and medium terms, even though it is assumed that the Zhezkent concentrates are supplied and that exploitation of the Koktau and Boshekul deposits are accelerated. A considerable amount of raw materials from unspecified sources is required to sustain its annual production at a level of 150,000 tons of copper that is considered as the minimum production level of a smelter of this kind for an economically viable operation.

Raw material supply sources for the JSC "Balkhashmed" and JSC "Shymkent Lead Plant" in the years 1992 and 1994 are shown in Table 2-2-1(1). Raw material supplies from foreign sources declined significantly for both Combines in 1994. It is reported that the situation is getting worse.

Table 2-2-1(1) Raw Material Sources of the JSC "Shymkent Lead Plant" and JSC "Balkhashmed"

	1992				1994			
	Sources	Marerial	Pb Content T.T.	Proportation %	Sources	Marerial	Pb Content T.T.	Proportation %
JSC "Shymkent Lead Plant"	JSC "Achpolymetal"	Conc.	33.5	21.2	JSC "Achpolymetal"	Conc.	2.5	3.2
	JSC "Zhezkazgantsvetmet"	Conc.	15.0	9.5	JSC "Tekeli Pb-Zn Combine"	Conc.	7.4	9.5
	JSC "Tekeli Pb-Zn Combine"	Conc.	2.0	1.3	JSC "Zezkazgantsvetmet"	Dust	4.4	5.7
	JSC "Akshatau Ken-Baytu Combinaty"	Conc.	2.0	1.3				
	Others	Slag	2	1.3				
	Total Domestic		54.5	34.5	Total Domestic	0	14.3	18.4
	Almalik	Conc.	44.0	27.8	Uzbekistan	Conc.	16.4	21.2
	(Uzbek)	Slag	8.0	5.1	Tazikistan	Conc.	0.1	0.1
	Kansai	Conc.	30.0	19.0	Other Import	Conc.	46.7	60.3
	Adrasman	Conc.	14.0	8.9				
	(Tazik)							
	Other C.I.S.	Conc.	7.5	4.7				
	Total Import		103.5	65.5	Total Import		63.2	81.6
Total Raw Material			158.0	100	Total		77.5	100.0

	1992				1994			
	Sources	Marerial	Cu Content T.T.	Proportation %	Sources	Marerial	Cu Content T.T.	Proportation %
JSC "Balkhashmed"	Own	Conc.	39.1	20.0	Own	Conc.	29.6	23.8
	JSC "EKCChC"	Conc.	10.0	5.1	JSC "EKCChC"	Conc.	7.4	6.0
	JSC "Zhezkent MCC"	Conc.	17.0	8.7	JSC "Zhezkent MCC"	Conc.	14.0	11.3
	JSC "Leninogorsk PC"	Conc.	8.0	4.1	JSC "Leninogorsk PC"	Conc.	0.8	0.6
	JSC "Zyryanovsk Lead Combine"	Conc.	3.0	1.5	JSC "Zyryanovsk Lead Combine"	Conc.	2.8	2.3
	JSC "UKPb-Zn Combine"	Blister	31	15.8	JSC "UKPb-Zn Combine"	Blister	19.7	15.9
	Total Domestic		108.1	55.2	Total Domestic		74.3	59.9
	Erdenet	Conc.	55.5	28.3	Erdenet	Conc.	40.0	32.3
	Chuquicamata	Conc.	14.6	7.5				
	Escondida	Conc.	13.2	6.7	Escondida	Conc.	9.3	7.5
	Others	Conc.	4.5	2.3	Iran	Conc.	0.4	0.3
	Total Import		87.8	44.8	Total Import		49.7	40.1
Total Raw Material			195.9	100.0	Total		124.0	100.0

2-2-2 Metal Production Plan

For the estimation of the metal production plan, assumptions are made as follows;

1) The domestic raw material supply will be made according to the mine-concentrator production plan shown in Table 2-1-2(1) and (2).
2) The Zhezkazgan Smelter will treat only raw materials provided by the Zhezkazgan and the Zillandinskaya Mines.
3) The Balkhash Smelter will operate basically at a production rate of 150,000 tons of copper cathode, regardless of raw material supplies
4) The Irtysh (Globokoe) Copper Smelter produces only blister and will gradually increase its production rate to 65,000 tons (contained copper) by 2004.
5) The Ust-Kamenogorsk Refinery will gradually increase its production rates to meet the blister production of the Irtysh Smelter by 2000.
6) Blister copper of the Irtysh will be supplied to Balkhashmed until 1999 for the amount exceeding the capacity of the Ust-Kamenogorsk Refinery.
7) Concentrator supplies from Erdenet and Chile sources will continue until 1999 as scheduled.
8) All the Zhezkent concentrates will be supplied to Balkhashmed during the forecast period, while concentrates from other sources in the East Kazakhstan Region (e.g. EKCCHC) are supplied to Balkhashmed until 1999 when the production rate of Irtysh Smelter will reach 40,000 tons per annum.
9) The lead and zinc production plans will be performed as shown in Fig 2-2-2(1).

The raw materials supply-metal production plan is shown in Table 2-2-2(1), (2) and (3). Concentrates imported from "others" listed in the table are supplies from unspecified foreign sources and indicate absolute shortage of raw materials.

The results of the estimation are summarized as follows;

1) Raw material supplies are insufficient for the planned production of copper, lead and zinc unless foreign supply sources are secured.
2) Shortages of copper concentrate supplies to the Balkhash will continue until 2005 if the supplies from Mongolia and Chile are stopped. New supply sources may have to be sought after 1999.
3) The production of the JSC "Shymkent Lead Plant" relies totally on the Almalik concentrates.
4) A substantial amount of zinc concentrate supply will be in excess of the planned zinc production beyond 2000. An adjustment of supply-demand balances may become necessary.
5) The annual metal production beyond 2005 will be stabilized at levels ranging from 380,000 to 400,000 tons for copper, 130,000 to 140,000 tons for lead and 250,000 to 290,000 tons for zinc, according to this production plan.

A raw material flow in 2000 is shown in Fig 2-2-2(2).

		Early period (1996 to 2000)		Middle period (2001 to 2005)	Latter period (2006 to 2010)
1. Amount of production		1996 (T/Y) (S document)	2000 (T/Y) (Estimate)	2005 (T/Y) (Estimate)	2010 (T/Y) (Estimate)
Lead	SHYMKENT	30,000	ALMALIC, Toll, Lead slag 50,000	ALMALIC, Toll, Lead slag → 50,000	ALMALIC, Toll, Lead slag → 50,000
	UST-KAMENOGORSK	47,000	KAZAKHSTAN → → 45,000	KAZAKHSTAN → → 60,000	KAZAKHSTAN → → 50,000
	LENINOGORSK	23,000	Battery scrap 30,000	Battery scrap 30,000	Battery scrap 40,000
	Total	100,000	125,000	140,000	140,000
				Amount of production at mines≒ 60,000 (peak period)	Amount of production at mines≒ 50,000
Zinc	UST-KAMENOGORSK	86,000	130,000	186,400	145,000
	LENINOGORSK	80,000	90,000	106,500	80,000
	Total	166,000	220,000	292,900	225,000
				Amount of production at mines≒300,000 (peak period)	Amount of production at mines≒225,000
Copper	UST-KAMENOGORSK	6,600	30,000	65,000	65,000
* Sulfuric acid		267,500	393,500	565,800	472,500
2. Facility plan					
(1) Roasting plant facilities					
UST-KAMENOGORSK				←	←
LENINOGORSK		←			←
(2) Sulfuric acid facilities					
SHYMKENT			←	→	
UST-KAMENOGORSK		←			
LENINOGORSK		←			←
GULBOKOE		←			
(3) Installation of sulfur burning facilities		←			
(4) Copper electrolytic facilities in UST-KAMENOGORSK		←			
(5) Copper smelting facilities in GULBOKOE				←	→
(6) Proper facilities plan in SHYMKENT		←	→		
3. Process improvement plan					
(1) JAROSITE process in LENINOGORSK		←			
4. Quality improvement plan		←	→		
5. Establishment of management technology system		←	→		
6. Establishment of cost management system		←	→		

* The production ratio of sulfuric acid to metal is assumed as follows:
  Copper 2.0
  Lead 0.5
  Zinc 1.3

Fig.2-2-2(1) Production Plan

Table 2-2-2(1) Raw Material Supply-Copper Production Forecast (1996-2010)

		1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Concentrate Production:																
(Contained Cu T.T.) Total	E. Kazakhstan	72	76	84	100	115	128	132	130	127	128	126	125	130	129	119
	JSC "Zhezkazgantsvetmet"	169	172	189	189	189	191	191	162	162	162	172	167	182	156	156
	JSC "Balkhashmed"	28	28	28	25	14	14	9	9	9	9	9	9	9	9	13
	Koktau-Chilisai			3	15	15	15	15	35	35	35	35	17	17	17	17
	Boshekul				20	20	39	39	39	39	39	39	27	27	27	27
	Aktogai											34	34	75	75	76
	Total	269	276	304	349	353	387	386	375	372	373	415	379	440	413	408
Concentrate Supply to:																
(Contained Cu T.T.)	JSC "Zhezkazgantsvetmet"	169	172	189	189	189	191	191	162	162	162	172	167	182	156	156
	JSC "Balkhashmed"	74	75	86	127	119	109	104	124	124	124	158	128	169	169	174
	JSC "Irtysh PC"	22	26	31	36	41	41	52	62	67	67	67	67	67	67	67
	Total	265	273	306	352	349	341	347	348	353	353	397	362	418	392	397
Balance of Supply-Demand																
(Contained Cu T.T.)		4	3	-2	-3	4	46	39	27	19	20	18	17	22	21	11
Concentrate Import From:																
(Contained Cu T.T.)	Erdenet	30	25	20	15											
	Chile	25	20	20	15											
	Others	12	18	9	9	26	46	51	31	31	31		27			
	Total	67	63	49	39	26	46	51	31	31	31		27			
Blister Supply from JSC "Irtysh PC" to:																
(Contained Cu T.T.)	JSC "UKPb-Zn Combine"	7	8	10	15	30	40	50	60	65	65	65	65	65	65	65
	JSC "Balkhashmed"	14	17	20	20	10										
	Total	21	25	30	35	40	40	50	60	65	65	65	65	65	65	65
Cathode Production	(T.T.)															
(Smelter Recovery 97%)	JSC "Zhezkazgantsvetmet"	164	167	183	183	183	185	185	157	157	157	167	162	177	151	151
	JSC "Balkhashmed"	150	150	150	169	150	150	150	150	150	150	153	150	164	164	169
	JSC "UKPb-Zn Combine"	7	8	10	15	30	40	50	60	65	65	65	65	65	65	65
	Total	321	325	343	367	363	375	385	367	372	372	385	377	406	380	385

