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Technical and Economic Evaluation of the Lac Single Superphosphate Factory in Albania

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Prepared by

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International Fertilizer Development Center
December 1993

Amit H. Roy
President and Chief Executive Officer

Executive Summary

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Executive Summary

Introduction

An evaluation was undertaken by the International Fertilizer Development Center (IFDC) of the Lac Single Superphosphate (SSP) Factory in Albania. The evaluation was funded under the terms of a grant from the United States Agency for International Development (USAID) for the purpose of assessing the technical and economic viability of the Lac SSP factory under the current market economy system.

The IFDC evaluation team consisted of Donald R. Waggoner, Chemical Engineer and Team Leader; Donald C. Young, Phosphate Fertilizer Specialist; Steven J. Van Kauwenbergh, Specialist, Geology and Mining; and Claude C. Freeman, Marketing/ Training Specialist (currently assigned to IFDC-Albania). The team spent 3.5 weeks in Albania during the period August 3-27, 1993.

The IFDC team was supported by a large number of Albanian counterparts who made valuable contributions to the team's efforts in Albania. These included the Vice Minister and other officials of the Ministry of Industry, Mineral Resources, and Energy; the Director and staff of the Lac factory; and representatives of the Albanian Copper Company; the Mineral Processing Research Institute; the Geologic Institute; and the Geological Enterprise of Gjirokastra. Valuable support was also received from the in-country offices of USAID and IFDC-Albania.

The study was limited to the Lac SSP factory which is only a small portion of a very large industrial complex that embraces mining of pyrites and copper ore, ore beneficiation, copper smelting/refining, and mining of phosphates. Although these related industries were examined in the context of their relationship to the Lac SSP factory operations, a detailed analysis of these operations was beyond the scope of this study. However, it was generally concluded by the IFDC team that extensive modifications and capital expenditures would

be required to restore these industries to technically, economically, and environmentally acceptable operations relative to western European standards.

The SSP fertilizer factory located at Lac is the sole phosphate fertilizer production unit in Albania. A previous study by IFDC for USAID in early 1992 indicated that the overall physical condition of the factory was not good but that it might be possible to continue operation if some of the factory units were renovated and modified.

The Lac SSP factory began operation in 1966 (27 years ago) and was operated continuously under the former centrally planned political/economic system. Under this system, fertilizer production and use were not based on response to market factors but rather on limitations of raw materials and the ability of the factories to produce. Costs of production were not of serious concern, and the factories often deteriorated due to lack of provision of funds for maintenance and/or replacement of worn-out equipment. Unfortunately, as a result of this situation, the current technical and mechanical condition of the Lac SSP factory has deteriorated, and it is estimated that more than US $3.1 million would be required to restore to an acceptable operating and environmentally sound condition the plant units essential for the production of SSP at a rate of up to 80,000 mtpy according to a "best case" scheme.

Conclusions

As a result of this study, it is concluded that continued operation of the Lac SSP factory is not feasible due to:

1. The age and generally poor condition of the factory equipment.
2. The substantial amount of capital funds needed to bring the Lac factory to a good operating and environmentally acceptable condition in the context of the "best case" scheme plus the substantial amount of capital funds that no doubt will be needed to restore operation of copper smelting, pyrite mines, and beneficiation plants to an environmentally acceptable level.
3. The relatively high cost of sulfuric acid produced by the existing technology based on roasting of pyrites to obtain sulfur dioxide (SO_2).

4. The need to import phosphate rock. Use of Albanian phosphate rock is not feasible due to its low analysis and high cost.
5. The resulting high cost of production, i.e., the plant-gate cost for bagged run-of-pile (ROP)-SSP (containing about 18% P_2O_5) of 7,503 leks/mt product (41,680 leks/mt P_2O_5) versus a landed cost of imported, bagged diammonium phosphate (DAP) of 13,737 leks/mt (29,863 leks/mt P_2O_5) after credit is given for the nitrogen in the DAP.[1]
6. High distribution costs (P_2O_5 nutrient basis) resulting from the low P_2O_5 analysis of SSP compared with that of DAP which is 18% N and 46% P_2O_5.

It is further concluded that:

1. Based on market requirements, the factory should be operated long enough to convert the existing stocks of pyrites, phosphate rock, and sulfuric acid to SSP. With the existing inventory of SSP (about 17,000 mt), a total stock of about 50,000 mt of SSP could be realized containing about 7,500 mt of P_2O_5.
2. Production of granular NPK grades at the Lac factory is not economically feasible.
3. Imported DAP is currently the most cost effective source of P_2O_5 fertilizer for Albania.
4. International bagged DAP prices must increase by about US $70/mt above today's prices (to a level of about US $220/mt f.o.b. producing country) before Lac-produced ROP-SSP can be competitive with imported DAP assuming no import duties.
5. Significant costs will be incurred in terminating the operations and work force at Lac and making the factory site environmentally benign.

The ensuing discussions in this Executive Summary cover the technical and economic factors which provide the basis for the above conclusions. These factors are described in more detail in the main evaluation report.

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[1]For the purpose of this report, US $1.00 is equal to 100 Lek.

Phosphate Fertilizer Supply and Demand in Albania

Phosphate Fertilizer Demand

Distribution (presumably equivalent to domestic consumption) of SSP in Albania in 1987 was approximately 174,000 mt (26,000 mt of P_2O_5). During the 1992/93 season, consumption of phosphate fertilizers was 18,584 mt of product of which 8,819 mt was SSP and 9,765 mt was diammonium phosphate (DAP) for a total of about 5,815 mt P_2O_5. It is expected that P_2O_5 consumption could possibly reach 10,000 mt during 1994. By 1999, the projected consumption of P_2O_5 is 12,800 mt based on an annual compounded growth rate of 5%. This amount of P_2O_5 is equivalent to 71,000 mt of SSP product as shown below:

Projected SSP Demand, 1994-99
(Assuming No DAP Imports)

Year	P_2O_5	SSP Product (18% P_2O_5)
	(mt)	(mt)
1994	10,000	55,550
1995	10,500	58,330
1996	11,025	61,250
1997	11,575	64,300
1998	12,155	67,530
1999	12,763	71,000

Although it is understood that DAP would be a strongly competitive product to replace ROP-SSP, it is possible that all of the P_2O_5 requirements could be supplied by ROP-SSP produced by the Lac factory. However, comparisons made between Lac ROP-SSP and DAP show that locally produced ROP-SSP is not competitive with imported DAP.

Phosphate Fertilizer Supply

There are three sulfuric acid units of various capacities in the Lac factory and two SSP units. Each of the SSP units has a design capacity of 110,000 mtpy of product. During recent years, actual production from SSP-1 has consistently been more than design capacity as follows:

	Annual Production From SSP-1		
Year	ROP-SSP	Granular SSP[a]	Total
	(mt)		
1986	98,560	68,918	167,478
1987	114,241	60,531	174,772
1988	104,113	60,887	165,000
1989	110,152	55,035	165,187
1990	99,342	42,183	141,525

a. Granular SSP refers to ROP-SSP that was subsequently granulated.

The SSP-2 unit was built in 1989 to use sulfuric acid from the No. 3 sulfuric acid plant (SA-3). The SSP-2 unit is an exact copy of the SSP-1 unit. One of the SSP units should be capable of supplying Albania's total P_2O_5 requirements for several years, well into the next century.

Similarly, operation of only one of three sulfuric acid (SA) units would provide more than enough sulfuric acid to produce the required amount of SSP. The No. 2 sulfuric acid unit (SA-2) uses off-gases from an adjacent copper smelter as a source of sulfur dioxide (SO_2). The existing SA-2 unit belongs to the copper enterprise, and its physical/mechanical condition is such that it should not be operated. The copper enterprise has estimated that a minimum of US $15.0 million would be required to renew the SA-2 plant. This would be approximately 80% of the cost of a new unit since essentially all the equipment needs to be replaced with the exception of the two catalytic converters.

The SA-1 unit is based on mined pyrites as a source of sulfur. The unit is old and in poor condition. About US $2.5 million worth of new equipment has been recently brought in from China for partially renovating the unit. An additional US $1.8 million is needed for installing the equipment. Renovation of the remaining plant sections is estimated to cost in excess of US $2.5 million. In spite of the fact that the Chinese equipment is onsite and already paid for, installation of the equipment and renovation of the remaining plant sections is not recommended since the reserves of the pyrite ore used by the plant as a raw material are only sufficient for about 5-6 years of operation.

The SA-3 unit was new in 1987 and has never been operated (except for six test runs of 4-6 hours' length each). The reason this plant has never operated is thought to be due to serious design errors in the pyrite roaster and associated waste heat boiler. The design capacity is 60,000 mtpy of sulfuric acid (100% H_2SO_4) produced by roasting of fine flotation pyrites (60%-85% minus 74 microns) from beneficiation plants used for upgrading of copper ore. The future availability of the flotation pyrites should greatly exceed the requirements of SA-3 provided the copper beneficiation plants continue to operate. However, the use of these fine pyrite concentrates has not been technically proven in the existing processing plant nor has the future of the copper plants been determined.

A Best Case Operating Scheme

About $26 million would be required to fully restore all of the operating units required for the Lac SSP factory. Since it would not be necessary to operate the entire factory to supply Albania's need for phosphate fertilizer, a possible operating scheme was devised to facilitate analysis of the operation of the Lac factory under the "best case" conditions. In determining the "best case" operating scheme, the following assumptions were made:

1. The maximum demand for P_2O_5 into the early 2000s would be about 12,800 mt. This is equivalent to about 70,000 mtpy of ROP-SSP (18% P_2O_5).
2. The total future demand in Albania for P_2O_5 would be satisfied by ROP-SSP produced at the Lac factory; imported phosphate such as DAP would not be considered.
3. DAP or other phosphate-based fertilizers would not be imported. However, costs for Lac-produced ROP-SSP would be compared with imported DAP to determine the competitiveness of the Lac product in the Albanian market.
4. The indicated future demand for P_2O_5 in Albania (12,800 mt annually) could be supplied by operation of one SA unit and one SSP unit.

The following is the operating scheme proposed on the basis of the above "best case" assumptions.

1. Operate SA-1 as is, with the exception of providing some spare parts, until SA-3 can be evaluated, modified, and placed into operation. Use the new equipment from China that is already onsite as needed for spare parts for SA-1. As soon as operation of SA-3 is proven, discontinue operation of SA-1.
2. Engage an experienced engineering firm to redesign the SA-3 pyrites roaster furnace and waste heat boiler, procure equipment, and oversee installation and startup of the modified unit.
3. Operate SSP-2 to produce ROP-SSP from imported phosphate rock and sulfuric acid produced in SA-1 and later in SA-3. Use SSP-1 as a source of spares for SSP-2.
4. Ship the ROP-SSP from the plant in bulk for handbagging as necessary by dealers. Do not operate the granulation unit because producing granular SSP adds about US $16/mt to the production cost. Since the average landholding per family is only 1.2 ha, and Albanian farmers have long experience with using ROP-SSP, the additional cost for granular SSP cannot be justified.
5. Do not produce granular NPK fertilizers at the Lac factory due to unfavorable economics.

As discussed on page 10 (Projected Production Costs), the economics of this "best case" operating scheme are quite unfavorable compared with imported DAP.

Raw Materials Supply

The two major inputs for producing SSP are sulfuric acid and phosphate rock. According to the "best case" operating scheme, sulfur for producing sulfuric acid at the Lac factory could be obtained from the following two sources:

- Natural pyrites.
- Flotation pyrites from beneficiation of copper ore.

Natural Pyrites

Sulfuric Acid No. 1 is designed to use natural pyrites containing 35%-40% sulfur. These pyrites are mined at Spac which is located about 66 km from Lac. The pyrites are

transported to the Lac factory by truck at a current delivered price of 3,190 leks/mt or about 8,860 leks/mt of sulfur (S). The remaining natural pyrite reserves at the Spac Mine and three other mines are estimated to be about 240,000 mt which is only sufficient for about 5-6 years operation of SA-1 at its design capacity.

Flotation Pyrites

Albania mines considerable quantities of copper-bearing ores that are usually beneficiated to increase the concentration of copper. Flotation byproducts from the beneficiation of copper ore can be further processed to yield a high-grade (40%-45% sulfur) pyrite. Sulfuric Acid No. 3 at Lac is designed to use these very fine-sized (60%-80% minus 74 microns) pyrites.

Assuming that copper ore continues to be mined and beneficiated, more than sufficient quantities of flotation pyrites would be available for SA-3. It is reported that a minimum of 1.5 million mt of flotation pyrites may be available. The current price of flotation pyrites delivered to the Lac factory is 2,400 leks/mt or about 5,580 leks/mt S.

Phosphate Rock

A low-grade phosphate rock is available from the Gjirokastra district in southern Albania. However, use of this rock is not recommended considering the condition of the mine, the low grade of the ore, the high cost of transport to Lac, and the additional processing costs in the factory (high usage of additional sulfuric acid and a low P_2O_5 grade SSP product). Thus, imported material is the only realistic source of phosphate rock. The current price of a good-quality phosphate rock (32%-33% P_2O_5) imported from North Africa and delivered to the Lac factory is about 6,000 leks/mt (about US $60/mt or US $185/mt P_2O_5).

Production Economics of Lac SSP Factory

At the time of the team's visit to Lac, ROP-SSP from storage was being hand bagged at the factory and shipped to dealers and consumers. There was approximately 17,000 mt

of bulk ROP-SSP in storage and about 1,000 mt of bulk granular SSP. These products had been produced using raw materials and intermediates that were on hand at the time the units were shut down in 1991.

The plant is experiencing difficulty in selling these products under the following price policy:

Product	Current Selling Price Ex-Factory (August 1993)	
	leks/mt Product	leks/mt P_2O_5
1. ROP-SSP, bagged (15% P_2O_5)[a]	5,000	33,330
2. Granular SSP, bagged (15.8% P_2O_5)[a]	7,700	48,730

a. Produced from imported Egyptian phosphate rock (30% P_2O_5) blended with about 25% of low-grade Albanian phosphate rock which results in a low P_2O_5 content in the SSP product.

As shown below, these prices are considerably lower than the cash cost of producing the products when the costs of the raw materials and intermediates are considered, not including capital charges.

Product	Production Cash Cost Ex-Factory	
	leks/mt Product	leks/mt P_2O_5
1. ROP-SSP, bagged (15% P_2O_5)	6,256	41,710
2. Granular SSP, bagged (15.8% P_2O_5)	7,930	50,190

Calculations of the above estimated production costs were based on operation of the plants "as is" with no capital improvements and on outdated (low) costs of raw materials and intermediates. More realistic production cost estimates for future operation of the factory

must include updated higher costs for raw materials and intermediates and the costs of capital investments (capital charges).

Projected Production Costs

Investment Estimates–Table 1 contains a listing of preliminary estimated investments required to operate the Lac factory according to the above outlined "best case" operating scheme. The total estimated investment is US $3,168,000.

Production Costs for "Best Case" Operating Scheme–Assuming a new investment total of US $3,168,000, annual loan amortization and interest would be 58.425 million leks assuming an annual interest rate of 10% with 20 equal semiannual principal payments over a 10-year period.

As shown in Table 2, costs of the two major raw materials, phosphate rock and sulfuric acid, account for about 81% of the cash cost of production of bulk ROP-SSP; 37,700 leks/mt P_2O_5. The price of phosphate rock used in the calculations was based on a 4-year-old price for Egyptian rock of 4,250 leks/mt. A more realistic current rock price would be about 6,000 leks/mt. The price increase for rock would add about 1,090 leks/mt to the cost of producing bulk ROP-SSP. Use of this better grade of phosphate rock (32%-33% P_2O_5) would increase the P_2O_5 content of the SSP from 15% to about 18%, and the cash cost of production would then be 37,500 leks/mt P_2O_5. Therefore, the only opportunity of making a meaningful decrease in the cost of ROP-SSP would be to decrease the cost of sulfuric acid.

Pyrite ore for SA-1 currently costs 3,190 leks/mt and this cost accounts for about 63% of the cost of producing sulfuric acid (Table 3). The remaining variable costs and the fixed costs are relatively low as compared to international standards for plants of this type. Therefore, a decrease in the cost of pyrites is the only means for making a significant decrease in the cost of producing sulfuric acid. The SA-3 plant which would be operated according to the "best case" operating scheme is designed to use flotation pyrites as a raw material. This material currently costs 2,400 leks/mt. Using this cost for pyrites and 6,000 leks/mt for phosphate rock, projected costs were estimated for sulfuric acid and ROP-SSP produced according to the "best case" operating scheme.

A summary of these costs follows:

	leks/mt
Production Cash Cost for Sulfuric Acid (36,600 mtpy of 100% H_2SO_4)	
Cost of pyrites @ 2,400 leks/mt	2,100.0
Other variable costs	453.8
Fixed costs	1,533.2
Subtotal	**4,087.0**
Production Cash Cost for ROP-SSP (70,000 mtpy)	
Cost of sulfuric acid @ 4,087 leks/mt	1,553.0
Cost of phosphate rock @ 6,000 leks/mt	3,744.0
Other variable costs	102.1
Fixed costs	1,167.0
Subtotal	**6,566.1**
Bags and bagging[a]	600.0
Capital charges (loan and interest payments)	832.0
Margin (5% of production cash cost)	328.3
Less credit for Na_2SiF_6 (sodium fluosilicate)	-450.9
Plant-gate cost per metric ton bagged ROP-SSP (18% P_2O_5)	**7,875.5**
Plant-gate cost for bagged ROP-SSP (mt P_2O_5)	**43,753**

a. Hand bagging is assumed. Use of bagging machines would reduce the cost of bagging labor. However, machine bagging would require higher quality, more expensive bags, and the total cost of bags and bagging would be about 1,200 leks/mt.

Lac ROP-SSP Versus Diammonium Phosphate (DAP)—The projected plant-gate cost for bagged ROP-SSP (18% P_2O_5) is estimated to be 7,875.5 leks/mt product which is equivalent to 43,753 leks/mt P_2O_5.

For comparison, the free-on-truck (f.o.t.) cost at Durres Port of imported diammonium phosphate (DAP) in bags after taking a credit for the nitrogen content of 18% is shown as follows:

	leks/mt Product (After Nitrogen Credit)[a]	leks/mt P_2O_5 (After Nitrogen Credit)[a]
Bagged DAP (without import duty)	13,737	29,863
Bagged DAP (with import duty and surtax)[b]	20,057	43,602

a. Credit for the nitrogen content of DAP was calculated based on a plant-gate price of urea of US $130/mt at the Fier Nitrogen Fertilizer Factory as calculated by IFDC and based on natural gas priced at international levels. (Refer to "Technical and Economic Evaluation of the Fier Nitrogen Fertilizer Factory in Albania," IFDC, July 1993).
b. Import duty is 30% of the c.i.f. value. A surtax of 5% of the c.i.f. value is levied on goods subject to the import duty.

The above cost comparisons do not take into account the additional costs on a delivered P_2O_5 basis associated with transporting SSP versus DAP. For example, assuming production of 70,000 mtpy of ROP-SSP and a transport distance of 100 km, the delivered costs would be as follows:

	Delivered Cost, leks/mt P_2O_5 (After Nitrogen Credit)	
	Truck	Rail
	(12 leks/mt/km)	(4.5 leks/mt/km)
Bagged DAP (no import duty)	31,787	30,615
Bagged DAP (with import duty and surtax)	45,477	44,305
Bagged SSP (ROP)	50,420	46,253

Based on the above comparison, ROP-SSP produced at Lac could not compete with DAP on a nutrient basis, even with the existing 30% import duty and 5% surtax levied on the c.i.f. value. Furthermore, this comparison does not consider the superior quality of the DAP versus SSP, and the better quality of the bags that would be used for imported DAP. Also, no consideration is given for the shorter distance from Durres than from Lac to high fertilizer use areas such as Lushnja.

The plant-gate cost of the bagged ROP-SSP must be less than 6,986 leks/mt (38,810 leks/mt P_2O_5) in order to be competitive with DAP subjected to the import duty and

surtax at a transport distance by truck of 100 km. If it is assumed that the flotation pyrites are delivered to the plant at no cost, the plant-gate cost of ROP-SSP would still be 7,038 leks/mt (39,100 leks/mt P_2O_5) at an annual production of 70,000 mt as follows:

		Plant-Gate Cost, ROP-SSP		
		leks/mt	leks/mt	leks/mt
		ROP-SSP Production Rate, mtpy		
		60,000	70,000	80,000
Cost of pyrites:	2,400 leks/mt	8,353	7,876	7,612
	1,000 leks/mt	7,866	7,389	7,126
	0 leks/mt	7,515	7,038	6,774

Therefore, it can be concluded that ROP-SSP produced at Lac cannot be competitive with imported DAP at today's prices even under the most favorable circumstances.

This conclusion has been based on the commercial importation of DAP into Durres from a North African Source as follows:

	Cost of Bagged DAP (Product Basis)	
	$/mt	Leks/mt
Bagged product (f.o.b.) (see Table 4)	150	15,000
Shipping	25	2,500
Port fees	15	1,500
Total Cost/mt Product (f.o.t. Durres)	**190**	**19,000**
Cost/mt P_2O_5 after credit for nitrogen (f.o.t. Durres)	**299**	**29,900**

Assuming a production of 70,000 mtpy and that the flotation pyrites can be delivered to the Lac factory for 1,000 leks/mt, the plant-gate cost for bagged ROP-SSP (18% P_2O_5) would be 7,389 leks/mt (41,050 leks/mt P_2O_5). The cost delivered at a location with a truck transport distance of 100 km would be 8,589 leks/mt or 47,716 leks/mt P_2O_5. Based on this cost, ROP-SSP produced at Lac would be competitive with DAP in the event that future

DAP prices f.o.t. Durres rise above US $260/mt. This would be equivalent to an increase in the bagged price f.o.b. North Africa from $150/mt to $220/mt. It is not likely that such a price increase will be encountered in the near- to medium-term future based on international prices during recent years (see Table 4 and Figure 1).

Thus, ROP-SSP produced at Lac will not be competitive with imported DAP even if DAP prices increase substantially in the future as shown in Figure 2.

Future Costs–For the most part, the cost calculations (except for raw materials costs) have been based on current actual costs. These are likely to be higher in the future and if this happens cost reduction measures would be necessary to offset the increases such that the overall production cost does not increase. For example, the number of people currently employed at the factory is much higher than is normal in similar facilities elsewhere. As wages increase in the future, the number of people must be decreased to contain costs. Similarly, improvements in efficiency of the use of raw materials, energy, and utilities must be made as costs of these items increase.

Granular NPKs

Consideration was given to producing granular NPK grades using the existing granulation unit at the Lac factory. The production of multinutrient (NPK) fertilizers was considered as a way of providing an agronomically balanced fertilizer while at the same time adding value to the SSP. Multinutrient (NPK) products normally sell at a premium over straight materials such as urea, DAP, SSP, and potash. With the NPK production scheme, ammonium phosphate (DAP or MAP) and potash would be imported at Durres and transported to Lac where they would be cogranulated with ROP-SSP produced at Lac. Most of the NPK grades would be sold in areas around Tirana and in the prime agricultural areas south of Durres.

NPK grades, thus produced, cannot compete in the market on a nutrient basis against imported straight materials such as DAP and potash.

Personnel Training

Lac factory managerial and technical personnel need to be more fully exposed to the technical and economic aspects of business operations in a competitive, free-market economy. Training is needed in the following three areas if a decision is made to keep the factory in operation:

1. Process economics, management, and profitability.
2. Technical aspects of production and maintenance in fertilizer plants.
3. Quality control and chemical analysis.
4. Linkage between production and integrated marketing systems.

It is envisaged that such training could take place in Albania, at IFDC Headquarters, and in factories in Europe or elsewhere that are similar to the Lac factory.

Marketing of Existing Stocks of SSP

At the time of this study, approximately 17,000 mt of bulk ROP-SSP product and 1,000 mt of bulk granular SSP product were in stock in the Lac factory warehouses. There are enough raw materials in stock to increase this product inventory to a total of about 50,000 mt of SSP product containing about 15% P_2O_5. The factory should be operated long enough to convert these raw materials into ROP-SSP. The ex-factory price for the bulk ROP-SSP should be less than 4,500 leks/mt (30,000 leks/mt P_2O_5) if the existing raw materials are used on a "no cost" basis.

The Lac SSP factory is experiencing difficulty in selling the current stocks of SSP. A recent survey by IFDC-Albania of 151 dealers identified the problems associated with marketing SSP as price (ex-factory), poor-quality bags, and excessive transport costs. IFDC-Albania is assisting the factory in developing a marketing strategy for the SSP based on the survey results.

The marketing strategy will include price discounts for purchase of bulk SSP, purchase of large quantities, and transport by rail.

The new marketing strategy will encourage bulk shipments by railway with hand bagging by dealers at locations as close as possible to the end-use areas. This will not only give lower transport costs as compared with truck shipments but will minimize bag breakage due to excessive handling of the poor-quality bags.

The most significant factor, which recently limited sales of SSP, was the availability of DAP. As soon as existing stocks of DAP in the dealers' inventory are sold, the new marketing strategy should be effective in selling the residual inventory of SSP.[2]

[2]The stock of DAP was completely sold by the end of September 1993.

Table 1. Estimated Investment Required for Operation of Lac SSP Factory According to "Best Case" Operating Scheme

Item	Estimated Investment
	(US $)
Sulfuric Acid No. 3 (SA-3)	
a. New boiler	1,500,000
b. Redesign of pyrites furnace	250,000
c. Engineering, installation, and commissioning	300,000
d. New acid circulation pumps (2 sets)	40,000
e. Spare parts (mostly electrical and instruments)	100,000
Subtotal	**2,190,000**
Single Superphosphate No. 2 (SSP-2)	
a. Renovate fugitive dust collection system plus scrubber in rock grinding area (environmental)	400,000
b. Meter for phosphate rock feed to mixer	75,000
c. Meter for acid feed to mixer	40,000
Subtotal	**515,000**
Sulfuric Acid No. 1 (SA-1)[a]	
a. Spare parts	98,000
b. Install portions of new cinder removal section recently imported from China (environmental)	60,000
c. Install sulfuric acid piping to SSP-2	15,000
Subtotal	**173,000**
Additional Environmental	
a. Spare parts and equipment replacement for lime milk unit	150,000
b. Install meters and valves for automatic dosing of lime milk	90,000
c. Repair leak in holding pond	50,000
Subtotal	**290,000**
TOTAL	**3,168,000**

a. The estimated investment of US $173,500 for SA-1 is only what is required for operating the unit temporarily until such time that SA-3 can be started up.