Table 2-2-2(2) Raw Material Supply-Lead Production Forecast (1996-2010)

		1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Concentrate Production:																
(Contained Pb T.T.) Total	JSC "EKCChC"				3	7	14	14	14	14	14	14	14	14	10	10
	JSC "Leninogorsk PC"	10	11	11	12	12	12	12	12	10	10	10	10	8	8	7
	JSC "Irtysh PC"	2	2	2	3	4	4	4	4	3	3	3	3	3	3	3
	JSC "Zyryanovsk Lead Combine"	6	9	6	5	8	9	11	11	11	11	11	11	11	11	8
	Chekmar							3	5	10	15	15	15	15	15	15
	Maleevsky Yar											1	3	5	7	7
	Total	18	22	19	23	31	39	44	46	48	53	54	56	56	54	50
Battery Scrup																
(Contained Pb T.T.)		24	25	27	29	32	32	32	32	32	32	32	32	32	32	32
Raw Material Supply to:																
(Contained Pb T.T.)	JSC "Leninogorsk PC"	24	25	27	29	32	32	32	32	32	32	32	32	32	32	32
	JSC "UKPb-Zn Combine"	18	22	19	23	31	39	44	46	48	53	54	56	56	54	50
	JSC "Shymkent Lead Plant"															
	Total	42	47	46	52	63	71	76	78	80	85	86	88	88	86	82
Balance of Supply-Demand																
(Contained Pb T.T.)		-31	-25	-28	-24	-16	-8	-9	-7	-10	-10	-9	-1	-1	2	-2
Concentrate Import From:																
(Contained Pb T.T.)	Almalik	32	32	42	47	53	53	53	53	53	53	53	53	53	53	53
	Others	31	25	28	24	16	8	9	7	10	10	9	1	1		2
	Total	63	57	70	71	69	61	62	60	63	63	62	54	54	53	55
Lead Production (T.T.)																
(Smelter Recovery 95%)	JSC "Leninogorsk PC"	23	24	26	28	30	30	30	30	30	30	30	30	30	30	30
	JSC "UKPb-Zn Combine"	47	45	45	45	45	45	50	50	55	60	60	55	55	50	50
	JSC "Shymkent Lead Plant"	30	30	40	45	50	50	50	50	50	50	50	50	50	50	50
	Total	100	99	111	118	125	125	130	130	135	140	140	135	135	130	130

Table 2-2-2(3) Raw Material Supply-Zinc Production Forecast (1996-2010)

		1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Concentrate Production:																
(Contained Zn T.T.) Total	JSC "EKCChC"	23	25	30	42	56	85	82	79	79	79	72	72	72	55	55
	JSC "Leninogorsk PC"	63	70	70	80	80	80	80	80	73	73	73	73	55	55	55
	JSC "Irtysh PC"	15	14	14	23	33	36	36	34	31	31	31	22	22	22	22
	JSC "Zhezkent MCC"	13	13	15	18	18	18	18	18	18	18	18	18	18	18	18
	JSC "Zyryanovsk Lead Combine"	38	39	41	40	62	74	91	91	91	91	91	91	91	91	62
	Chekmar							8	17	34	51	51	51	51	51	51
	Maleevsky Yar											12	23	47	58	58
	Total	152	161	170	203	249	293	315	319	326	343	348	350	356	350	321
Concentrate Supply to:																
(Contained Zn T.T.)	JSC "Leninogorsk PC"	75	75	80	90	100	100	106	106	111	119	111	106	100	94	89
	JSC "UKPb-Zn Combine"	77	86	90	113	144	156	166	183	194	207	200	200	194	194	161
	Total	152	161	170	203	244	256	272	289	305	326	311	306	294	288	250
Balance of Supply-Demand																
(Contained Zn T.T.)		-32	-50	-47	-30	5	37	43	30	21	17	37	44	62	62	71
Zinc Production (T.T.)																
(Smelter Recovery 95%)	JSC "Leninogorsk PC"	80	90	85	90	90	90	95	95	100	107	100	95	90	85	80
	JSC "UKPb-Zn Combine"	86	100	110	120	130	140	150	165	175	186	180	180	175	175	145
	Total	166	190	195	210	220	230	245	260	275	293	280	275	265	260	225

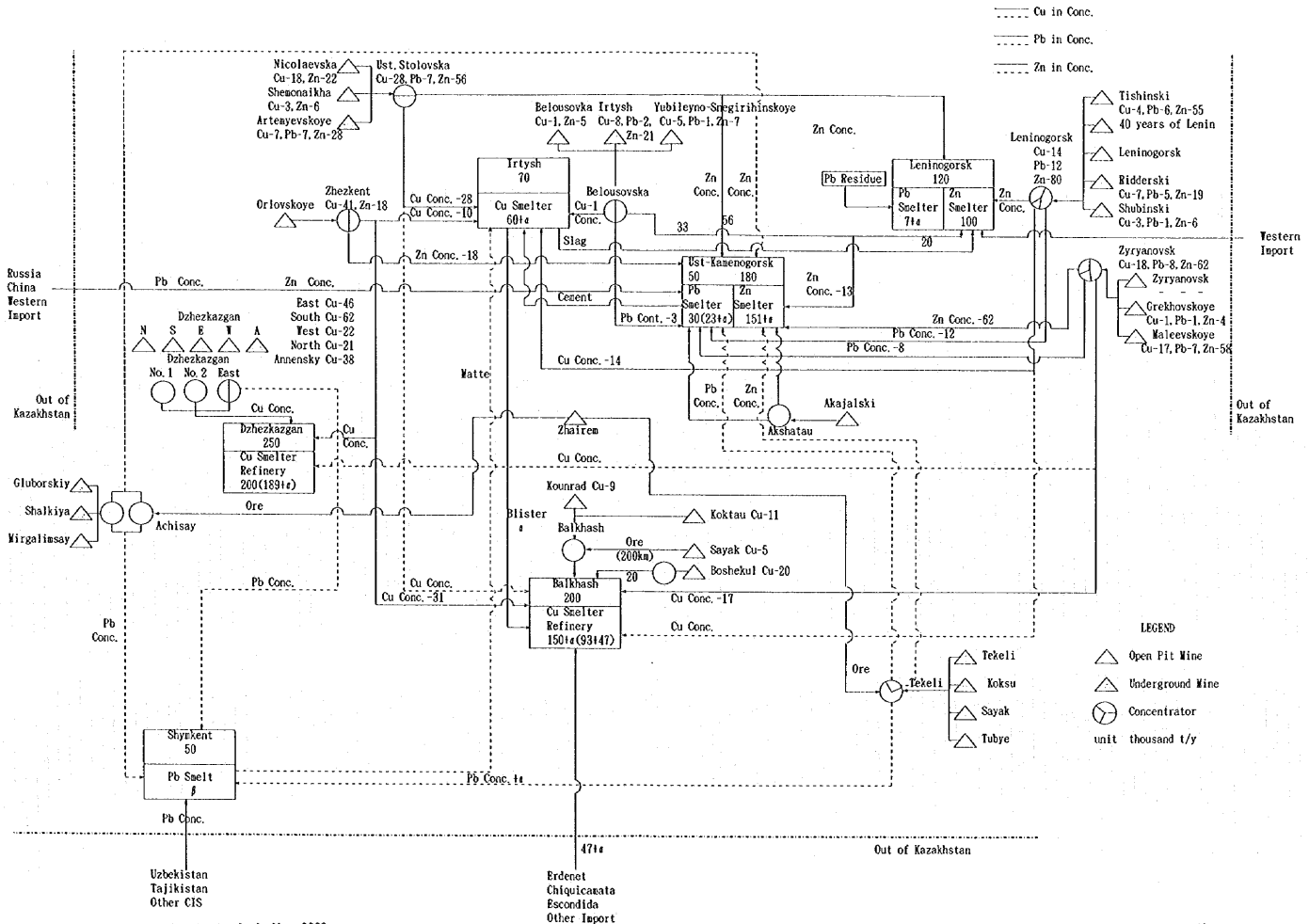


Fig.2-2-2(2) Raw Material Supply Flow in the Year 2000

2-2-3 Sulphuric Acid Production

Sulphur must be dealt with one way or another in non-ferrous metals smelters because they treat sulphide minerals and emit sulphurous acid gases which are hazardous to the environment. In an ordinary procedure, sulphurous acid gases are fixed as sulphuric acid. Therefore, the market for sulphuric acid is one of the important factors which are studied for conditions of smelter location. Although statistical data obtained in the course of the current investigation are insufficient, this study indicates the sulphuric acid supply and demand for the period between 1993 and 1995 as shown in Table 2-2-3(1).