Table 2. Phosphate Fertilizer Complex Lac—Estimated Cost of Production—Lac No. 1 ROP Superphosphate Plant (Mid-1993 leks)

Annual Production, 82,500 mt product

A. Variable Costs					
Item	Unit	Cost/Unit	Consumption	Cost	% of Total Cost (Bulk)
		(leks)	(mt)	(leks/mt)	
Phosphate Rock	mt	4,250.00	0.62	2,652.00	46.9
Sulfuric Acid	mt	5,056.70	0.38	1,911.43	33.8
Water	m^3	4.00	16.00	64.00	1.1
Electric Power	kWh	1.80	19.00	34.20	0.6
Limestone	mt	300	0.013	3.90	0.1
Total Variable Costs	leks/mt			4,665.53	82.5

B. Fixed Costs			
Item	Annual Cost (x 1,000 leks)	Cost leks/mt	% of Total Cost (Bulk)
Operating Wages	4,374.00	53.02	0.9
Annual TA Maintenance Materials[a]	2,392.50	29.00	0.5
Annual TA Maintenance Wages[a]	1,496.90	18.14	0.3
Normal Maintenance Materials	15,840.00	192.00	3.4
Normal Maintenance Wages	341.70	4.14	0.1
Work Unit Supplies	43,972.50	533.00	9.4
Administration and Services[b]	2,620.30	31.76	0.6
Miscellaneous Expenditures[c]	10,655.69	129.17	2.3
Total Fixed Cost	81,693.59	990.23	17.5
Total Cost/mt Bulk ROP-SSP		5,655.76	100.0
Bags, Bagging, and Loading		600.00	
Total Cost/mt, Bagged ROP-SSP, Ex-Factory		6,255.76	

a. TA = Turnaround.
b. Includes transport, laboratory, and shipping/receiving.
c. Calculated at 15% of fixed costs.

Table 3. Phosphate Fertilizer Complex Lac–Estimated Cost of Production–Lac Sulfuric Acid, No. 1 Sulfuric Acid Plant (Mid-1993 leks)

Annual Production, 40,000 mt sulfuric acid (100% basis)

A. Variable Costs					
Item	Unit	Cost/ Unit	Consumption	Cost	% of Total Cost
		(leks)	(mt)	(leks/mt)	
Pyrite Ore	mt	3,190.00	1.00	3,190.00	63.2
Fuel Oil	kg	8.70	4.00	34.80	0.7
Salt (Water Treatment)	kg	10.00	2.80	28.00	0.6
Water	m^3	4.00	52.00	208.00	4.1
Electric Power	kWh	1.80	80.00	144.00	2.8
Lime	mt	3,000	0.013	39.00	0.8
Total Variable Costs	leks/mt			3,643.80	72.2

B. Fixed Costs			
Item	Annual Cost (x 1,000 leks)	Cost leks/mt	% of Total Cost
Operating Wages	5,880.60	147.02	2.9
Annual TA Maintenance Materials[a]	5,292.00	132.30	2.6
Annual TA Maintenance Wages[a]	2,352.20	58.81	1.2
Normal Maintenance Materials	20,000.00	500.00	9.9
Normal Maintenance Wages	863.14	21.58	0.4
Work Unit Supplies	8,000.00	200.00	4.0
Administration and Services[b]	4,117.00	102.93	2.1
Provision-Catalyst Replacement	2,640.00	66.00	1.3
Miscellaneous Expenditure[c]	6,975.74	174.39	3.4
Total Fixed Costs	56,120.68	1,403.02	27.8
Total Cost/mt		5,046.82	100.0

a. TA = Turnaround.
b. Includes transport, laboratory, and shipping/receiving.
c. Calculated at 15% of fixed costs.

Table 4. Spot Prices of Diammonium Phosphate (DAP) f.o.b. North Africa; January-August 1993.

Month	Bulk DAP f.o.b. North Africa	Bagged DAP f.o.b. North Africa
(1993)	US $/mt (Range)	US $/mt (Range)
January	155-158	160-170
February	140-158	155-170
March	125-145	150-155
April	125-135	145-150
May	125-135	145-150
June	125-135	145-150
July	120-135	140-145
August	125-135	140-145

Source: Weekly Telefax Report; FMB Consultants, Ltd.; Middlesex, United Kingdom.

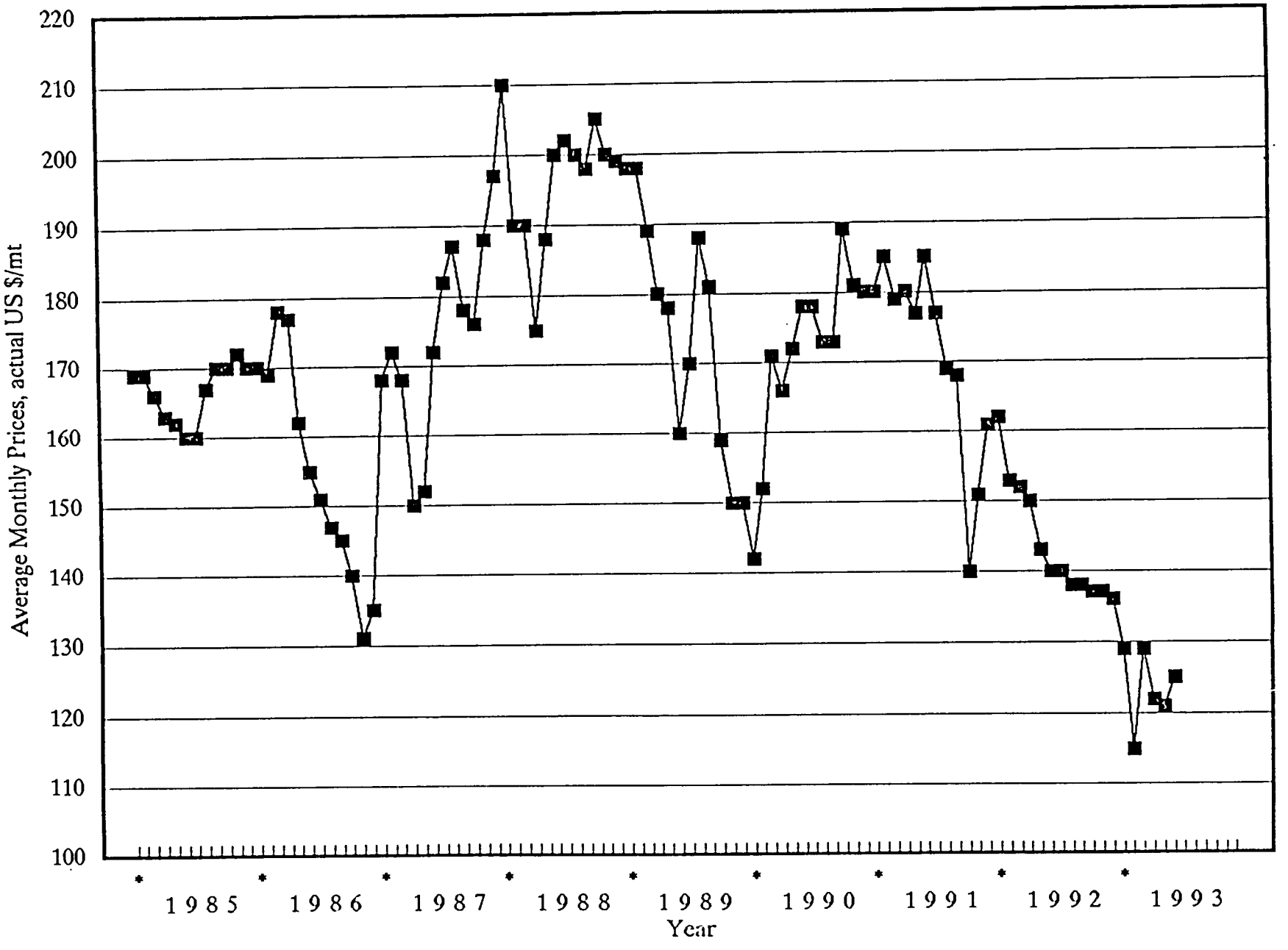
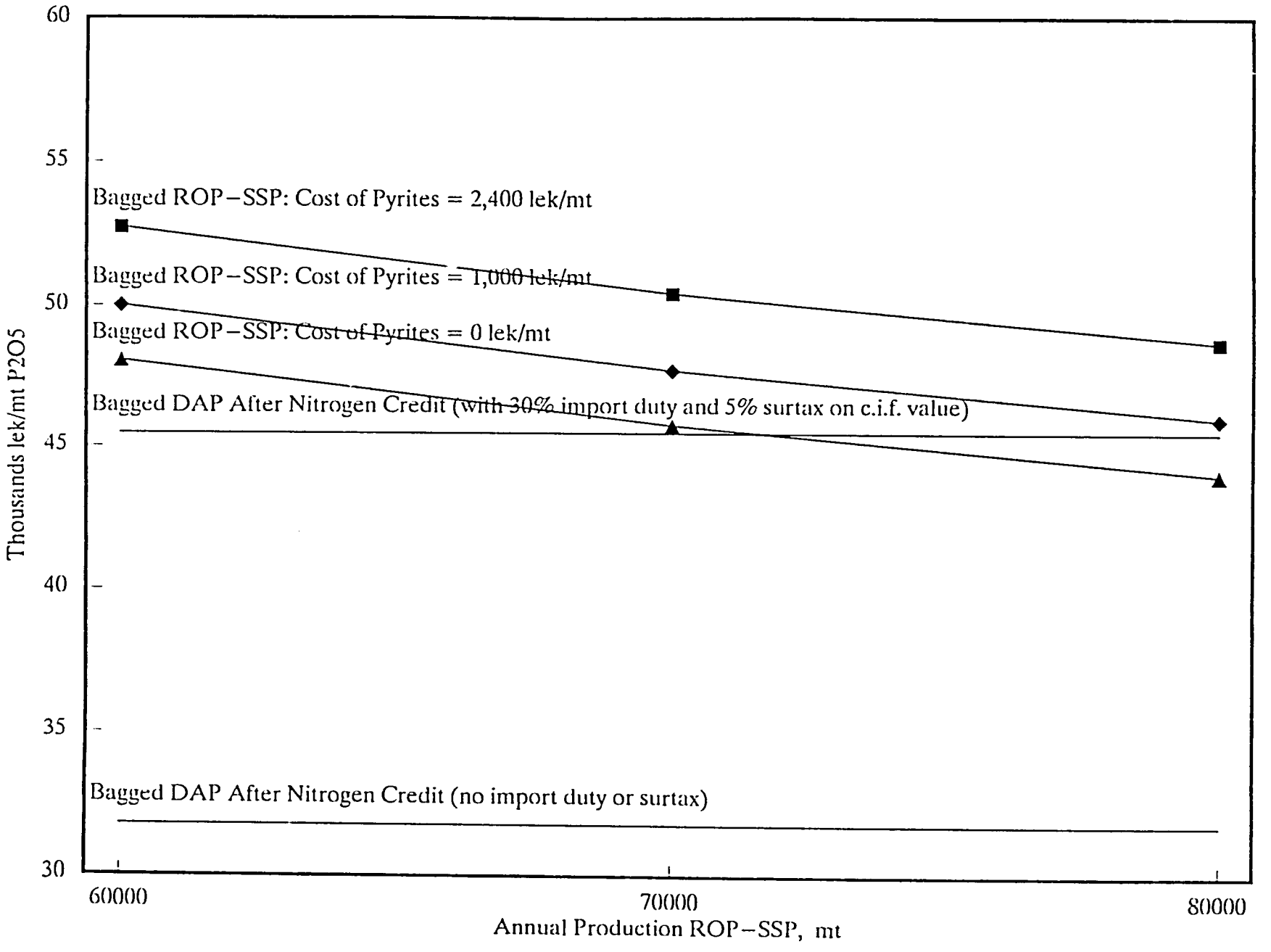


Figure 1. DAP Prices (f.o.b. U.S. Gulf, bulk US $/mt)


60
55
50
45
40
35
30
Thousands lek/mt P2O5
Bagged ROP–SSP: Cost of Pyrites = 2,400 lek/mt
Bagged ROP–SSP: Cost of Pyrites = 1,000 lek/mt
Bagged ROP–SSP: Cost of Pyrites = 0 lek/mt
Bagged DAP After Nitrogen Credit (with 30% import duty and 5% surtax on c.i.f. value)
Bagged DAP After Nitrogen Credit (no import duty or surtax)
60000
70000
80000
Annual Production ROP–SSP, mt

Technical and Economic Evaluation of the Lac Phosphate Fertilizer Complex in Albania

1. Introduction

Beginning in mid-1991 until the present, dramatic changes are taking place in the political, social, and economic structure of Albania. These changes have not only affected agriculture but have also had a severe effect on the fertilizer production and distribution system that was previously controlled as a part of the centrally-planned economic system. Under the old system, fertilizers and other agricultural inputs were supplied to the state farms and communes according to a centralized plan.

The disruption that took place in 1991 resulted in serious shortages at the farm level of almost all agricultural inputs including fertilizers. In 1992, the United States Agency for International Development (USAID) initiated a project for assisting Albania in restructuring the fertilizer supply, distribution, and marketing system such that it could be integrated into the free trade economy which is gradually emerging in Albania. The eventual aim of the project is to facilitate future privatization of the system. USAID entrusted the International Fertilizer Development Center (IFDC) with the responsibility of implementing the project.

The first activity of the project was the creation of a network of dealers for marketing fertilizers at the retail level. Indigenous production of fertilizers had also been disrupted in 1991, and serious shortages existed throughout the country. In an effort to partially relieve these shortages and increase food production USAID provided funds in 1992 for IFDC to import 20,000 mt of urea fertilizer and 10,000 mt of diammonium phosphate fertilizer (DAP) on an emergency basis. These imported fertilizers were distributed and marketed through the IFDC network of dealers which currently numbers more than 300.

For obvious reasons, continued importation of all fertilizers needed in Albania is not desirable, and indigenous production should be encouraged where economically feasible. Currently, there are two fertilizer factories in Albania: a nitrogen fertilizer factory south of Tirana at Fier and a single superphosphate (SSP) fertilizer factory located north of Tirana at Lac. Under the former political and social structure in Albania, funds were not provided

for adequately maintaining these factories, and, as a result the technical and mechanical integrity is not good. IFDC has recently completed a technical and economic evaluation of the Fier Nitrogen Fertilizer Factory (FNFF), and recommendations have been made for improving its performance.

This report is of a similar study of the Lac SSP factory performed by IFDC for USAID. To facilitate the study, IFDC fielded a team of four specialists in Albania for a 3.5-week period (August 4-28, 1993). Three of the specialists were from IFDC Headquarters in Muscle Shoals, Alabama, U.S.A., and the fourth was a marketing specialist who is on long-term assignment in Albania.

The members of the team were:

Donald R. Waggoner–Chemical Engineer, Fertilizer Production Specialist, Team Leader

Steven J. Van Kauwenbergh–Specialist, Geology

Donald Charles Young–Phosphate Fertilizer Production Specialist

Claude Freeman–Marketing/Training Specialist (currently assigned to Albania)

The majority of the team's time in Albania was spent at the Lac SSP factory and in visits to the mining and ore processing facilities which supply raw materials to the factory. The Lac SSP factory, which is the only producer of phosphate fertilizer in Albania, was totally shut down during the visit of the team due to the storage building being full of run-of-pile (ROP) SSP.

During the visits to the Lac factory, the team inspected every equipment item in all of the units of the complex. Each equipment item was rated as to its condition based on visual observations and discussions with plant engineers and operating personnel.

The purpose of the study was to provide technical assistance to the Lac SSP factory for determining if the available resources and facilities at the Lac complex could be used effectively and efficiently to improve the future viability of the company. This also is interrelated to the availability of raw materials such as iron pyrite from Albanian mines, off-gases (containing SO_2) from an adjacent copper smelting plant, and imported phosphate ore. Evaluation of the concept of producing an SSP-based NPK granular fertilizer was also an objective of the study. This report contains the team's recommendations based on the results

of analysis of a "best case" operating scheme. Also, a previous IFDC report, "Fertilizers in Albania–Situation, Analysis, and Recommendations," dated February 1992, was used as input for this study.

The total output of the study is contained in this report. The report contains the following sections in addition to an Executive Summary and this introductory section.

Description of Production Units

This section describes the producing units of the factory as they are presently configured and discusses the production capacities and interrelationships between the various units.

Raw Materials Resources

This section discusses the indigenous raw materials resources available to the Lac factory. Particular emphasis is given to natural and flotation pyrites and phosphate rock. Assessments are made of the exploitable reserves, and technical, economic, and environmental factors related to current and future operation of the mines.

Production History

This section briefly reviews historical production records of the various plant units.

Factory Problems

In this section, discussions are given of technical, mechanical, and environmental problems currently facing Lac factory management.

Solutions to Problems

This section describes the actions necessary to overcome or minimize the technical, mechanical, and environmental problems. Estimates are given of the investments required for solving the problems.

Possible Operating Schemes

This section discusses the various options available for future operation of the Lac factory including production of granular NPK grades. In order to facilitate technical and economic analyses of the factory, a possible operating scheme is chosen based on "best case" conditions.

Production Costs

In this section information is provided relating to historical production costs. Also, estimates are made of future production costs according to the recommended possible operating scheme. Analyses are made of the costs with respect to variations in the cost of flotation pyrites and plant production rates. Costs of ROP-SSP produced at Lac are compared on a nutrient basis with imported DAP.

Organization

This section briefly analyzes the organizational structure of the factory, the manning level, and the training needed to prepare the factory personnel for a market economy environment.

Marketing

In this section, details are provided concerning development of the current fertilizer marketing system in Albania, creation of a network of private fertilizer dealers, the Albanian market for P_2O_5 and marketing prospects for Lac SSP.

Conclusions

This section summarizes the conclusions reached as a result of the study.

A Terms-of-Reference (TOR) for the study is included in Appendix A and a listing of persons contacted is given in Appendix B.

2. Description of Production Units

The Lac SSP factory, the sole phosphate fertilizer production facility in Albania, is located about 60 km north of Tirana. The factory contains two sulfuric acid (SA) units, two ROP-SSP units, and an SSP granulation unit. An adjacent metallurgical plant also supplies the SSP factory with sulfuric acid which is produced in the SA-2 unit from SO_2 containing off-gases from copper smelting. Pertinent data describing these production units are given in Table 1. In addition to the main production units, the Lac complex contains the following auxiliary facilities:

- Two sodium fluosilicate units which process the hydrofluosilic acid formed in the fluorine scrubbers of the SSP-1 and SSP-2 units.
- Water treatment unit for producing demineralized water for the waste heat boilers.
- Neutralizer units for producing lime slurry to neutralize the excess free acid in the water collected in the chemical sewer system.
- Storage tanks for strong (>93%) and weak (<93%) sulfuric acid.
- Nitric acid concentration unit.
- Oleum unit ($H_2S_2O_7$).
- Laboratory.
- Maintenance shops.
- Holding pond for treatment of acid-bearing aqueous effluents.

Figure 1 is a schematic flow diagram of the factory complex. Raw materials necessary for operation are iron pyrites from the Spac mine, flotation pyrites from several copper ore beneficiation plants, SO_2 containing off-gases from the adjacent metallurgical factory, imported phosphate rock and limited quantities of low-grade phosphate rock from an indigenous mine at Gjirokastra in the south of Albania.

The oldest units in the factory, SA-1, SSP-1, and SSP granulation, were built in 1966 (27 years ago) as an integrated train. Sulfuric Acid Plant No. 2 (SA-2) was built 13 years ago (1979) to use SO_2 off-gases from the copper smelter located next to the SSP factory.

A third sulfuric acid unit (SA-3) was completed in 1987 to use flotation pyrites from copper ore beneficiation. The plant has never been operated due to serious deficiencies in the design of the pyrites roaster and the waste heat boiler. In 1989, SSP-2 was built to utilize

the sulfuric acid from SA-3. The SSP-2 unit is identical to SSP-1 and has only been operated for about 5 months to produce about 80,000 mt of ROP-SSP.

No. 1 Sulfuric Acid Unit (SA-1)

A simplified flow diagram for the SA-1 unit is shown in Figure 2.

The SA-1 plant was built in 1966 as part of an integrated train which also included SSP-1 and an SSP granulation unit. Process technology, design, and equipment erection were from China. The SA-1 unit was designed to use iron pyrite (FeS_2) containing 40%-45% sulfur. The iron pyrite is mined at the Spac mine and transported to the Lac factory by truck; a distance of about 66 km. The daily design capacity is 120 mt of 100% sulfuric acid which is equivalent to 40,000 mtpy.

Pyrite ore from the Spac mine is stored in a concrete warehouse of 3,000-mt capacity containing two overhead bridge cranes. Pyrite reclaimed from storage is sent via a reclaim hopper and conveyor belt to a jaw crusher where the size is reduced to minus (-) 30 mm. A scalping screen is used to remove +4 mm particles which are further reduced in size in a roll crusher. Oversize (+4 mm) is screened out and recycled to the roll crusher.

Beneficiation pyrite (up to 30% of the total pyrite feed) is dried from about 15% moisture down to about 5% moisture in a rotary drum dryer fired with fuel oil.

The dried beneficiation pyrite which is a flotation product from copper ore beneficiation is mixed with the ground pyrite ore, and the mixture then undergoes a final screening step after which it passes to a batch weighing system. The pyrite mixture from the batch weighing system is passed by conveyors to a fluidized bed furnace for roasting of the pyrites. The furnace temperature is maintained at 900°-950°C, and the overhead gases from the furnace contain about 13% SO_2 and about 300 g/m^3 of dust.

The dust-laden hot gases flow to the waste heat boiler where the temperature of the gases is reduced to about 400°C and steam (1.7 mtph) is raised at a pressure of 6-8 kg/cm^2 g. About 10% of the dust in the gas stream is removed in the boiler. From here, the gases pass through two parallel cyclones which remove about 70% of the dust. The next step in the process, dry electrostatic precipitators, is designed to remove the balance of the dust. However, these precipitators have only worked for less than 1 year during the 26 years of plant operation.

Ash from the furnace and fly ash (dust) from the boiler and cyclones are cooled in a system of rotary coolers and finally water-quenched to a temperature of 80°C before being transferred by conveyor to an ash stock area from whence transfer is made by truck to the ash storage pile.

Gases from the dry electrostatic precipitation pass to two wash towers in a series where they are further purified by washing with weak sulfuric acid. The temperature of the gases is reduced to about 35°C at the outlet of the second wash tower.

Gases exiting the second wash tower flow to a wet electrostatic precipitator where the mist is partially removed. Next, a third washing tower sprayed with sulfuric acid (concentration of less than 5% sulfuric acid) is used to increase the droplet size of the mist which is then almost totally removed in a second wet-electrostatic precipitator. Final drying of the gases is accomplished in a drying tower utilizing 93% sulfuric acid. From the drying tower, the gases pass via a mist eliminator to a single absorption/single contact sulfuric acid unit. Oxidation of SO_2 to SO_3 takes place in a four-bed catalytic reactor. The design rate of conversion is 95% (actual about 94%). The SO_3 formed in the catalytic oxidation step is absorbed in sulfuric acid in the absorption tower. Design absorption efficiency is 99.98%-99.99%. Depending on market requirements, oleum can be produced in a separate absorption unit.

No. 2 Sulfuric Acid Unit (SA-2)

In early 1991, the SA-2 unit was placed under control and operation of the metallurgical complex adjacent to the Lac factory and as such is not considered part of the Lac factory. However, SA-2 is designed to supply the Lac factory with sulfuric acid produced from SO_2 containing off-gases from copper smelting at the metallurgical complex. For this reason, SA-2 was included in the study. The design capacity of SA-2 is 45,000 mtpy of 100% sulfuric acid. Figure 3 is a schematic flow diagram showing the interconnection between copper smelting and SA-2.

Off-gases produced during smelting of copper ore in the water-jacketed blast furnace and air-blown converters are processed in a gas cleaning system prior to passing to SA-2. The gas cleaning system consists of precipitators, cyclones, and bag filters. Originally, off-gases from the electric furnace were designed to be mixed in with the off-gases going to

SA-2. However, due to very low concentrations of SO_2 (0.5%-1%), these gases are vented up stream of the gas cleaning system.

After passing through the gas cleaning system, the combined off-gases from the blast furnace and converters are split into two streams using in-line blowers and processed in two identical parallel trains as shown on the schematic flow diagram of SA-2 (Figure 4). The following process description will be only for one train but will apply to both trains.

Gases from the in-line blowers at about 230°C with SO_2 content of about 6% flow to a heating system where the temperature is increased to about 420°C using a fuel oil fired furnace and two heat exchangers in series. From the heating system the gases flow to the contact unit which is composed of two parts. The first part is the preconverter which has two catalyst beds. The first bed contains pellets of Al_2O_3 which removes trace impurities; mainly oxides of arsenic, tellurium, and selenium. The second bed contains vanadium catalyst for beginning the oxidation of the SO_2 in the gases.

Gases from the preconverter enter the converter which is an oxidizing reactor containing four beds of vanadium catalyst. Heat exchangers are provided for cooling the gases between each of the beds and cooling can also be done by introducing cooler gases directly from the in-line blower.

Gases from the reactor at about 430°C and containing moisture, SO_2, SO_3, CO, CO_2, and nitrogen pass to spray tower which uses 93% sulfuric acid at 50°C to condense most of the moisture and absorb the SO_3 from the gases to form sulfuric acid. From here, the remaining gases flow to a condensing tower packed with raschig rings and sprayed with 76% sulfuric acid at 50°C. In this tower, condensation of moisture and absorption of SO_3 to form additional sulfuric acid is completed.

Gases from the condensing tower go to the stack via a mist eliminator.

Hot sulfuric acids from the two towers and the mist eliminator are cooled in the acid coolers, collected in tanks, and either recycled to the spray towers or sent to product storage.

In the past, during times when SA-2 was not operating and copper smelting was in operation, the off-gases from copper smelting were vented to the atmosphere via a tall stack. This created intolerable environmental conditions for plant personnel and the surrounding

countryside and communities. Thus, SA-2 is essentially an environmental control unit for copper smelting which should never be operated unless SA-2 is also in operation.

In view of the fact that the condition of SA-2 has deteriorated to the point that its operation is no longer possible, the metallurgical complex must consider other means preventing release of SO_2 to the atmosphere.

No. 3 Sulfuric Acid Unit (SA-3)

Background—The No. 3 Sulfuric Acid Unit (SA-3) was designed to operate using iron pyrite concentrate from copper ore beneficiation plants as feed. The SA-3 unit was built in 1987 and is 6 years old. The unit, which has a design capacity of 60,000 mtpy of 100% sulfuric acid, is of Polish design and uses mainly Polish equipment. SA-3 has never been successfully operated due to serious design errors in the fluidized-bed pyrite furnace, and the waste heat boiler.

SA-3 has operated for only 32 h during six attempts to commission the unit. After approximately 4 h of operation, the waste heat boiler (fire tube) becomes blocked with cinders and the plant has to be shut down. In addition to the boiler blockage problem, the fluidized bed furnace does not fluidize well and the pyrite feed tends to agglomerate. The Polish company which designed the plant has done some work toward improving the furnace operation. However, the company is no longer in business.