Table 2-2-3(1) Supply and Demand of Sulphuric Acid in Kazakhstan

		1993	1994	1995
Supply	Smelters		552.9	493.7
	Copper		(215.1)	(215.2)
	Lead/Zinc		(337.8)	(215.2)
	Pyrite Combustion		240	240
	Elemental Sulphuric combustion		240	240
	Import			57.9
	Total Supply	1,179.0	1,032.8	1,031.6
Demand	Fertilizer	856.7	718.3	938.3
	Synthetic fiber	1.5		
	Synthetic Rubber etc.	49.0	49.0	49.0
	Export		265.5	
	Total Demand	907.2	1,032.8	987.3

Sulphuric acid production will fluctuate depending upon the sulphide compositions of smelter feeds (mainly concentrates). Table 2-2-3(2) indicates the average annual production rates and theoretically corresponding amounts of sulphuric acid at 100% recovery of sulphur, assuming sulphide compositions of smelter feeds. The JSC Zhezkazgan ores, consisting mainly chalcocite, are low in the theoretical sulphuric acid ratio to a ton of copper metal. The theoretical sulphuric acid production is regarded as the maximum attainable. In the same table, the actual production in the period between January and September, 1996 is cited and indicates generally low recovery rates of sulphur, although the JSC "Zhezkazgantsvetmet" and JSC "Leninogorsk PC" are performing relatively well.

Estimation of yearly production rates of sulphuric acid is extremely difficult due to insufficient information and has been omitted from the production plan of this report. If the sulphuric acid plants perform to their best, an annual total production of around 1 million tons of sulphuric acid can be easily expected, assuming that 60% of the theoretically maximum production can be achieved, and will meet the present demand as shown in Table 2-2-3(1).

Table 2-2-3(2) Sulphuric Acid Production

Name of JSC	Planned Metal Production (T.T)			* Sulphide Ratio	** Theoretical Production		Actual Production, 1-9, 1996		Remark
	Cu	Pb	Zn		H_2SO_4 (T.T)	*** Ratio	H_2SO_4 (T.T)	*** Ratio	
Zhezkazgantsvetmet	180			cc: py =3:1	234	1.30	96.9	0.699	Average H_2SO_4 Ratio to Metals in Actual Operations in Japan Cu: 2.7 Pb: 0.7 Zn: 2.0
Balkhashmed	150			cp: py =1:0	459	3.06	32.7	0.495	
Glubokoe (Irtysh)	65			cp: py =1:0	201	3.06			
Leninogorsk PC			90	Zn: py =3:1	224	2.49	90.7	1.471	
UK Pb-Zn Combine		50		ga: py =2:1	48	0.95			
Shymkent Lead Plant		50	150	Zn: py =3:1	374	2.49			
				ga: py =2:1	48	0.95	0.2	0.076	
Total	395	100	240		1,588		220.5		

Note * Assumed Sulphide Ratios in Concentrate
** Assuming 100% Recovery of Sulphur
*** Ratio of the Amount of H_2SO_4 to that of Metal Produced

When there is insufficient market for sulphuric acid, it is recommended to produce artificial gypsum from sulphuric acid. While sulphuric acid is difficult to store because of its chemically reactive nature in liquid form, gypsum, having a solid form and chemically stable nature, can be stored outdoors for a long period without degeneration. It is commonly believed that artificial gypsum is not cost competitive in Kazakhstan because there are many gypsum deposits which are being mined cheaply. However, production of gypsum is an environmental issue rather than a matter of commercial interest. Taking into account the economic development of Kazakhstan, uses of gypsum will widen, particularity in the construction industry.

2-2-4 Precious Metals and Other By-products

Insufficient data have been obtained with regard to precious metal production in the course of the current investigation because such information was designated as confidential from the national secret point of view. At the present time, the plant on extraction and refining of gold and silver is operating at JSC "UK Pb-Zn Combine". The same production has been set up in Balkhash at the JSC "Balkhashmys" and in Stepnogorsk at JSC "Tselinny Mining and Chemical Combine". A number of non-ferrous metals industry and gold mining industry enterprises are producing "dore" alloy. A new plant is being constructed at the JSC "Balkhashmed" but is not yet in operation. A gold doré plant is attached to the lead plant of the JSC "Leninogorsk PC" but is not in operation as well.

The total 1995 gold and silver productions are recorded at 10 and 370 tons, respectively. Taking into account the high gold and silver contents in polymetallic ores, it will be possible to significantly raise levels of the production with appropriate improvement and reinforcement of the present facilities and equipment. The gold and silver production will further increase in future when base metal deposits with high precious metals content, such as the Kosmurun and Mizek, are exploited.

In addition to precious metals, the following by-products are being produced in the course of producing copper, lead and zinc metals; copper sulphates, bismuth metals, lead bismuth alloys, cadmium metals, zinc oxides, lead oxides, ammoniated rhenium and so forth. Generally, their quality is unsatisfactory for marketing to electronic and other high technology industries in western countries.

No production plan, either for precious metals or for other by-products, can be prepared due to insufficient information.

2-3 Rationalization and Modernization of Production Lines

2-3-1 Overview

Improvement has to be made in facilities and equipment, process and quality control systems, product marketing, corporate management and so forth. The major engineering problems that have been identified at various combines in the course of the two site investigations are summarized in Table 2-3-1(1), together with recommended measures to solve the problems.

Table 2-3-1(1) Recommendations for Improvement of Combine (1)

JSC	Improvement Items	Improvements to be Effected
UK Pb-Zn Combine	Refining ①Establish the base for a smelting-refining complex of copper, lead and zinc ②Promote production of higher grade products (secure future demand)	①Fully utilize the KIVCET Process for lead smelting for cost reduction (energy saving) and environmental improvement. ②Convert the idle zinc electrolysis plant to copper electrolysis plant, for integrated operation involving Irtysh Refinery. ③Ensure sulfuric acid production ; acid plant to be reinforced, including installation of sulfur burning equipment. ①Higher grade copper, lead and zinc to be produced, receive the LME price. ②Higher grade by-products;secure future demand. ③Establish quality control system.
Leninogorsk PC	Mining ①Tishinsky Mine • Improve haulage equipment for developing lower part • Cost reduction (10$/t) • Raise productivity • Re-estimate low-grade ore reserves in deep portion ②Ridder-Skolnoye • Define auriferous bonanza ③Shubinsky Mine Ore dressing ①Cost reduction ②Improve operation performance Refining ①Establish basis for zinc refinery to treat its own ore ②Plant exclusively for treating lead batteries (Owns new battery dismantling facilities)	①The skip equipment at No. 16 level to be moved and improved; LHDs to be increased(study larger type) for cost reduction, (4.7$/t). ②LHD operation rate to be raised to 50→60% level by maintenance of parts. ①Reduce welfare cost by 1/2. ①Cost reduction (20%); review accounting apportionment of indirect expenses; renew equipment. ②Reinforce countermeasures for spontaneous combustion. ①Install a tailings thickner to raise tailings slurry density during transportation to tailings dam, thereby saving energy. ②Study applicability of heavy-media separation to Tishinsky ore, for reduction of personnel and maintenance. ③Reduce personnel of repair division (by preventive maintenance, nurture of multi-functional operators). ①Improve flotation operation and automatic reagent control system (distributed process control by FA computers). ②Separate treatment of slime (slime flotation). ③Install large flotators (cap. 20~30m³) ①Improve recovery of by-products (gold and silver) by utilization of the Jarosite process. ②Higher grade zinc will be produced, receive the LME prices. ③Ensure sulfuric acid production; acid plant to be reinforced, incl. installation of sulfur burning equipment. ①Actively collect battery scraps, which has to be made a national policy. ②Complete stoppage of sintering machine (advice for improvement).
Shymkent Lead Plant	Refining ①Establish raw materials procurement system (for maintaining operation) ②Promote diversification of products(secure demand)	①A base for imported ore treatment (strategic point of communication to the Central Asia and the Middle East). ②To be made a toll smelter, by the state policy guidance. ③Actively collect lead slag; treat copper smelter flue dust. ①Promote lead battery business; the ongoing plant construction to be continued. ②Promote lead chemicals business; study merger of Irtysh copper refinery. ③Ensure sulfuric acid production; acid plant to be reinforced, incl. installation of sulfur burning equipment.
Zhezkazganstvetmet	Mining ①More efficient operation control ②Raise productivity ③Safety measures, etc. ④Effective utilization of mineral resources	①Systematization of data and information by computers. ②More efficiency and improved quality of ore reserve calculation by introduction of geostatics method and computers. ③Flexibility in setting cut-off grade. ①Concentrate and simplify stopes. ②Simplify ventilation system; reduce airflow; introduce computers (ventilation simulation). ③Remote-controlled LHDs and hydraulic long-hole drills. ④Use larger open-pit mining equipment (loaders, dump-trucks, drills). ①Study mining methods for mechanical stabilization of worked-out pits; AE (acoustic emission) measurement; introduction of a cave collapse forecast system. ①Implement leaching of copper oxide ore (1.0% Cu, 15 million t)and SX-EW process.