Process Description—The SA-3 unit uses pyrite concentrate with a sulfur content of 40%-45% and a moisture content of 10%-12%. The pyrite concentrate is very fine-sized, i.e., 60%-80% minus 74 μm. Figure 5 is a schematic flow diagram of the SA-3 unit.

Pyrite concentrate is delivered to the unit by rail and is stored in a concrete storage building with a capacity of 6,000 mt. An overhead bridge crane transfers the pyrite from storage to an 8-h feed bin via a system of hoppers and conveyors. A table feeder transfers the pyrite from the feed bin to the front chamber of the fluid-bed furnace. Fluidizing and combustion air are supplied to the bottom of the furnace by a blower.

Hot gases at 880°-900°C containing about 13% SO_2 flow out the top of the furnace through the tube side of the waste heat boiler. Gases exit the boiler at 350°C and flow to cyclones which remove 75% of the entrained dust (cinders). The dust loading is then reduced to 0.2-0.3 g/nm^3 in a dry electrostatic precipitator. Dust from the furnace, waste

heat boiler, cyclones, and the dry electrostatic precipitator is collected in a screw conveyor/cooler which transfers the dust to a wetting chamber. The cooled, wet dust goes by conveyor belt to storage.

Gases from the dry electrostatic precipitator are further cooled and cleaned in a double tower. The scrubbing/cooling medium in the first tower is dilute sulfuric acid which removes fine dust and traces of oxides of arsenic, tellurium, and selenium. Fresh water is used in the second tower for cleaning and scrubbing the gases that then flow to the wet electrostatic precipitators for removal of sulfuric acid mist. The next step in the process is to further dry the gases by scrubbing in a tower with 93% sulfuric acid. The gases then enter the mist tower and are transferred by blowers to the catalytic converter for oxidation of SO_2 to SO_3. The converter contains four beds of vanadium catalyst and the reaction is exothermic. Gases exiting the converter are cooled by exchanging heat with the converter inlet gases and flow to the absorber section where the SO_3 is absorbed in concentrated sulfuric acid. Product sulfuric acid from the absorber unit of 93% or 98% concentration is stored in the product acid tanks.

About 12 mtph of high pressure steam is produced in the waste heat boiler. About 4 mtph of this steam is reused in the process. There are plans to use the balance of the steam in a turbo-generator to produce electricity for internal consumption within the factory.

Acid wastewater (about 16 m^3/h) is neutralized with lime milk prior to discharging to the holding pond system.

No. 1 and No. 2 Run-of-Pile Single Superphosphate Units (ROP-SSP 1 and 2)

The ROP-SSP 1 unit was built in 1966 and is of Chinese design. The unit was built as part of an integrated train to produce sulfuric acid and SSP.

The ROP-SSP 2 unit was built in 1989 by Albanian engineers and is a duplicate of ROP-SSP 1. Therefore, the following process description of ROP-SSP 1 applies to either of the units.

Figure 6 is a schematic flow diagram of ROP-SSP 1. The design capacity of the unit is 110,000 mtpy of ROP-SSP. The original design was for 60,000 mtpy to be transferred to the granulation unit and the remaining 50,000 mtpy to be distributed as ROP-SSP. A

separate unit is provided for producing up to 600 mtpy of byproduct sodium fluosilicate from the hydrofluosilicic acid (7%-9%) formed in the fluorine scrubbers of ROP-SSP 1.

The major process steps in the unit are phosphate rock handling and grinding; the reaction section, storage and curing, and neutralization.

The No. 1 ROP-SSP unit uses phosphate rock from several North African sources (Egypt, Jordan, Algeria, and Morocco). The phosphate rock is imported through the port at Durres, south of Tirana, transported by rail to Lac, and transferred to a concrete storage building with a capacity of 20,000-25,000 mt. The imported rock is mixed with up to 25% of low-grade Albanian phosphate rock (about 25% P_2O_5) and reclaimed from storage with an overhead bridge crane. The phosphate rock mixture is ground in an air swept ball mill. The mill is equipped with a coal-fired furnace for drying the rock to less than 2% moisture content. The rock is ground to 85% minus 0.15 mm. Provisions are made in the ball mill circuit for separation and recycle of oversize back to the ball mill. Onsize material from the separation step is transported by screw conveyor to the reactor feed hoppers. Dust-laden air from the pneumatic conveyors and separator in the size classification system along with air from the fugitive dust collection system passes through a battery of cyclones and a bag filter before being discharged into the atmosphere. Dust collected in the cyclones and bag filter flows to the screw conveyor feeding the reactor feed hopper.

The rock discharges from the hopper through a slide gate into a series of two screw conveyors that discharge into an elevator which returns the rock to the feed hopper. An adjustable slide gate on one of the screw conveyors is used to bleed rock feed to the reactor. This slide gate is manually adjusted to control the amount of rock continuously fed to the reactor. There is no rock flowmeter in the plant.

Sulfuric acid (76%) is fed to the reactor by manual adjustment of a valve on the acid feed tank discharge line. Water is fed to the reactor by the same method. These flows are manually controlled to supposedly yield an acid equivalent to 68% sulfuric acid in the reactor.

The rock, acid, and water are continuously mixed in an open-top, oval reactor with three turbine agitators (four turbine agitators in ROP-SSP 2). After about 1.5 min retention time in the reactor, the mix is discharged into a rotating, circular den containing a vertical cutter wheel. After 2 h, the SSP discharges from the den through a bottom chute onto a

conveyor belt that transports it to the curing shed. The SSP cures for about 15 days in the shed and is turned and mixed every few days by an overhead crane. During the curing process, periodic analyses are made for free acidity. When the free acidity of fresh SSP is less than 5% the curing process is finished and the product SSP is ready for shipment. There are no bagging facilities for ROP-SSP product.

Prior to shipment or transfer of the ROP-SSP to granulation, the excess free acid is neutralized with powdered limestone. A separate unit is provided for grinding, feeding, and mixing the limestone with the ROP-SSP product. A schematic flow diagram of the limestone neutralization unit is shown on Figure 7. The ROP-SSP 2 unit has space in the building for a limestone neutralization unit. However, the unit has not been installed.

Before venting to the atmosphere, the fluorine-laden off-gases from the rotary curing den are collected and water-scrubbed using two cross-flow scrubbers in series followed by one spray tower scrubber. This scrubber design is an adequate fluorine treatment system which should prevent environmental problems. The scrubber solution (7%-9% hydrofluosilicic acid) is reacted with a sodium chloride (NaCl) solution to produce sodium fluosilicate which is crystallized, centrifuged, dried, bagged in 40-kg bags of special construction, and either used domestically or exported.

Mother liquor (weak hydrochloric acid) from the centrifuge is discharged into the chemical sewer and neutralized with lime milk prior to discharge into the factory holding pond.

Single Superphosphate Granulation Unit

The SSP granulation unit was built in 1966 as a part of the original train for producing sulfuric acid and SSP (ROP and granular). Figure 8 is a schematic flow diagram of the unit. Design capacity of the plant is 65,000 mtpy.

The SSP granulation unit consists of a rotary-drum granulator 6 ft (1.8 m) in diameter and 24 ft (7.3 m) long; a cocurrent, coal-fired rotary dryer 7 ft (2.1 m) in diameter and 46 ft (14.0 m) long; an ambient air rotary cooler; two parallel, double-deck vibrating screens; a roll crusher for oversize; and various items of materials handling equipment, i.e., belt conveyors, screw conveyors, bucket elevators, and bins and hoppers. Cured ROP-SSP passes through the neutralization step for neutralization of the excess free acid with limestone and

is conveyed from SSP-1 to a hopper in the SSP granulation unit. The ROP-SSP flows from the hopper through a slide gate for flow control onto a conveyor belt which feeds the granulator feed hopper. Recycle is mixed with the fresh ROP-SSP in the feed hopper. Granulation is accomplished by water sprays in the granulator. According to the original design, steam was to be used to promote granulation. However, due to a shortage of steam in the factory, it is no longer used in granulation.

Granules discharging from the granulator are dried in a cocurrent rotary-drum dryer. The dryer furnace uses Albanian coal. After drying, the granules flow via a bucket elevator to the double-deck vibrating screens. The top screen has a 4.2-mm opening and the bottom screen opening is 1.2 mm. Oversize (+4.2 mm) material is sent to the roll crusher and then returned to the screens. Undersize from screening along with dust collected from the cyclones and bagged filters (no longer operable) is recycled to the granulator. Product size granules are cooled in the rotary cooler and sent to bulk storage.

Originally, the SSP granulation unit had bagging equipment and the capability to bag directly from production and/or storage. No bagging equipment remains today.

3. Raw Material Resources

Background

This analysis of indigenous raw material resources available to the Lac SSP plant should be considered cursory. Information concerning pyrite and pyrite concentrates was mainly supplied by personnel from ALBBACER, the Albanian copper company, and personnel from the Mineral Processing Research Institute, Tirana. The distances between certain points and tonnages of available material should be considered approximate. Quoted figures on reagent usage are average figures or specific to cited cases. A minimum amount of documentation was provided. Most of the information was obtained through verbal interviews and reports prepared especially for the IFDC mission.

Pyrite and pyrite concentrate production for feed to the roasters at the Lac SSP plant is intimately linked with ALBBACER activities. The Lac SSP plant has been supplied with natural pyrite mainly from the Spac Mine Pyrite concentrates have been produced at several beneficiation plants. However, most of the pyrite concentrate production was sold to Viet Nam during 1981-87 and apparently one shipment was sold to Turkey. It was reported that 30,000-40,000 mtpy was sold to Viet Nam during the best years. Pyrite concentrate use at Lac was very limited. Several brief test runs of Sulfuric Acid Plant No. 3 were unsuccessful. An unknown but limited amount of pyrite concentrates have been mixed with as-mined pyrite for test purposes in Lac Sulfuric Acid Plant No. 1. Based on sulfuric acid production figures from Plant No. 1 (assuming 1 mt pyrite [40% S] = 1 mt 98% sulfuric acid), over 1.2 million mt of natural pyrite feed was consumed at Lac between 1967 and 1992.

Discussions with ALBBACER personnel and field trips arranged to mines and beneficiation plants mainly centered around mines which traditionally supplied the Lac metallurgical complex and SSP factory. The mines and beneficiation plants supplying both the now separated metallurgical complex and SSP factory are being utilized at low capacity due to lack of demand from the Lac facilities. Total ALBBACER copper capacity was said to be 15,000-16,000 mtpy, and the production figure for 1993 was estimated at about 7,000 mt. Mines that supply the other two ALBBACER smelting units at Kukës and Rubik were not visited and discussions of these facilities were limited. These facilities were

discussed only when direct questions about them were asked and in these cases, figures on ore reserves, etc. were unavailable.

At no time were exploration geologists made available to discuss other possible resources of pyrite. ALBBACER personnel simply indicated that all resources of pyrite had been identified. It is suggested that the main interest of ALBBACER is copper production and the utilization of pyrite concentrates produced as a byproduct of copper ore beneficiation.

Considerable disagreements concerning reserves of pyrite were noted between ALBBACER reserve figures and reserve estimates obtained from the Mineral Processing Research Institute in Tirana. These discrepancies are noted in the text. For the purposes of this report, ALBBACER reserve figures are utilized. A comprehensive review of all Albanian pyrite/pyrite concentrate resources would require an extensive review of exploration data, mine maps and plans, and the input and cooperation of a significant workforce of Albanian nationals. Such a study might take several months.

Information was also difficult to obtain concerning phosphate production in the Gjirokastra area. The mines near Gjirokastra have been closed for 3 to 4 years. Information was obtained through the Geologic Enterprise of Gjirokastra, the Mineral Processing Research Institute (Tirana), and the Institute of Geologic Research (Tirana). Although the Geologic Enterprise of Gjirokastra had discovered and explored the phosphate deposits of the area, they were not involved in mining the deposits. All personnel associated with mining had left the area and were unavailable. The geologists associated with the Geologic Enterprise were very helpful but had not been directly involved in mining. Information derived from the Institute of Geologic Research was largely academic in nature and was mainly concerned with the hypothetical conditions of formation of the deposits and mineralogical aspects. Information obtained from the Mineral Processing Research Institute was mainly the results of 27 years of research concerning possible ways of beneficiating the phosphate ores and production of useful byproducts.

Sulfur Resources

The sulfur resources of Albania are mainly associated with iron sulfide (pyrite) and copper sulfide bearing ore bodies located in the mountainous northeastern area of Albania. Pyrite is produced directly from several mines and shipped without treatment to the Lac SSP plant. Pyrite concentrates are a byproduct of copper sulfide beneficiation plants.

Other sulfur sources in Albania include offgases from copper smelters located at Rubik, Kukës, and Lac; the Lac metallurgical complex supplied Lac Sulfuric Acid Plant No. 2 with offgases intermittently for over 10 years. Sulfur may also be produced as a byproduct of petroleum refining and natural gas production in Albania. The analysis of potential offgas production and potential production from hydrocarbons was beyond the scope of this aspect of the study.

Pyrite resources are located in the Mirdita and Puka Districts. Concentrated pyrite concentrates can be produced at beneficiation plants in the Mirdita, Puka, and Shkodër Districts.

Mirdita District

Spac Mine

The Spac Mine is located in the Mirdita District northeast of Lac. The Spac Mine was established in 1965. Prior to the establishment of the Lac complex, copper concentrates from the Spac Mine and Reps beneficiation plant were smelted at the Rubic smelter. Production from Spac and the Reps beneficiation plant was eventually designed to provide feed for the Lac complex. Total distance to Lac from the Spac Mine is about 66 km. The road is paved to the Reps beneficiation plant; the last 10 km section of the road to the Spac Mine is not paved. The last 10 km of the road is also very tortuous, developed on steep slopes and shear cliff faces.

Facilities at the mine include a hotel, mine offices, and the remains of a prison camp that formerly housed up to 1,000 prisoners. Housing and working conditions at the mine are very primitive by western standards, and most of the workers live in the village near the

Reps beneficiation plant which has over 2,000 inhabitants. About 600 workers are currently employed in the mine. There are approximately 400 mine workers, 170 beneficiation plant workers, and 30 administrative personnel.

The Spac Mine is developed in a steeply dipping ore zone (70°) that contains elongate pod-like ore bodies. The upper zone contains pyrite bodies, and the lower ore bodies are worked for copper sulfides (chalcocite). At Spac these ore bodies are distinct, and separate mines were developed to work each type of ore body.

The pyrite deposit is mainly contained within one ore body. The pyrite body is about 9-10 m thick at maximum perpendicular to strike, about 60 m wide, and appears to extend about 60-80 m below the current mine workings. The mine manager and his senior staff had no knowledge of the geology of the deposit; they indicated that all the ore bodies in the area had been delineated by geologists and the geologists' work was done in this area.

The current main mine accessway and haulage is an adit driven horizontally into the hillside at about the 360-m level. The accessway is about 700 m long and is lined with precast concrete pillars and beams for approximately the first 100 m. There are several abandoned main mine accessways up the hillside which appear to be developed on about 30-40 m intervals. The internal mine workings were not physically inspected, and the following description was obtained through discussions with Spac mining engineers.

Four sublevels at and above the current accessway are being mined and/or developed. At Spac the sublevel vertical spacing is 7 m. Mining is by room and pillar development and sublevel sloping. In the lowest development level 3 x 3 m drifts are driven horizontally at right angles to the width and length of the ore body. In the level above, 3 x 3 m drifts are driven at right angles to the main tunnel transversing the long horizontal axis of the ore body leaving 5 m wide pillars. The upper level is developed similar to the middle level with the 3 x 3 m horizontal drifts offset over the 5 m wide pillars below and pillars remaining from the workings above. Vertical shafts are driven into the roof at the end of the horizontal sublevel drifts. The roof ore and remaining 5 m wide ore pillars above the highest working level are then drilled and blasted retreating away from the edges of the ore body and back to the main horizontal sublevel accessway. Vertical sublevel accessways and ore rilling shafts to the sublevels below and main level accessway are developed in the country rock in the hanging wall.

There is no mechanization at the pyrite mine at Spac other than the pneumatic hammers that are used for drilling blasting holes. One main air line enters the mine at the main adit. Dynamite is used for blasting. Workers walk into the mine and access to sublevels is by ladder. It was indicated that the portals at the end of the upper level drifts where the remaining sublevel roof ore and upper pillars are drilled and blasted were very well supported to protect the workers breaking and removing ore. Blasted ore is broken up with sledge hammers and loaded into 1-mt hand cars (on rails) in sublevels and at main level ore rilling stations. Light is provided by handheld carbide lamps. No provisions for adequate mine ventilation were noticed.

The worked out area above the sublevels is allowed to cave naturally. Spac mining engineers indicated about 95% of the ore body was effectively mined by this method. The dilution factor (contamination with country rock) was said to be about 10%.

Ore is transferred from the main mine accessway to the remains of a loading station. It appears the loading station may have been used to directly load trucks via ore chutes at one time. It may have been covered and ore was apparently brought to it from the presently abandoned mine entrances above the present mine entrance. Loading may have been mechanized at one time. At the present time the mine is approximately on the same level as the top of the ore chute bins. Ore cars are simply dumped by hand over the retaining wall housing the chutes to the roadway below. Trucks are loaded using a front-end loader.

The capacity of the mine was given as 40,000 mt of pyrite per year by ALBBACER officials. All the production is relegated to the Lac SSP plant and they have not required any pyrite since April 1993. At the present time about 20 mt of pyrite is mined per day. Approximately 3,000 mt of pyrite is stockpiled at the loading station. The director of the mine indicated the mine could produce 80-100 tpd. Assuming a 365-day working year this translates to 29,200-36,500 mtpy.

Spac mining engineers displayed working mine maps for the various sublevels and also vertical cross sections on 10- or 15-m intervals. Variations in ore body geometry undetected by drilling are compensated for during mining, and sublevel developments are superimposed upon one another. It appears the Spac mining engineers are very well aware of their reserve situation. The limits of the ore bodies are well known. The pyrite and copper ores are very distinctively dark gray or black and are readily distinguishable from country rock.

Pyrite is directly transported to the Lac complex. The mine used to provide transport but the Lac factory obtained three Iveco trucks in 1993. The Iveco trucks are 25-mt capacity but cannot be loaded to more than 20 mt due to load limitations on bridges along the haulage route. The selling price was quoted as about $22.00/mt to Lac with Lac providing transportation. Up to January of this year the selling price was quoted as about $26.00/mt including delivery.

Ore from the copper mine at Spac is processed in the Reps beneficiation plant. The copper ore from Spac (1.2%-1.8% Cu, 4%-5% S) is not suitable for byproduct recovery due to the low sulfur content. Copper ore mining at Spac is currently being mechanized. Five small load-haul-dump (LHD) units were recently obtained.

Total resources of in-situ pyrite at Spac were given by ALBBACER personnel as 120,000 mt with a 40% S product grade (Table 2). At 95% mining recovery this calculates to 114,000 mt of recoverable reserves. A report obtained from the Mineral Processing Research Institute indicates there are 300,000 mt of exploitable pyrite reserves at Spac (>40% S). The data sources and criteria used to develop this estimate were not explained.

Gurth Mine

The Gurth Mine is located 5-6 km up the valley from the Spac Mine. The Gurth Mine entrance is visible from the Spac Mine entrance. The Gurth Mine is not being worked at the present time. Approximately 20,000 mt of pyrite reserves at 36% S has been identified at Gurth by ALBBACER (Table 1). Approximately 190,000 mt of copper ore at 20%-30% S (average 25% S) and 1.2%-1.8% Cu is available at Gurth (Table 3).

Detailed mine plans for the Gurth Mine were not presented. Spac mining engineers indicated the Gurth ore body was similar to Spac and the mining methods were the same. There is only one mine entrance at Gurth and apparently the pyrite must be worked simultaneously with the copper ore. Pyrite concentrates were produced from the Gurth Mine for export to Viet Nam.

Thirre Mine

The Thirre Mine also provides feed for the Reps beneficiation plant. The mine is currently closed. The ore is only suitable for copper production.

Rrenjoll Mine

The Rrenjoll Mine was not visited. The mine has not been worked for 10 years. There is no equipment at the mine. ALBBACER personnel indicated the road to the mine was very rough, might be impassable, and there was basically nothing to see. A figure of 50,000 mt of pyrite reserves at 35% S was quoted (Table 2). It was said the mine could be reactivated and produced at a rate of 5,000-10,000 mtpy.

Reps Beneficiation Plant

The Reps Beneficiation Plant processes ore from the Spac, Gurth, and Thirre Mines. The Reps beneficiation plant was established in 1970. The equipment of one beneficiation section is of Chinese manufacture and the process is based on Chinese-provided technology. The other section of beneficiation equipment was duplicated in Albania. Copper ore is dumped in a stockpile area above the beneficiation plant. A jaw crusher reduces the ore to 50-60 mm lumps maximum and a cone crusher further reduces the ore to minus 13-15 mm minimum. The ore is screened and oversize is returned to the cone crusher.

The ore is slurried and fed into a large ball mill. Hydrated burnt lime is introduced in the ball mill at approximately 16 kg/mt. The burnt lime raises the pH of the system to about 12. Ball mill discharge is fed to a large spiral classifier. Dewatered oversize ball mill discharge is returned to the ball mill system (plus 74 microns). Underflow is fed to the flotation cells. This system is designed to provide flotation feed at approximately 55%-60% minus 74 microns (200-mesh). There are four large ball mill systems in the Reps plant and a fifth which, at maximum production, was designed to grind oversize.

The ore is conditioned with a xanthate collector (average 80 g/mt total) and pine oil (50 g/mt total) in a small conditioning tank at the end of each flotation cell bank. Solids contents in the flotation tanks were said to be 20%-25%.

The flotation scheme is rather complicated employing a bank of rougher cells, two banks of scavenger cells, and two cleaner stages. A portion of the total collector and frother dosage is added in the scavenger banks. Mineralized froth is removed by paddle skimmers.

Only the copper sulfide ore from Gurth is processed for byproduct pyrite at Reps. In order to float the pyrite the pH must be dropped to approximately 5.0-5.5. About 18 kg of sulfuric acid per mt of raw ore is used to drop the pH. Significant amounts of xanthate (200-240 g/mt) and pine oil (≈90 g/mt) must be used to recondition the pyrite flotation feed. Flotation for pyrite is carried out in a separate section of the flotation plant at Reps. The cells used for pyrite flotation are badly damaged due to the corrosive effects of sulfuric acid.

The copper sulfide and pyrite flotation products are both dewatered on large drum filters (2) and fed into ground level concrete lined storage bins of 200-300 mt capacity. The concentrates contain 10%-12% moisture. Trucks are loaded with clam shell buckets on overhead cranes. There are about 30 trucks of various makes and vintages at Spac for ore and concentrate haulage.

The xanthate collector ($1,500/mt) and pine oil frother ($1,200/mt) are currently obtained from Germany. The hydrated burnt lime is produced in Albania, and sulfuric acid was obtained from Lac.

Approximately 1 mt of concentrated pyrite is produced from each 4 mt of Gurth copper sulfide ore at Reps. About 10,000 mt of concentrate (40%-45% S) is stockpiled at Reps. The Director of the Reps beneficiation plant indicated the pyrite concentrate production cost was about $10.00/mt and concentrates would be sold to the Lac plant for approximately $22.00/mt. The copper sulfide concentrate (16% Cu) is sold to the Lac metallurgical plant for about $210.00/mt.

The pyrite concentrate produced from Gurth ore is relatively fine. Granulametric analyses indicate the pyrite concentrate is 65%-80% minus 74 microns and 20%-30% plus 74 microns.

Pyrite concentrates can be produced from lower grade ores (4%-6% S). However, research indicates 17 mt of copper ore (6% S) is required to produce 1 mt of pyrite concentrates at 35%-40% S.

Using 95% mining recovery and a yield of 1 mt of pyrite concentrate per 4 mt of raw copper ore, 47,500 mt of pyrite concentrates is available from the Gurth Mine (Table 3).

Other Beneficiation Plants and Mines in the Mirdita and Shkodër Districts

The Rrëshen beneficiation plant is located in the Mirdita District about 30 km from Lac and supplies the Rubik smelter with concentrates. Ore is obtained from the Rubik and Derven Mines. The Rubik Mine is located about 10 km from the Rrëshen plant. The copper ore from the Rrëshen Mine contains 15%-25% S (Table 3). The copper ore from the Rubik and Derven Mines is transported to the Rrëshen plant by trucks.

The Kurbnesh beneficiation plant is located in the Mirdita District about 70 km from Lac. The Perlati Mine is located about 19 km from the Kurbnesh beneficiation plant. Perlati ore is transported to the Kurbnesh beneficiation plant by trucks. The Kurbnesh Mine also feeds the Kurbnesh beneficiation plant but the S content (4%-6%) is too low for pyrite concentrate production.

The Mjeda beneficiation plant is located in Shkodër District. The Karma Mine is located about 30 km from the beneficiation plant and ore haulage is by truck. The Karma deposit reportedly contains 1.4%-2.0% Cu and 20%-30% S (Table 3).

ALBBACER personnel indicated the combined potential annual pyrite concentrate production rate of the Rrëshen, Kurbnesh, and Mjeda beneficiation plants is 15,000 mtpy at 40%-45% S. However, a report prepared by the Mineral Processing Research Institute does not indicate the Kurbnesh beneficiation plant can produce pyrite concentrates. This report also indicates substantial amounts of direct shipping pyrite ores may be available from the Perlati deposit. Details of the reserve situations at the mines supplying the Rrëshen, Kurbnesh, and Mjeda beneficiation plants were not presented by ALBBACER personnel.

Puka District

There are eight mines in the Puka District which feed the Fushe Aires beneficiation plant:

Mine	Cu Content	S Content	Reserves (mt)
Lak Roshi	2.0-2.5	10-20	450,000
Paluce	0.8-1.1	10-15 (average = 10)	800,000
Tuc	0.8	4-6	400,000
Keira	0.7	4-6	50,000
Qafe Bari	1.4-1.6	15-20	300,000
Rruga Rinije	0.7	10-15	150,000
Munella	0.6-0.7 1.2-1.4	20-28 20-28	2,000,000 6,000,000
Porave	1.1-1.5	10-15	100,000

The Porave, Rruga Rinije, and Keira Mines are considered not profitable at this time and are shut down. The Munella Mine is shut down pending further studies by a German organization.

Qafe Bari Mine

The Qafe Bari Mine is developed on an elongated flattened pod-like ore body that dips at approximately 30%. The mine was established in 1977. Pyrite is concentrated in the northeastern uppermost levels of the ore body at the juncture with the foot wall. There is an estimated 50,000 mt of pyrite in situ (Table 2) and the pyrite product ranges from 35% to 37% S. The ore body is developed on the contact of a diabase intrusion (foot wall) with chloritized country rock.