Table 2-3-1(1) Recommendations for Improvement of Combine (2)

JSC	Improvement Items	Improvements to be Effected
Zhezkazganstvetmet	Ore dressing ①Improve and stabilize operation ②Prevent mine pollution Refining	①Improve flotation operation; introduce automatic control system for reagents. ②Install instrumentation equipment (sensors, flowmeters, pressure gauges, watt meters). ①Increase tailings slurry pumps. ②Improve water recycling circuit by installing tailings thickeners. ①Improve acid plant. ②Study conversion to another furnace other than electric furnace. ③Install new casting machine. ④Improve quality control system. ⑤Construct in-house power generation plant.
Balkhashmed	Mining ①Study cost reduction ②Close/reduce unprofitable mines ③Promote survival measures Ore dressing ①Improve operation performance ②Effective utilization of mineral resources Refining	①Convert from rail transportation to truck transportation. ①Study reduction/closure of Kounrad and Sayak Mines. ①Promote projects of leaching of copper oxide ore (0.25% Cu, 250million t) and SX-EW process. ①Modification of processes. ②Improve water recycling circuit by installing tailings thickener. ①Install equipment for recovering smelter slag (flotation). ①Improve acid plant. ②Fully utilize the Vanukov process instead of reverberatory furnaces. ③Improve quality control system.
Zyryanovsk Lead Combine	Mining Zyryanovsk Mine ①Reduce ground water (24,000t/day), an increasing cost factor. ②Prevent dilution. ③Raise operation rate of machinery Grehovsk Mine ①Review mining method for raising ore grade. ②Study mine closure. Maleevskoye Mine Ore dressing ①Cost reduction. ②Improve operation performance.	①Plan preventive measures of water inflow from old pits; abandon part of galleries. ①Reduce ore mined by sublevel caving method. ①Improve procurement of parts. ①Mining of high-grade ore. ②Improve parts supply system. ③Separate non-production divisions. ④Use larger LHDs; study Western manufacturer's machines (4~6 m³/bucket). ①Convert mining method mainly to mechanized cut and fill method, to improve pillar recovery. ②Construct filler plant, ventilation shaft, waste water treatment plant and concentrator. ③Solve shortage of parts for mining equipment; improve payment and inventory adjustment. ④Reduce mining recovery to improve dilution. ①Reduce personnel of repair division by preventive maintenance and nurture of multi-functional operation. ②Reduce personnel for site sampling and of assay divisions by promoting automation. ①Improve flotation operation and automatic control system of reagents (distribution process control by FA computers). ②Study influence of water recycling; repeated ore dressing test using recycled water. ③Study ore dressing methods for Maleevskoye ore: Prevent oxidization of crude ore; study particle sizes, reagents, etc; review of flow chart (separate thorough treatment of slime). ④Construction of concentrator at Maleevskoye Mine site.

Table 2-3-1(1) Recommendations for Improvement of Combine (3)

JSC	Improvement Items	Improvements to be Effected
EKCChC	Mining Nicolaevsk Mine • Improve working pit slope Shemonaiha Mine Artemyevskoye Mine • Early development Ore dressing ①Cost reduction ②Improve operation performance ③Others	①Plan open-pit stripping(approx 5 million m³ for 3 years ; 9 million $), improve explosives consumption(2.95$→0.32$). ②Reduce working pit slope(27°). ③Improve maintenance of heavy machinery to raise operation rate from 40%→60%. ④Use larger dump trucks(increase 110 ton trucks). ①Gradually shut down the mine due to exhaustion of ore reserves ; effective utilization of abandoned pits. ①Convert to trackless mining method. ②Complete businees plan ; accelerate fund raising. ①Reduce flotation process operators by introducing automation system into flotation operation(distribution process control by FA computers). ②Reduce personnel by nurture of multi-functional operators. ①Separate treatment of slime(slime flotation). ②Depression of pyrite in flotation process ; improve separation of marmatite and pyrite(study of lime and cleaning) ; improve NaCN addition control. ③Improve Copper-lead separation performance ; review flow chart(Cu-Pb semi-bulk, differential flow) ; applicability of hot water flotation. ①Continue testing for the hard-to-treat Artemyevskoye ore to improve performance. ②Feasibility study on Artemyevskoye ore.
Irtysh PC	Mining ①Irtysh Mine • Improve productivity(increase operating days) • Recover delay in backfilling • Improve underground work conditions • Separation of non-production divisions ②Yubileyno-Snegirihinskoye Mine • Early development(disclosure of business plan) ③Belousovk Mine Ore dressing ①Cost reduction ②Improve operation performance	①Promote mechanization(renewal of old equipment and system). ②Increase capacity of filler plant. ③Complete NW ventilation shaft for access to a bonanza in lower part. ④Rationalize personnel arrangement ; reduce electric power cost and welfare costs. ⑤Spin-off of beer and brick factories. ①Construct surface facilities including concentrator. ②Construct only production-related facilities at mine site. ③Utilize idle machinery in the country, to minimize investment expenditure. ④Utilize infrastructure facilities at JSC "Irtysh PC"(long-distance commuting). ①Gradually shut down the mine. ①Reduce reagent requirement per ton of concentrate ; reduce types of reagents. ①Raise Zn concentrate grade ; depress Fe(pyrite). ②Stabilize receiving of crude ore.
Zhezkent MCC	Mining ①Prevent dilution, ensure safety Ore dressing ①Improve operation performance, Prevent fluctuation	①Improve filling surface by cut and fill mining method. ②Devise preventive measures for accidents. ①Reduce personnel by preventive maintenance and nurture of multi-functional operators. ②Study influence of water recycling ; improve water recycling circuit; study where to use recycled water; prevent fluctuation in recycled water volume and pressure; differential use of recycled water by quality ; separate treatment of unprocessed water ; use of activated carbon. ③Promote automatization of ore dressing operations(distributed process control by FA computers). ④Separate treatment of slime(slime flotation). ⑤Raise Cu concentrate grade(study Pb removal from Cu concentrate, review concentrate pricing system). ⑥Improve performance of Cu/Zn separation ; study use of zinc sulfate and sulfurous acid.

Table 2-3-1(1) Recommendations for Improvement of Combine (4)

JSC	Improvement Items	Improvements to be effected
Tekeli Pb-Zn Combine	Mining ①Review crude ore transportation and mining system (Government assistance unavailable) ②Exploration of surrounding area.	①In current circumstances, continuance of the entire combine is not possible. ②Separate non-production divisions. ③Discontinue crude ore transportation (the concentrator to be moved). ④Government exploration to be continued.
Achpolymetal	Mining Ansaiy • Continue the enterprise by barite production • Renew equipment; improve operation rate. • Cost reduction by changing mining method. Gulbokiy, Mirgalimsaiy • Operation is difficult to continue. • Improve environmental conservation. • Effective utilization of infrastructure. Achisai • Oxidic zinc ore ($ZnO_2(CO_3)SiO_2$) cost 45$/t	①Renew dump trucks. ②Improve parts supply system. ③All the combine's resources to be concentrated in the mine. ④Increase production to comply with the barite market. ⑤Discontinue mining in deep part of open-pit; change to underground mining. ①Solidify existing waste fill built up underground. ②Separate water supply division and make it an independent business(the provincial Government participation). ③Nurture industries utilizing infrastructure. ④Market research for barite concentrate. • Study production increase of barite concentrate by expanding Achisai Mine. • Study expansion of barite concentrates' market. ⑤Discontinue underground operation of Gulborskiy and Mirgalimsaiy Mines. ⑥Utilize ODA for solidification treatment of filling materials built up underground at Gulborskiy and Mirgalimsaiy Mines. ⑦Discontinue operation of Kentau concentrator ; study utilization of idle machinery (Shalkiya Mine or JSC"Sary-Arakapolymetal"). ⑧Reduce export duty on zinc oxide (petition Government ; sale to the Almalic combine of Uzbekistan seems advantageous). ①Quickly mine out. ②Promote mining of Talap ore deposits.
Sary-Arkapolymetal	Mining ①Discontinue long-distance transportation of crude ore.	①Study construction of concentrator at the mine site (e.g., removal of idle equipment). ②Overall review of feasibility study.
Shalkiya Mine Management	Mining ①Confirm relative high grade zone in ore bodies. ②Electrification; improve transportation and drainage costs.	①Selective mining in the upper, lower and boundary zones. ②Feasibility study for construction of concentrator. ③Ore dressing tests. ④Request Government for assistance (exemption/reduction of infrastructure utilization fees, Ex, electricity, road maintenance, tree planting). ⑤Exploration of surrounding areas. ⑥Receive surplus personnel of the JSC"Achpolymetal". ⑦Seek financial sources for development.

2-3-2 Facilities and Equipment

Facilities and equipment are generally superannuated or obsolete in all the combines visited, which has been one of the major causes for low productivity and environmental hazards. It is, as a matter of course, desirable to replace or renew these facilities and equipment by new and modern equivalents, but will, at the same time, require a tremendous amount of investment. Most major facilities and equipment are, though unsatisfactory in their productivity, operational with appropriate maintenance and supervision. At the present stage, excessive investment will neither be allowed nor be recommended from the economic point of view. Investment should be limited to the most urgent and effective items for reformation of the presently troubled states of all combines.

It is necessary to review the traditional concept for optimizing the number of spare facilities and equipment for continuous operations. In the view of the JICA Survey Team, excessive facilities and equipment have been installed in many combines. For example, where two furnaces are required for smelting, a total of four furnaces are installed; two for operation, one for repair and one for spare. With appropriate maintenance and surveillance, the number can be reduced.

In maintaining facilities and equipment, failures are dealt with after they occur, rather than taking adequate preventive measures. Accordingly, the relative proportion of costs for maintenance becomes high and reaches, for example at the JSC "Shymkent Lead Plant", nearly 29% of the total operating cost. Inventory of spare parts and consumables has not been well controlled for proper maintenance. Systems for adequate preventive maintenance and inventory control have to be established.

Kivcet and Vanukov furnaces are well known for their prominent technology as the state of the art in smelting in the former USSR. The Kivcet technology in particular has been exported to such western countries as Italy, Bolivia and recently Canada. However, no adequate operating data were provided by the combines adopting these furnaces on the occasions of the two site investigations. Accordingly, technological assessment of these furnaces cannot be properly made.

Two Vanukov furnaces are employed at the JSC "Balkhashmed". However, their performance appears to be unsatisfactory with generally low utilization and availability according to the verbal information obtained at the site. Although it is claimed that the Vanukov furnaces are operating satisfactorily at the Norlisk Copper-Nickel Smelter in Russia, no operating data are available as well.