The pyrite and copper ores are mined using the same methods used at Spac. Main level entries are developed every 40 m. Sublevels are developed every 6 m. The ore body is 20-65 m thick perpendicular to strike, 200 m wide, and extends from 845 m to 720 m above sea level. All mine developments (sublevels, ore passes, etc.) are in the hanging wall.

The mine is electrified and a small Chinese-manufactured electric locomotive is used to move ore trains on the 1,400 m long main entry level. They have another locomotive in storage for a spare. Hand cars are used on the sublevels. The mining engineers indicated that miners used electric jack hammers to break large ore lumps.

The 1-mt ore cars are brought to the ore dumping yard area by the electric locomotive. Hand labor is used to move individual ore cars and dump the cars using a cylindrical cage into an inclined covered storage area. A cable slusher is used to load ore to ore chutes and into trucks. There are three separate ore bins and slusher systems. Water inflow can be a problem at Qafe Bari. Some ore cars contained dry copper ore while in others the ore was very wet (to the point of plastic flow).

At the present time the pyrite-bearing portion of the Qafe Bari Mine is being preserved. The pyrite cannot be effectively mined without copper ore production. A small amount of pyrite was produced this year but there was no market. Approximately 1,300 mt of pyrite is stored at Qafe Bari. If copper ore production at the mine is increased and the copper ore contained in the northeastern portion of the ore body is mined, the mine will progress below the pyrite body and the pyrite reserves will be lost forever.

Ore recovery at Qafe Bari was said to be 93% and the dilution factor is 17%. The water problem in the mine results from infiltration along the broken ore zone and becomes significant when the uppermost pillars remaining in broken country rock are produced.

Pyrite is directly trucked to Spac, about 114 km. Copper ore is trucked 20 km to the beneficiation plant at Fushe Aires along the same road. There is one shift of about 120 miners currently working at the mine. Trucks of 8 mt (Czech manufacture, 16 units), 13 mt (Russian, 6 units), and 20 mt (Italian, 2 units) are used to move ore to the beneficiation plant and transport pyrite and copper ore concentrates to Lac. Four trips to the mine for transport of copper ore are possible during each shift.

Other Mines in the Fushe Aires Area

The Fushe Aires beneficiation plant has received feed from up to eight copper mines (including Qafe Bari). Four of these mines are currently closed. Five of the eight mines produce ore that contains 10% or less sulfur, and these mines are considered not suitable for pyrite concentrate production. The Lak Roshi Mine is currently producing copper ore, could produce pyrite concentrates, and contains 450,000 mt of copper ore reserves (Table 3).

The Munella Mine is the largest copper resource in the area. The mine is approximately 35 km from Fushe Aires. It is divided into two reserves. The low-grade copper reserves contain 0.6%-0.7% copper and are about 2 million mt. The high-grade reserves (1.2%-1.4% Cu) are 6 million mt and average about 28% S (Table 3) and could be utilized to produce pyrite concentrates. Munella Mine is currently shut down pending investigations by foreign investors (German). No further information was available concerning these potential investors.

A report by the Mineral Processing Research Institute indicates there are direct shipping grade pyrite ores at Munella (>40% S). A combined figure for Munella and the Perlati Mines (Mirdita District) was given by the Mineral Processing Research Institute as 3.5 million mt of natural pyrite. No breakdown for the two mines was given and the figure was quoted as a rough calculation. No information was given concerning the geometry of these pyrite ore bodies or if pyrite mining must be integrated with copper ore production.

Qafe Bari mining engineers indicated all the mines in the area mined similar ore bodies and were mined by similar methods. The dips of the ore bodies are up to 90°. The Munella deposit ore body dips at about 40°. Where the ore is more competent, sublevel development may be on as much as 10 m intervals.

Fushe Aires Beneficiation Plant

There are two beneficiation sections at Fushe Aires. One contains Chinese equipment and the equipment in the other section was duplicated within Albania from the Chinese equipment. The beneficiation scheme is the same as the Reps beneficiation plant. One of the beneficiation sections (Albanian manufacture) is used to treat ores from several mines that have smaller liberation sizes. The grind in this plant is approximately 90% minus 74 microns, and two of the large ball mills are used in a series.

Depending on the ore, reagent requirements are different. For first stage flotation (Cu sulfides) Qafe Bari ore requires 120 g/mt xanthate collector, 80 g/mt pine oil, and 18 kg/mt hydrated burnt lime. Similar to Reps, first stage flotation tails are pumped to the pyrite flotation section of the plant where the ore is reconditioned and the pH of the flotation cells is adjusted to about 5.5 using sulfuric acid. Qafe Bari engineers indicated they had lined the flotation cells in the pyrite section with plastic sheeting and wood to reduce corrosion.

General Comments on Flotation Plants

The two flotation plants visited are over 20 years old. These plants are suffering the effects of corrosion, erosion, and lack of maintenance. Entire banks of flotation cells have been robbed for parts. Where two to six V belts are required on pieces of equipment, usually there is only one belt.

Albanian duplicates of Chinese parts or entire pieces of processing equipment are apparently a problem. Complaints include quality of castings, bearings, and seals. Albanian-produced equipment is said to require significantly more maintenance, and catastrophic failures occur frequently.

Recovery of copper sulfides at the existing beneficiation plants is said to usually be on the order of 85%-90% from the raw ore. Pyrite recovery is about 50% or less.

There is an overall lack of control instrumentation. Control is mainly by visual estimates, operator experience, and manual adjustments of flow streams. Reagent addition may be measured by timing flows or through the use of primitive floatmeters. However, solids content in the flotation cells is basically controlled visually, and water and flotation feed flow rates may fluctuate substantially.

In the best case, handheld pH meters may be used to measure flotation cell pH. At times it was said litmus paper is dipped into the cells. In any case pH adjustments are then made by adjusting unregulated hand valves.

Beneficiation engineers at the Mineral Processing Research Institute, Tirana, have indicated they have developed a new processing scheme for sulfide ores. In this scheme copper sulfides and pyrite are floated in the first stage using xanthates and pine oil, or other

collectors and frothers, at a pH of 7.0-7.5. In the second stage of flotation the pH is raised to 12.0 and the copper sulfides are floated and pyrite is the underflow product. Copper sulfide recovery is said to be the same as current practice. Pyrite recovery is increased to up to 90%. The process requires less material handling and lower requirements of reagents and pH modifiers. This scheme has never been implemented in any of the ALBBACER beneficiation plants.

Mineral Processing Research Institute engineers have also suggested modifications of grinding circuits and means of controlling flow rates of raw materials, pH modifiers, and reagents. Most of these recommendations have not been implemented. With the exception of research, the function of the institute appears to have been mainly to provide services in equipment failure situations and when grade of concentrates has fallen off at beneficiation plants.

Complexities of Pyrite and Pyrite Concentrate Production

Production of pyrites and pyrite concentrates is complicated by several factors. Upon exposure to the atmosphere, pyrite-containing ores begin a process of auto-oxidation and deterioration. Pyritic ores, under suitable conditions, can spontaneously ignite. Mining engineers at Spac indicated fires were a problem in the mine.

Upon exposure to the atmosphere under humid conditions, pyrites and copper sulfides begin to oxidize. The reaction products include iron sulfates, copper sulfates, sulfuric acid, and heat. Sulfur-bearing species can be leached from open storage piles. Although the exact breakdown characteristics of Albanian sulfide ores are not known, other pyrite ores have been known to lose up to 9%-10% of their total sulfur content in 4 months under ambient temperature and atmospheric conditions.

Another problem can be the physical breakdown of sulfide-containing particles and formation of fines. Under the surfaces of piles, particles can also agglomerate. Due to the oxidation of mineral surfaces, flotation characteristics can change. If sulfides are stored in large piles, retention of heat becomes significant, and spontaneous combustion problems may increase.

Although this facet of copper ore and pyrite production was never mentioned or discussed with ALBBACER officials, the mining and storage plans appear to account for the characteristics of sulfide production. Ore storage areas at the beneficiation plants are relatively small, and ore is stored in individual piles from dump trucks. If ore is not needed at the smelter and beneficiation plant, production is cut back at the mine. Storage areas after beneficiation are relatively small. Pyrite storage at the Lac Sulfuric Acid Plant No. 1 is about 2,500-3,000 mt. Storage at Acid Plant No. 3 is about 6,000 mt. Both areas are covered. If pyrite is not needed, production is cut back at the mines and/or beneficiation plants.

Due to the storage characteristics of pyrites, it is simply not desirable to develop large buffer stocks of pyrites. Any production problems or lack of demand encountered in the fertilizer plant result in production stoppages at the mine. Similarly, if problems are encountered in mining, feed to the fertilizer plant can be curtailed. The Lac SSP plant can maintain a stock of sulfuric acid in storage tanks.

Pyrite concentrate production is even more intimately linked with copper production. Many of the richest copper-containing ores have the highest sulfur contents. The pyrite concentrate is only worth approximately 10% of the copper concentrate, and an entire separate flotation and dewatering section must be maintained in the beneficiation plant. If there is no market for the pyrite concentrate, the pyrite-containing underflow from copper sulfide flotation is destined for the spoil piles. Copper production cannot be halted due to lack of demand for the pyrite byproduct. Perhaps this factor may account for the lack of information offered regarding certain copper-producing mines feeding the Rrëshen, Kurbnesh, and Mjeda beneficiation plants and associated smelters. These plants may be producing the bulk of the copper in Albania today, and any emphasis put on byproduct pyrite might serve to complicate their ability to produce copper.

ALBBACER personnel indicated about 25,000 mt of pyrite concentrate was stored at various beneficiation plants. Some of this concentrate may have been produced 3-5 years ago. It is suggested that if the No. 3 Sulfuric Acid Plant at Lac can be redesigned to utilize pyrite concentrate, these storage piles should be tested for chemical characteristics and physical deterioration. It might be very wise to utilize newly mined and beneficiated material

for test purposes and utilize old storage stock to supplement fresh material during any eventual production.

Similarly, the stocks of pyrite at Spac (3,000 mt) and Qafe Bari should be sampled and checked for any deterioration prior to use as feedstock for Sulfuric Acid Plant No. 1.

Pyrite and Pyrite Concentrate Reserves

The pyrite reserves of Albania are tabulated in Table 2. The potential pyrite concentrate reserves are tabulated in Table 3.

Based on available information, the pyrite mine at Spac is the most favorable deposit to produce. The S content is about 40% and the pyrite can be produced independent of copper production. The Spac Mine is said to have produced most of the pyrite used at Lac (Table 4). Between the years of 1983 and 1988, the analyses of pyrite dipped below 40% and in 1986 and 1987 went below 37% S. ALBBACER officials indicated that several problem conditions were operative at Spac at this time. They indicated a lower quality pyrite zone was encountered, and perhaps poor mining techniques contributed to a lower quality of ore.

The sulfate analyses during this period may be indicative of another problem. Preceding and during this period sulfate analyses approximately doubled. Although this is impossible to confirm, this condition may be indicative that mined pyrites may have been stored for extended periods of time in the open.

Lac phosphate plant personnel indicated the sulfur content of pyrite feedstocks must be above 33%-34% in order for the fire in the sulfide roaster to be self-sustaining. The resource at Rrenjoll, Gurth, and Qafe Bari range from 35% to 36% sulfur. If poor mining techniques are utilized and/or the ore is allowed to oxidize and be leached under exposed conditions, it is possible the sulfur content could be reduced to or below the critical 33%-34% S level.

The Rrenjoll Mine can be produced without copper production. The section of the Qafe Bari Mine containing pyrites is being preserved. The situation at the Gurth Mine is unknown but it is assumed pyrites are produced in the course of copper mining.

It would be advantageous if the production of pyrites from these mines could be coordinated and blended with production from the Spac Mine or high sulfur analysis pyrite concentrates (>40% S). The Lac personnel indicated they had utilized up to 35% pyrite concentrate in Sulfuric Acid Plant No. 1.

For production purposes it would be advantageous if the pyrite in the Qafe Bari Mine was produced. This would allow copper mining activities in this mine section and indeed the whole mine to proceed according to mine plans. The same situation could be applicable to the Gurth Mine. The mine at Rrenjoll probably would require a major overhaul and this could be implemented at a suitable time in the future.

The total pyrite reserves available in Albania, based on available data, are 226,000 mt at a weighted average for all pyrite bodies of 37.7% S. As previously discussed, more pyrite may be available. The life of these reserves would be determined by their rate of consumption.

The pyrite concentrate reserves of Albania are estimated at greater than 1,491,329 mt between 40% and 45% S (Table 3). This is a low estimate because no reserve figures were available for the Rubik, Derven, Perlati, and Karma Mines. The life of the Albanian pyrite concentrate reserves is not determined by their rate of consumption. The life of these reserves is determined by the rate of mining due to copper production.

The potential capacity for all beneficiation plants to produce pyrite concentrates was indicated as 50,000 mtpy. Due to low copper production, less than half of capacity, many mines are shut down or operating at reduced capacity. If the industry revives, the copper mines may again produce at full capacity. In either case, if there is no demand for pyrite concentrates, the pyrite-containing flotation rejects will be sent to the spoil piles. Production of copper cannot be curtailed by byproduct production of relatively low value pyrite concentrates. At the present time the reduced production from the copper industry is conserving byproduct pyrite concentrates.