The Kivcet furnaces have been adopted at the Globokoe and the Ust-Kamenogorsk Smelters but were not in operation for repair on the occasions of the site investigation. This type of furnace appears to be effective for reducing both energy consumption and environmental damage. According to verbal information obtained at the site, the following disadvantages are associated with the furnaces;

(1) complicated processes for treatment of raw materials prior to feed,

(2) inflexibility for accepting different types of feed materials, particularly of recycled raw materials, and

(3) difficulty in controlling slag quality due to swift furnace reaction.

From the energy conservation point of view, flash furnaces may be an alternative option instead of electric furnaces at the JSC "Zhezkazgantsvetmet". However, this option must be technologically studied in detail for material balances, because the Zhezkazgan ores, comprising mainly chalcocite, are low in sulphur and high in silica contents.

The sulphuric acid plants of all the smelters must undergo major reconstruction or readjustment from the view points of working conditions in the plants and environmental protection. According to Table 2-2-3(1), the sulphuric acid production rates in proportion to the amount of produced major metals are generally low in comparison with the theoretical values. Although major causes exist in the obsolete or superannuated facilities and equipment, the present situation will be significantly improved by maintaining continuous operations which is indispensable in protecting sulphuric acid plants from corrosion. Introduction of appropriate processes for treatment of dilute sulphurous gases will be also effective. Frequent disruptions, mainly due to interruption of electricity supply, will further deteriorate facilities and equipment.

2-3-3 Process and Quality Control

The present ore reserve estimation in Kazakhstan is being done using a polygonal, panel or other conventional method depending on ore configurations. It has been argued on the basis of comparison between estimation and actual production that the conventional methods tend to overestimate ore grades. In recent years, 'Geostatistics' has been introduced as a standard method for ore reserve estimation in the western world. An economic review of each mining block should be made occasionally according to its tonnage and grade, accessibility, haulage distance, metal prices and other mining and economic parameters in order to maximize operating profits. For example, a cut-off grade of each mining block may be changed, when necessary, referring to metal prices and other parameters. For this purpose, construction of a data base which contains the above mentioned parameters is necessary. A number of computer software packages combining 'Geostatistics' and data base for planning and controlling mining operations are available.

It is desirable from the environmental protection point of view to reclaim concentrator effluent as much as possible. Reclaiming effluent will also be effective in reducing consumption of flotation reagents in some cases. However, a variety of reagents are used in processing polymetallic ores and some of them, when left in reclaimed water, may cause adverse effects on recovery rates and concentrate grades. In particular, it is necessary to eliminate hazardous reagents such as copper sulphate (an activator), cyanides (a depressant) and others. Effective activators and depressants that are suitable for reclaiming effluent are available and commonly used in concentrators in western countries. Flotation tests will be necessary to identify which reagents are the most effective. Installation of tailing thickeners will be effective for controlling the quality of reclaimed water.

The grade of copper concentrates produced in Kazakhstan are substantially lower compared to those produced in the average concentrators in the western world. It is not technologically difficult to raise the concentrate grades by minor modifications of the present procedures. Traditionally, not much attention appears to have been paid to transportation costs most probably because of irrationally inexpensive tariffs controlled by the Central Government of the former USSR. When the Koktau and the Boshekul deposits are exploited, metal grades of concentrates produced at these deposits will become an important parameter influencing operating costs, taking into account their remote locations. Data collection and data base construction will be necessary to appropriately control the total performance of concentrator operations. Adequate instruments should be installed for collecting satisfactory data. A system should also be established in order to properly collect samples, analyze them and feed back the analytical data to the ore dressing process for controlling operating parameters. The present instrumentation in the concentrators in Kazakhstan appears to be generally inadequate for countering any changes in operating conditions. Automation of the operation systems may be desirable.

The lead produced at the JSC "Shymkent Lead Plant" is the only product that has been registered at the London Metal Exchange. The Shymkent lead and the zinc produced at the JSC "Leninogorsk PC" appear to satisfy the quality standards required by the LME, according to the information obtained in the course of this Project.

However, the quality of metals produced in Kazakhstan is generally poor particularly in trace element contents, resulting in low sales prices. Comparison of standard products between Kazakhstan and Japan is shown below.

Copper

	Cu	Se	Te	Bi	Sb	As	Pb	S	Ni	Fe	Ag
	(%)	ppm									
Kazakhstan	99.99	≦0.5	≦0.5	≦0.2	≦1.5	1.0	1.0	12	0	4	13
Japan	99.99	≦0.4	≦0.1	≦0.1	≦0.1	0	0.4	7.0	0	0	10

Lead

	Pb	Ag	Cu	As	Sb	Sn	Zn	Bi	Fe
	(%)	ppm							
Kazakhstan	99.985	10	10	5	10	5	10	60	10
Japan	99.995	1	1	1	1	1	1	5	1

Zinc

	Zn	Pb	Fe	Cd	Cu
	(%)	ppm			
Kazakhstan	99.985	80	28	27	7
Japan	99.998	13	2	2	1

Consciousness of quality control is generally low, although formats for quality control, such as process flows, process control standards and quality standards, are provided. At the present time, products are sold with little attention paid to their quality as required in the international market.

It is necessary to introduce a concept of the Deming Cycle (Plan, Do, Check, Action) for quality control practice. A comprehensive set of systems for controlling processes, costs and quality should be established as follows;

(1) A system to prepare, review and finalize operating plans.

(2) A system to counter adverse operating results by relevant sections in a timely manner according to their responsibilities clearly defined.

(3) A system to control material consumptions, production times and hence production costs.

(4) A system to analyze and assess quality of products with adequate instrumentation.

(5) A system to optimize processes.

(6) An education system to elevate the awareness of engineers and workers for cost and quality control, and familiarize them with statistical approaches.

In addition, instrumentation should be upgraded in order to collect adequate data and construct a data base. Continuous and stable operations are also essential for quality control.

2-3-4 Environmental Protection and Safety Control

Environmental problems, associated with operations of mines, concentrators, smelters and refineries, are summarized as follows;

(1) Dusts generated by handling ores and powdery materials, are hazardous to human health because of their abnormally high contents of heavy metals and silicates and will deteriorate working conditions. Dusts from dry tailing dams may disperse in a significantly large area when strong winds blow and will adversely affect residential areas in the vicinity of the tailing dams.

(2) Mine wastes, flotation tailings, slag and other waste materials dumped in open air may become continuous supplies of water containing heavy metallic ions to the environment when exposed to rainwater for a long period. The leachate will regionally pollute surface soil and water, and may infiltrate to underground water.

(3) Mine water and plant effluent contain abnormal amounts of metallic solids and ions, and will pollute soil and both surface and underground water.

(4) Vapor and fugitive gases from plants, particularly from smelters and refineries, will disperse in a considerably wide area and cause regional air pollution, affecting residential areas. The most notorious pollutant is sulphurous gases that are generated by smelting operations, as it has been repeatedly mentioned in this report.

The majority of the above mentioned problems may be overcome by appropriate monitoring of operations and application of preventive measures. Unfortunately, however, the costs for environmental protection are rather high and tend to be reduced as much as possible. Never-the-less, environmental protection is one of the most important responsibilities of the corporate management. In the world scene, the ISO 14000 (International Standard Organization) has been introduced and enforces all the industries to abide by its standards.

As a general approach, the following measures are recommended;

(1) Investigation of the present state of environmental deterioration, identifying pollutants in quality and quantity, sources of pollutants, affected areas, degrees of pollution, and so forth.

(2) Monitoring working conditions in mines and plants including air quality (dust, oxygen, sulphurous gasses, toxic substances), temperature, humidity and so forth.

(3) Monitoring discharge water from mines, waste dumps and tailing dumps and plant effluent from concentrators, smelters and refineries.

(4) Monitoring vapor and fugitive gasses from smelting and refining plants.

(5) Restoration of contaminated soils and conservation of water-sheds.

In order to implement the measures above mentioned, it is necessary to establish a firm system and organization for controlling environmental problems with adequate instrumentation. Employment of environmental specialists and education of employees will be also important. As aforementioned, environmental control is costly and requires a wide range of technology. In this regard, assistance and cooperation by the State

Government will be indispensable financially and technologically. Technical cooperation of foreign countries, where environmental protection methods are being practiced for the non-ferrous metals industry, can be sought.

Mine and factory safety is being routinely carried out under supervision of the Ministry of Industry and Trade and does not appear to include serious problems except for poor working conditions created by environmental deterioration in mines and plants as above mentioned. Recently, however, an unfortunate accident of ground subsidence occurred above a mine of the JSC "Zhezkazgantsvetmet" and caused some causalities. Subsidence caused by underground caving may be forecast by monitoring acoustic omission released by rock bursts. A study is also being carried out by mining engineers at the site for techniques to stabilize the ground by intentional caving for preventing subsidence.

2-3-5 Utilization of Waste and Unused Materials

Recovery of valuable minerals and metals from mine wastes, discarded ores (mostly oxide), tailings and slag, is desirable from the view point of environmental protection. A total amount of 15 million tons of oxide ore with an estimated grade of 1% copper exist at the Zhezkazgan Mines. Of the total amount, 2 million tons have been mined and stockpiled. At the Kounrad Mine of the JSC "Balkhashmed", a total amount of 250 million tons of oxide ores with an estimated grade of 0.25% copper are stockpiled. Leaching extraction of copper from these resources will be beneficial from the raw material supply and environmental points of view. Although the studies for leaching or SX-EW processes have been completed, construction is yet to commence.

Trial flotation of slag from smelting furnaces is being carried out at the Balkhash Concentrator. According to verbal information, approximately 54 million tons of smelting furnace slag with an average grade of 0.67% copper have been stockpiled since the early days of the smelter operation. The test results to-date indicate that some 60% of copper can be recovered by slag flotation. It is planned to treat 1.8 million tons of slag per annum, commencing in 1997. This operation will annually provide the smelter with approximately 7,800 tons of copper in concentrates.

2-3-6 Energy Conservation

Energy consumption to produce a ton of copper, lead and zinc metals is as follows;

Copper: 5.39×10^6 kcal/ton

Lead: 3.95×10^6 kcal/ton

Zinc: 12.47×10^6 kcal/ton

In general, the proportion of energy costs is high in smelting and refining processes for these metals. Therefore, energy conservation is one of the important items for controlling operating costs.

The measures for energy conservation are summarized as follows;

(1) Conversion of Smelting Processes.

Utilization of sulphur contained in raw materials (sulphide) is a fundamental technology for saving energy consumption in smelting processes, and is commonly adopted in various types of smelting furnaces in the world. The Kivcet and the Vanukov furnaces are of this category; the former type is installed at the JSC "UK Pb-Zn Combine"and JSC "Irtysh PC", and the latter at the JSC "Balkhashmed". Assessment of operating conditions of these furnaces is impossible because no operating data were released to the JICA Survey Team on the occasions of the site investigation as they are considered confidential. Judging from the verbal information and the on-site observation, none of these furnaces are working in a satisfactory condition from the energy conservation point of view. Full use of these furnaces is desirable from the energy conservation point of view. It is desirable to take advantage of these furnaces as much as possible.

(2) Various improvements for reducing consumption of fuels.

(3) Reduction of unit costs of fuels

It may be possible to reduce unit costs by changing fuels to inexpensive alternatives, for example, use of coal or coke instead of heavy oil.

(4) Reduction of Exhaust Heat

It is possible to increase combustion efficiency by oxygen enrichment of blasting air.

(5) Utilization of Exhaust Heat

It is possible to generate electricity by a waste heat boiler utilizing exhaust heat. This procedure has been adopted in some smelting plants.

(6) Various Improvements in Refining Plants

- Increase of acidity of electrolytic solutions
- Increase of electrolytic solution temperature
- Reduction of electrode intervals
- etc.

(7) Installation of Energy Saving Instruments

At the present time, the unit price of electricity in Kazakhstan appears to be generally low in comparison with that in most western countries, although it varies from place to place. It is, however, an essential problem whether the present electricity price is adequate for operating power plants economically taking into account the fuel (mostly coal) and other costs for power generation or it is necessary to increase the price in the immediate future for stable power supply. Frequent interruptions of power supply are becoming serious recently for normal operation of smelting and refining plants. It has been reported that power plants often interrupt supply to combines because of their unpaid debts. However, such frequent interruptions as above mentioned may have been, in many cases, caused by unstable operations at the power plants.

Under the present situation of power supply as above mentioned, installation of an independent power plant may be the only option to secure a stable power supply. It is a very difficult argument whether installation of an independent power plant is economically justifiable or not. A comprehensive and nation-wide study will be required for establishing appropriate power supply and electricity pricing systems.

The underground ventilation system is one of the important items in mining operations for energy conservation. A great deal of electricity is consumed for ventilation in underground mines particularly during the severe winter of Kazakhstan. For example, the 1996 budget of the Zhezkazgan Mines indicates the total electricity consumption of 266 million kWh, of which 172 million kWh or two-thirds are to be consumed for underground ventilation. If 20% of the electricity consumption can be reduced by rationalization of the ventilation system, the saved electricity cost will amount to nearly 70 million tenges at an assumed unit cost of 2 tenges per kWh or to more than one million US. dollars. An optimum underground ventilation system can be easily designed by simulation using personal computers.

2-4 Corporate Management

2-4-1 Corporate Structure

The corporate management in Kazakhstan principally follows the system inherited from the USSR era, and appears to be inflexible in adjusting itself to any changes of business circumstances. A cooperate structure in Kazakhstan is usually complicated, comprising a number of sectors whose roles and duties are strictly defined. There is no system to laterally exchange data and information between the sectors. This type of corporate structure is suitable for producing a large amount of goods with simple specifications under stable market conditions. However, market needs and conditions have been changing very swiftly in recent years. This requires corporate management to respond to such changes without delay in order to survive under the free trade economic circumstances.

2-4-2 Management Practice

JSC "Leninogorsk PC", JSC "Balkhashmed" and JSC "Zhezkazgantsvetmet", consist of mines, concentrators and smelter-refineries. Although these production sectors are included in a single entity, their performance should be assessed separately. Clear settlement of accounts must be placed between individual production sectors. It is common practice in the western country that concentrates are sold to a smelter at international market prices with prevailing sales terms and conditions, even if the concentrator and the smelter belong to the same corporation. In other words, each production sector should be competitive on the international standard basis. Overhead, such as head office, internal transportation, public relations and other indirect costs, should be shared by each sector according to the degree of benefit it receives.

Although raw data are routinely collected on items necessary for production and cost control in the present practice in Kazakhstan, there is no system for efficient utilization of the collected data. Therefore, it is necessary to construct an appropriate data storage and retrieval system for achieving maximum efficiency in production lines. The roles of data bases in a corporate structure are schematically illustrated in Fig.2-4-2(1). Necessary information should be exchanged between departments in order to improve corporate performance as a whole.

The present workforce in most combines are large for their production capacities as compared to those in western operations. Reduction of the numbers of workers is necessary, particularly in the non-production sector, as improvement of facilities and equipment progresses. Although salaries and wages in Kazakhstan are much lower than in most western countries, their escalation is certainly anticipated within the next few years due to inflation. Since the non-ferrous metals industry is principally labour-intensive, the burden of labour costs will quickly increase as inflation progresses. A comparison of the workforce at operations in Kazakhstan and other countries is shown in Table 2-4-2(1).

According to Table 2-4-2(1), the workforce of the mines in Kazakhstan is two to three times as big as that of North American mines. The number of personnel working in plants of Kazakhstan is far too large compared to that in Japanese plants and reaches nearly ten times.

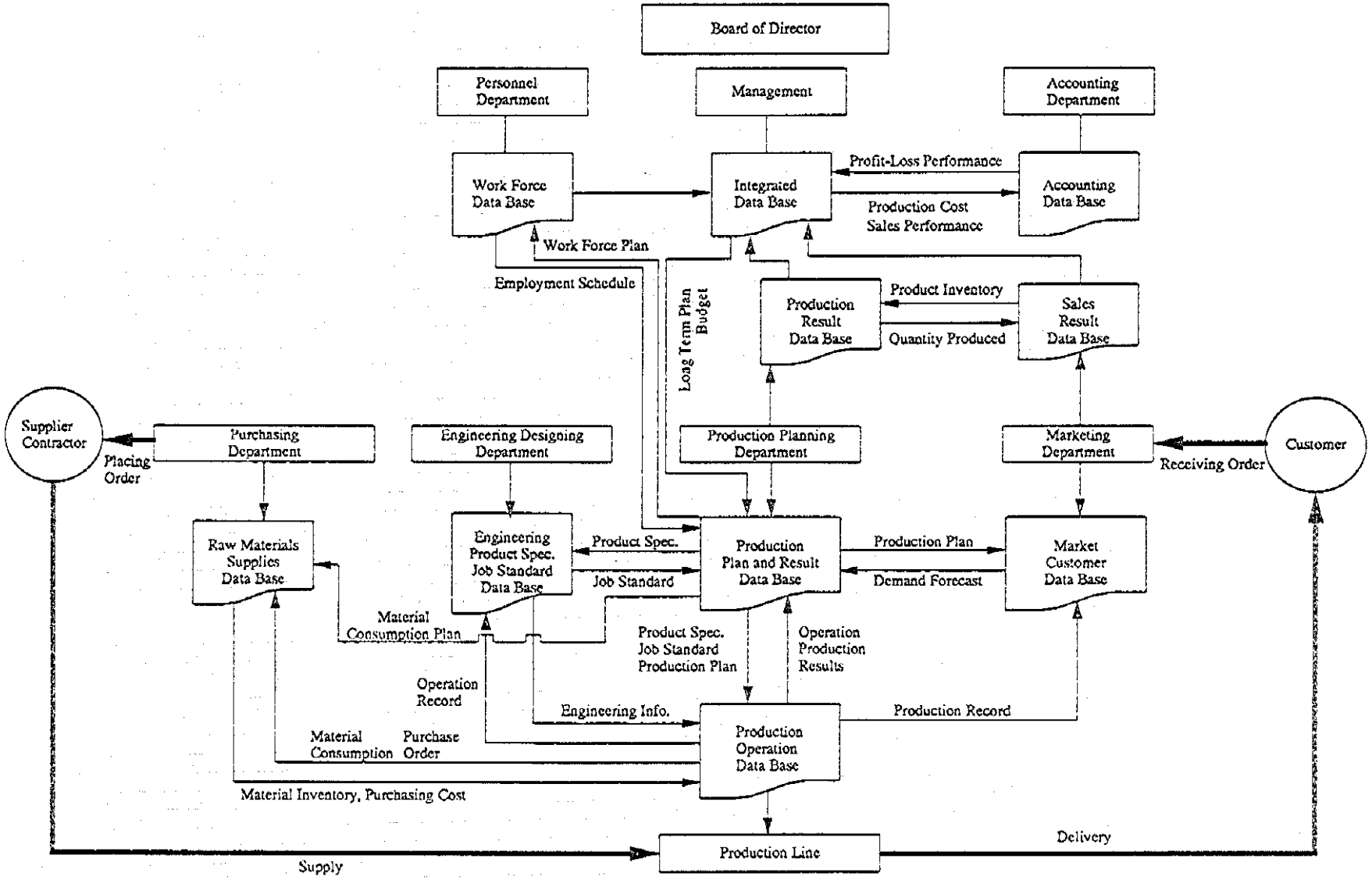


Fig.2-4-2(1) Corporate Structure and Use of Data Base

Table 2-4-2(1) Comparison of Number of Employees

Open Pit Mines

	Kazakhstan		North American Standard		
	Dzhezkazgan (North)	EKCChC	A	B	Note
Crude Ore Production	15,000 t/D	2,000 t/D	10,000 t/D	20,000 t/D	
Stripping Ratio	7		8	8	
Number of Employees					* East Kazakhstan
Salary	123		60	97	Mine-400
Hourly	491		164	272	Concentrator-440
Total	614	840	224	369	

Underground Mines Table Consists of Production and Employees for JSCs Zhezkent MCC, Zyryanovsk Lead Combine and Leninogorsk PC.

	Kazakhstan						Western Countries			
	Dzhezkazgan						Room & Pillar	Cut & Fill	Polaris Canada	Red Dog USA
	East	West	South	Zhezkent	Zyryanovsk	Leninogorsk				
Production t/D	22,000	15,000	20,000	3,000	6,000	8,000	14,000	2,000	3,000	3,000
Number of Employees				Mine	Mine	Mine			Mine	
Salary	290	176	281	1,000	1,250	2,080			127	
				Concentrator	Concentrator	Concentrator			Concentrator	
Hourly	1,470	994	1,594	440	742	870			44	
Total	1,760	1,170	1,875	1,440	1,992	2,950	420	188	171	350

	Japan		Kazakhstan	
	Name of Plant	Manpower	Name of Plant	Manpower
Copper Smelter & Refinery	Tamano Production Capacity Blister 263,000 t/yr Electrolytic Copper 191,000 t/yr	200	Dzhezkazgan Production Capacity Blister t/yr Electrolytic Copper 211,000 t/yr	21,246 (1994) (Combine Total)
	Onahama Production Capacity Blister 294,000 t/yr Electrolytic Copper 247,000 t/yr	450	Balkhash Production Capacity Blister t/yr Electrolytic Copper 308,000 t/yr	11,182 (1994) (Combine Total)
Lead Smelter	Chigirishima Production Capacity Electrolytic Lead 94,800 t/yr	170	Shymkent Production Capacity Refined Lead 160,200 t/yr	2,587 (Combine Total)
Zinc Refinery	Iijima Production Capacity Electrolytic Zinc 156,000 t/yr	190	Leninogorsk Production Capacity Electrolytic Zinc 156,000 t/yr Refined Lead 20,000 t/yr	13,460 (Combine Total)
	Hachinohe Production Capacity Distilled Zinc 108,000 t/yr Crude Lead 40,000 t/yr	180	Ust-Kamenogorsk Production Capacity Electrolytic Zinc 186,400 t/yr Refined Lead 145,900 t/yr Electrolytic Copper 40,000 t/yr	9,544 (Combine Total)

2-5 Marketing

2-5-1 Market Trend

(1) Metal Market

The world metal consumptions are expected to increase toward year 2000 from the 1995 levels, for copper to 14 million tons from 12 million tons, for lead to 6.3 million tons from 5.4 million tons and for zinc to 8.9 million tons from 7.3 million tons. However, metal prices behave erratically in the short term, influenced by world political, economical and social incidents. Therefore, it is very difficult or even impossible to predict future metal prices. It is generally anticipated that metals prices will stay stagnant for the next few years and will make an upturn after the year 2000.

The 10 year average copper price has increased at the rate of 2.5% per year, while the yearly increase of the world consumption is estimated at approximately 7% (from approximately 6 million tons in 1975 to 12 million tons 1995). The increasing rate of copper price at 2.5% per year may be regarded to trade off the world average inflation rate in US dollar term. The present copper price of US$ one for a pound of copper (US$2,200 per ton) appears to be reasonable judging from the last 20 years' trend. It is advisable that a long-medium term project is evaluated on the basis of the present copper price. Judging from the long term metal price and consumption trends, the present zinc price at around US$1,050 per ton appears to be reasonable, while the lead price at nearly US$700 per ton may be regarded as being too high for long term expectation.

Precious metal prices will remain stable at around US$400 per ounce for gold and US$5 per ounce for silver.

(2) Sulphuric Acid

According to verbal information obtained at the JSC "Zhezkazgantsvetmet", the sales prices of sulphuric acid range from US$15 to 20 (occasionally up to 30) per ton, and are much lower than the current prices in Japan ranging between 12,000 and 19,000 yen per ton (approximately US$109 and 172 at the exchange rate of 110 yen for 1 US$). Although the price of goods are generally high in Japan compared to other countries, price differences of more than seven fold between the two countries appears to be unreasonable for producer's goods such as sulphuric acid. The price in Kazakhstan may be inherited from the pricing system determined by the Central Government in the era of the former USSR. In general, the Kazakhstan pricing systems for producer's and consumer's goods appear to be still in confusion and will take some time to be stabilized on the basis of supply and demand. The unreasonably low price of sulphuric acid will discourage smelters from recovering sulphur in the course of smelting processes and may lead to further deterioration of the atmospheric environment.

2-5-2 Transportation

The transportation of the non-ferrous industry products and raw materials represents a large share, by volume and by weight, of the total inland materials transportation. Therefore, the rationalization of transportation is essential by selecting suitable systems considering the materials transportation circumstances.

(1) Stop Long Distance Transportation of Crude Ore

Crude ore transportation should be limited to only short distances and discontinued for long distances. Presently, ore of the Zhairem Mine is transported to the Tekeli Concentrator about 1,100 km. Its transportation cost is US$ 8 per ton of ore (Fig. 2-5-2(1)). This is equivalent to US$ 120 per ton of concentrate and 30% of its sales price.

Urgent study of this matter is necessary considering rising future rail costs.

(2) Rationalization of Inland Transportation

The concentrate should be treated at the nearest smelter. Long distance transportation should be limited to only customers. Transportation cost of concentrates is commonly borne by the mine. On toll based sales, the transportation fee should be borne by the seller according to the toll agreement. Reinforcement and improvement are required to maintain the factories for transportation facilities considering the domestic manufacturing of the facilities.

(3) Consolidation of Transportation Base

A system must be established to make transportation facilities, freight cars, loading and unloading equipment and stock yards available for joint use by relevant parties and organizations. It is important to minimize the overall transportation costs in Kazakhstan. Truck transportation requires five times the energy as rail transportation however trucking is chosen over rail transportation for its convenience and mobility.

(4) Transportation of Finished Products

Since the Kazakhstan market for finished product (metals) is limited, most of the products must be sold in the international market. Where exports are to West European countries, the products will be sold on the basis of C.I.F. (cost, insurance and freight) St. Petersburg. The freight cost from Zhezkazgan to St. Petersburg is approximately US$90 per ton of cathode according to the verbal information. It is estimated at US$0.04 per pound of copper which is significant compared to the total smelting-refining cost of US$0.185 per pound of copper. The inland freight of US$90 per ton between Zhezkazgan and St.Petersburg appears to be comparable to the international standard for the distance of some 3,500 km. Based on an example of a North America freight of US$0.03 per ton-km, the freight is estimated at US$105 per ton for the distance of 3,500 km.

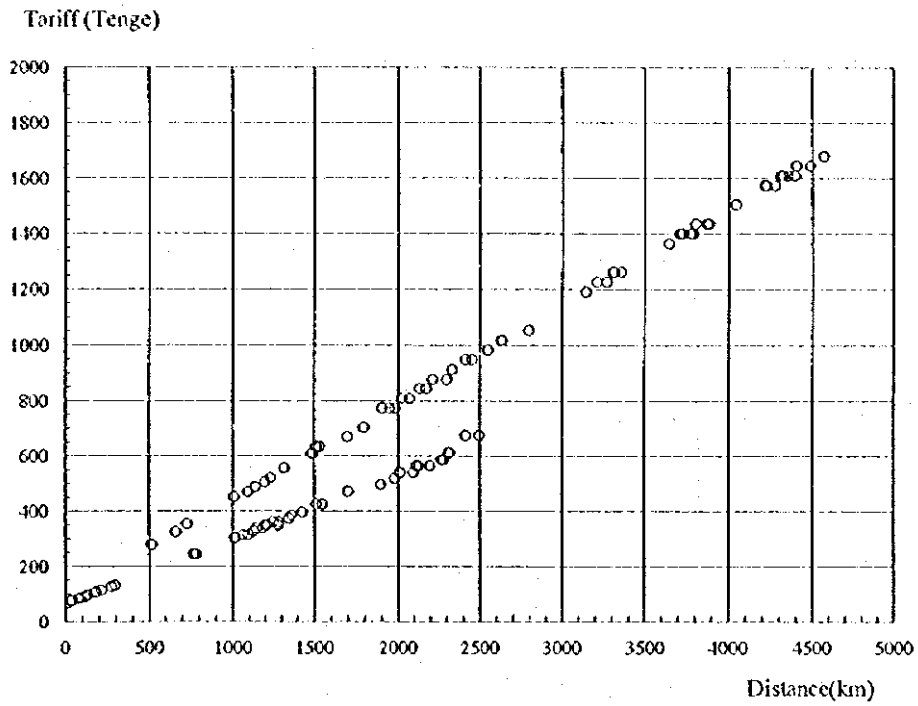


Fig. 2-5-2 (1) Domestic Railway Tariff per ton of Goods

2-5-3 Marketing Strategy

The most important strategy is to maintain the quality of products at international standards and to sell them at adequate prices. At the present time, metal traders are purchasing the products of Kazakhstan at substantially lower prices than those on international markets, claiming that the products are low in quality compared to international standards or are not registered at LME. They are then selling them at higher prices, upgrading or processing them at minimal costs if necessary. The producers of Kazakhstan appear to be weak in their bargaining power because of their geographical locations and unfamiliarity with international trading. In particular, depressed Russian industries have placed the non-ferrous metals industry of Kazakhstan in a considerably difficult position for marketing its products. As mentioned in the previous section, it is costly to sell the products to West European countries due to transportation costs for long distances. An alternative market can be sought in China, whose metal consumption is growing at a significant pace as its industrialization progresses. However, transportation costs will again be a major problem because industrial centers are mostly concentrated in the far southeast of the vast country.

It is hoped to create domestic industries which use a large amount of non-ferrous metals, such as automobile, electric appliances and other manufacturing industries. However, markets for the products of these industries are very limited in the CIS countries excluding Russia and have no prospect for rapid growth in the foreseeable future.

Adding value to products is desirable but it will raise costs as well. Therefore, it is a matter of balance between added values and increased costs. The market for processed metals is different from unprocessed metals. Thorough market research will be required.

Presently, the only effective strategy is to produce cost-competitive products with adequate quality by reducing production costs, raising productivity and controlling quality.

As for marketing technique, it may be an option to establish a metal trading corporation, strongly supported by the Ministry of Industry and Trade, which exclusively handles all metal products. Sales competition among metal producers will further weaken their bargaining power against foreign metal traders. Alternatively, a supervisory organization may be attached to the Ministry in order to monitor pricing in metal trading transactions. The latter option is now adopted by the Government of the Republic of South Africa.

2-6 Industrial Restructuring

2-6-1 Polymetal Combines in East Kazakhstan

There are 6 polymetal combines in the East Kazakhstan region. The JSC "UK Pb-Zn Combine" includes the Irtysh copper smelter (at Glubokoe) Copper Smelter and a complex comprising lead-zinc smelter/refineries and a copper refinery. The JSC "Leninogorsk PC" consists of four mines, a concentrator, a complex of zinc smelter-refinery and a lead plant for treatment of battery scrap. The JSC "Zhezkazgantsvetmet", JSC "Zyryanovsk Lead Combine", JSC "Irtysh PC" and JSC "EKCChC" are composed of mines and concentrators. All these combines except for the JSC "Irtysh PC", are being managed by domestic or foreign enterprises under management contracts or trust agreements with the Government of Kazakhstan.

According to the financial analysis of the production plan (2-1 and 2-2), only 6 operating and planned mines are economically viable. Although it may be possible to make the other 7 mines profitable by rationalization and modernization of the present operations, their prospect does not appear to be bright. Since sudden closure of unprofitable mines will create adverse effects such as serious shortage of raw materials, industrial unrest and social upheaval, it may be inevitable to maintain their operation at least for the next few years. One option may be to integrate all the combines in the East Kazakhstan Region into a single corporate entity, provided that the corporation can make a profit as a whole. With this transition, the corporation will be able to gradually liquidate unprofitable operations without causing deleterious effects and to improve its economic performance. The following conditions must also be fulfilled for satisfactory results.;

(1) Release the combines from the burden of social welfare and service costs for associated communities by transferring these responsibilities to the local government.

(2) Rescheduling repayment of accumulated debts.

(3) Transformation of management of infrastructure sectors such as power generation, water supplies and inter-combine transportation to the local government.

(4) Creation and promotion of the following local businesses to absorb surplus workforce resulting from rationalization of the combines, a) explosive manufacture, mining and agriculture machinery shops, construction material plants and material handling services by separating service sectors of the present combines and by utilizing existing infrastructure, b) metal manufacturing plants, recycled material handling services (for example, collection of scrap batteries) and, c) construction contractors, financial services, retailers and so forth.

(5) Establishment of business training institutions to train and foster entrepreneurs for local and small business.

(6) Financial support by the state and local governments, establishing special funds for promotion of small local businesses.

(7) Political and financial support by the state government, centered on the Ministry of Industry and Trade.

A schematic procedure of the restructuring is shown in Fig.2-6-1(1).

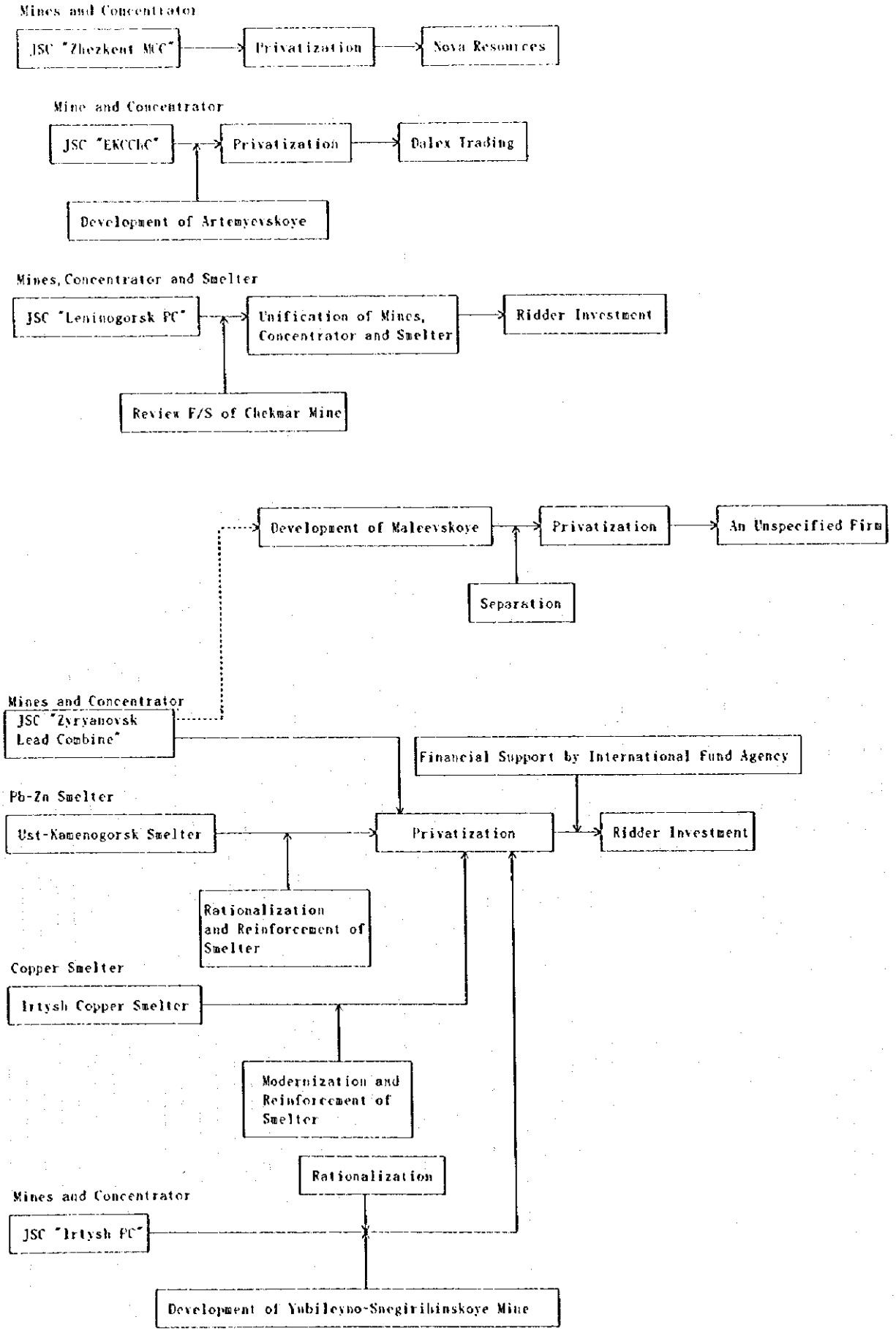


Fig.2-6-1(1) Schematic Procedure in Restructuring of East Kazakhstan

2-6-2 Shymkent Lead Plant

The Shymkent Lead Plant as a custom smelter, is now in an extremely difficult position due to a shortage of raw material supplies. Assuming that raw material supplies are secured, the following measures should be taken to restore the present deteriorated state of its operations.

(1) Raw Metal Supply

The raw material supplies are assumed as follows;

Zhezkazgan: Concentrates, 10,000-15,000 T/Y Lead Content.

Mines in Southern Kazakhstan: Concentrates, 10,000 T/Y Lead Content.

Zhezkazgan: Lead Dust, 5,000 T/Y Lead Content.

Balkhash: Lead Dust, 5,000 T/Y Lead Content.

Imported (Purchased or Tolling)

Almalik, Uzbekistan : Concentrates, 10,000-15,000 T/Y Lead Content.

Other CIS: Concentrates and Lead Dust, 10,000 T/Y Lead Content.

Based on the above assumption, the lead production of the Shymkent Plant is expected to be approximately 50,000 T/Y with sulphuric acid production of 25,000 T/Y.

(2) Facilities

The present facilities have been designated for the production of 160,000 tons of lead per annum which greatly exceeds the planned production on the basis of likely supplies of raw materials as above mentioned. Accordingly, the facilities should be reduced and rearranged as follows;

	Present	Post Reformation
Sintering Machine	75 m^2 x 2 series	70 m^2 x series
Furnace	10.2 m^2 x 3 series	10.2 m^2 x 1 series
Sulphuric Acid Plant	240 T/D x 3 sets	240T/D x 1 set

(3) Market Forecast

The 50,000 tons of lead per annum will be consumed as follows;

Own Consumption:	Lead Chemical Compounds and Manufactured Lead, 5,000 T/Y
	Lead Battery, 15,000 T/Y
Other Domestic Consumption:	10,000 T/Y
Export (including return to toll customers):	20,000 T/Y

According to the expected consumption as above, it is desirable for the Shymkent Plant to produce lead