Byproduct pyrite concentrates, due to their nature, cannot be simply stockpiled for future use. Also, production costs are incurred during the beneficiation process. There are reportedly 25,000 mt of pyrite concentrates stockpiled at the various beneficiation plants. There never has been a viable market for pyrite concentrates within Albania due to the failure to bring Lac Sulfuric Acid Plant No. 3 into operation. Exports of pyrite concentrates

were apparently halted in 1987. Without a commercial incentive, pyrite concentrates will not be produced.

In the future the production of pyrite and potential production of pyrite concentrates may be dependent on the ability of ALBBACER to continue operations in the rationalizing market economy of Albania. It was beyond the scope of this study to fully analyze ALBBACER. However, it should be pointed out that ALBBACER (1) operates a labyrnthic network of mines and production plants based on relatively small ore bodies utilizing relatively low volume high cost truck transport for haulage between mines, beneficiation plants, and copper smelters, (2) uses relatively primitive mining methods relying on very low cost labor by world standards, (3) operates relatively old beneficiation plants that obviously suffer from maintenance problems and may require major reconstructive investment, and (4) operates in a socioeconomic climate where little or no costs are incurred concerning environmental controls. Changing conditions relative to one or several of these factors may severely affect the economic viability of ALBBACER. It is suggested that many of these factors would deter potential foreign investors or lending institutions from investing in the Albanian copper industry.

It is possible that if ALBBACER fails, mining operations at Spac and Rrenjoll, which are not dependent on copper production, could be reorganized. All other pyrite and pyrite concentrate-producing mines require byproduct copper sulfide production and/or beneficiation.

General Comments on Environmental Conditions Related to Pyrite and Copper Ore Mining, Beneficiation, and Processing

There are apparently no environmental controls on mining, beneficiation, or copper processing in Albania. At this time, waste from mining is deposited as conveniently as possible a short distance from the entrances to the mines. Mine waters are drained directly to the closest ravine. Effluents from beneficiation plants are disposed of similarly. Solid beneficiation wastes (perhaps containing as much as 10%-15% S) are "stacked" below the beneficiation plants on the sides of stream valleys. These stacks become yellow colored as

the pyrite is oxidized. Downstream of all such operations the streams appear to be devoid of all flora and fauna.

Smelting operations vent all gases directly into the atmosphere. It is difficult to judge the effects on the local flora because there is no frame of reference, and apparently the general area of the copper deposits that were examined is relatively sparsely vegetated. Electrolytic copper plants were not inspected. However, it is probably a safe assumption that gaseous emissions, liquid effluents, and spent liquors are not treated before disposal.

Phosphate Resources

The known phosphate resources of Albania are contained in sedimentary phosphorites located in southern Albania in what is termed the Ionian Tectonic Zone. This area is highly structurally deformed, exhibiting large-scale compression features such as anticlines and synclines, and high angle reverse faults and thrust faults. Smaller scale tectonic features are superimposed upon the broad-scale features. Phosphatic beds and phosphorite (>50% apatite) are found in the Late Cretaceous and Middle Jurassic age strata. The most important of these deposits are of late Cretaceous age and are located to the west and northwest of the city of Gjirokastra in the center of a dissected anticline called the Kurveleshi plateau.

Four deposits have been explored and delineated: (1) Nivice, (2) Gusmare, (3) Fushe Bardhe, and (4) Bogaz. The Nivice and Bogaz deposits are low grade, and little information was available concerning them. The Fushe Bardhe deposit was worked by open-pit and underground methods between 1980 and 1990 for direct application phosphate rock. The Gusmare deposit was worked by underground methods during the same period to supply Albanian phosphate rock to the Lac SSP factory.

Fushe Bardhe Deposit

The road to the Fushe Bardhe deposit is located about 15 km north of Gjirokastra. The unpaved road to the mine is not well maintained, is rather torturous in areas, and it is approximately 17-20 km to the main mine workings.

The phosphate bed in the area is up to 5 m thick and averages about 10%-12% P_2O_5. The phosphate bed was worked by both surface and underground methods. The underground methods involved driving adits into exposed phosphatic strata and then driving tunnels at right angles for various lengths within the strata. There was no attempt to develop a room and pillar mine plan. Mining was performed using pneumatic hammers to drill blast holes, and the ore was then dynamited. Broken ore was further reduced in size using sledge hammers, loaded into mine cars by hand and with shovels, and removed from the mine adit using push cars. The underground mine inspected at the Fushe Bardhe site ranged from about 3 x 3 m to 4 x 4 m in cross section. The main adit was about 100 m long, and the one cross tunnel driven at a 90° angle to the mine adit was about 75-80 m long. Nothing remained of the rail sections for the handcars and no handcars were on site.

The open pit at Fushe Bardhe was developed where a small syncline is located concordant with the topography of a stream valley. The mine was worked in three levels of about 8-10 m benches. Up to 10 m of overburden was removed in areas, although generally the overburden was much thinner.

The ore is a thinly laminated phosphatic limestone with chert beds. Microcrystalline phosphate lamella can range from submillimeter size to about 1 cm. Phosphate-rich beds can reach several centimeters in thickness. Individual carbonate and chert-rich beds can be over 10 cm in thickness.

The remains of a Chinese power shovel with an approximately 1 mt to 1½ mt bucket and a small Chinese crawler mounted backhoe were onsite. This equipment does not appear to be salvageable.

The ore was loaded into trucks and transported approximately 60 km to a grinding plant near Memaliaj. The phosphate ore was jaw crushed and dry ground in an air-swept ball mill. The product was ground to approximately minus 0.2 mm. All processing equipment was of Chinese manufacture. The processing plant was not inspected. The ball mill apparently was removed but it was thought the jaw crusher might still be onsite. The ground phosphate rock was then distributed by trucks and rail to various areas in Albania where acid soils are located.

The guaranteed phosphate content of the product was 12% P_2O_5. During the height of production, 30,000-40,000 mtpy was produced and consumed at state-owned collective

farms. Personnel from the Geographical Enterprise of Gjirokastra and the Mineral Processing Research Institute indicated farmers accepted the product but crop response was not apparent until the second and third years after application. It was said that agronomic research conducted in Tirana indicated the ground Fushe Bardhe rock was 75% as effective as SSP. It is not known under what conditions these agronomic tests were conducted or how the data were evaluated and presented.

The Mineral Processing Research Institute in Tirana has conducted extensive beneficiation tests of Fushe Bardhe ore. The chemical and mineralogic characteristics of Fushe Bardhe ore are probably most representative of the bulk of the phosphate rock available in Albania. Beneficiation research included calcination and flotation tests.

A report supplied by the Mineral Processing Research Institute indicated a sample used for flotation tests contained 11.28% P_2O_5 and was sized at minus 1 mm plus 0.1 m. Conditioners, modifiers, and pH adjusters included oleic acid, acidic petroleum derivatives, phosphoric acid, and sulfuric acid. Carbonates were first floated at a pH of 5. The underflow (containing phosphate) was dewatered, reconditioned with oleic acid and acidic petroleum derivatives, and phosphate was floated from silica at pH 7. A phosphate concentrate assaying approximately 20% P_2O_5 was produced at about 57.5% P_2O_5 recovery and about 33% total weight recovery of the original sample. A scavenging circuit produced a concentrate assaying 18% P_2O_5 with about 19.9% P_2O_5 recovery. The calculated P_2O_5 content and P_2O_5 recovery for the combined concentrates are 19.43% P_2O_5 and 77.4%, respectively. The silica content is calculated to be 11.06%.

Calcination experiments were also conducted on Fushe Bardhe ore. A 16% P_2O_5 sample was calcined at 950°C. Steam and/or water was used to quench the concentrate and hydrate the lime that was then removed by air separation methods. A second steam treatment at 4-6 bar is used to disassociate phosphate grains, and dust particles are removed by screening at minus 0.75 mm. This treatment produces a first concentrate with 20% P_2O_5 at 57% overall weight recovery. A second chemical treatment using molasses and centrifuging produced a second concentrate with 30% P_2O_5 and 38% overall weight recovery. The Mineral Processing Research Institute expert indicated about 200 kg of coal (4,500 kcal/kg) was required to process 1 mt of feed to produce the first concentrate by this method.

The first concentrate can also be treated with ammonium chloride from a soda plant in Vlora to remove excess CaO. A 28% P_2O_5 concentrate is produced by this method.

No reserve estimate was offered for additional minable reserves at Fushe Bardhe. Apparently additional drilling is needed to further evaluate reserves in the area.

Gusmare Mine

The Gusmare mine is located on an unpaved road about 25 km from the main road north of Gjirokastra. It is about 65 km from the intersection with the main road to the railhead at Ballsh. It is about 130 km from the railhead to the Lac SSP factory. The mine at Gusmare was not visited. A four-wheel-drive rental vehicle was not available and the Geologic Enterprise at Gjirokastra did not have any vehicles in running condition.

This description of the Gusmare mine is based on discussions with the Geologic Enterprise of Gjirokastra and Mineral Processing Research Institute personnel (Tirana). Some exploration maps were presented upon which mining plans were superimposed. The Albanian experts did not know how accurate these plans were. A separate mining enterprise was established to mine the deposits and the Geologic Enterprise of Gjirokastra was never involved in the mining operation.

The mine was developed on a steeply dipping (45°-50°) bed which strikes roughly N30W at about 1,000 m above sea level. The bed varies from 1 to 6 m in thickness. The thickest portion of the phosphate bed is found near the surface decreasing in thickness with depth. The phosphate bed is terminated at depth by a fault zone (below the 850 m level). There is a major fault zone to the west of the bed that is mined. Beyond this fault zone the same phosphate bed is exposed, dipping at approximately 90°. This phosphate bed is offset (perhaps 20-25 m displacement) by another fault at a depth of less than 20 m. This phosphate bed then continues almost vertically to depth to about the 850-m level where it begins to be folded into a syncline to the east.

Production during the first 1-2 years was based on surface mining. Three levels of underground mining were developed on about a 36-m vertical spacing. The first two levels were connected to the surface by adits in the adjacent hillside. Production from the third level required hoisting the ore to the second level.

Mining was accomplished by drilling with pneumatic hammers and blasting with dynamite. Apparently the mine is one open underhand slope along the length of the mine (250 m). Some pillars were left at ore passes to prevent caving. Ore was broken by hand methods and individual ore "particles" (as seen at the Lac factory phosphate rock storage shed) can be up to 40 cm in maximum dimension. Ore was moved by hand cars and a Chinese manufactured electric locomotive was used to transport ore car trains from the central second level adit. Ore rilled to the third level was transported up approximately 45% inclines in ore cars using electric cable winches. There may have been as many as three main passes to each of the first two levels for access and for moving ore to the surface. Approximately 20-23 miners and 80 laborers and administrative personnel were employed at the Gusmare Mine.

The ore at Gusmare is similar to the ore at Fushe Bardhe composed of microcrystalline phosphate lamilla interlaminated with carbonate and chert. Near the surface the bed, or portions of the bed, can have P_2O_5 contents of 25% or greater. At 30-60 m below the surface the ore begins to range from 20% to 25% P_2O_5. In the area of the mine, the first two levels of mining have essentially removed all ore with 25% or greater P_2O_5. The third level appears to have progressed into mining 20%-25% P_2O_5 material. Approximately 50-60 m below the third development level, the P_2O_5 content ranges from 15% to 20% P_2O_5 and ultimately at depth the P_2O_5 content is about 15% or less.

Reserves at Gusmare > 20% P_2O_5 were quoted at 300,000 mt. Reserves to the north in an adjacent mining block were said to be known as about 200,000 mt at 25% P_2O_5 or greater and an additional 300,000 mt is available at depth at 20%-25% P_2O_5. Approximately 3 million mt of resources at 15%-20% P_2O_5 is available in the area. In the total area from Fushe Bardhe to Gusmare it was said there was > 50 million mt of phosphate ore at 10%-12% P_2O_5.

The Gusmare Mine operated from 1980 to 1990 supplying 15,000-20,000 mtpy to the Lac SSP plant. No production records or product analyses were available. The ore was shipped directly from the mine; no further crushing or grinding was performed. Trucks hauled the ore to the railhead at Ballsh. There were no detailed estimates of production costs available.

The Mineral Processing Research Institute indicated flotation tests on Gusmare ore (about 10% P_2O_5) resulted in a 15% P_2O_5 concentrate. Gusmare ore did not respond to flotation as well as Fushe Bardhe ore.

Data presented by Dr. M. Koci, Institute of Geologic Research, indicate the Gusmare ore has a microgranular texture, and phosphate particles are well intergrown with the predominant cementing/matrix mineral, calcite. Liberation studies down to the minus 0.016 mm plus 0.05 mm size range by both microscopic estimates and heavy media methods indicate that effective liberation did not occur. The phosphate grains and calcite appear to be very well intergrown. Also, in high-grade samples (>30% P_2O_5) the calcite matrix was replaced by secondary microcrystalline apatite.

The Mineral Processing Research Institute also presented a plan where 20% P_2O_5 Gusmare rock is crushed and screened and washed with water. When the phosphate and carbonates particles are wet with water, the phosphate turns a brownish color while the carbonates are distinctively white. Several stages of hand picking produce a concentrate at 27.6% P_2O_5, 40.75% overall weight recovery, and 16.5% P_2O_5 recovery. A second concentrate suitable for direct application at about 18% P_2O_5, 58.8% P_2O_5 recovery, and 46.21% overall weight recovery is also produced.

Development of Phosphate Mining and Beneficiation Facilities

Phosphate rocks such as mined at Gusmare containing approximately 25% P_2O_5 with a high content of carbonates (roughly calculated as 15%-20% $CaCO_3$ excluding possible carbonate in carbonate apatite) are not used for the manufacture of fertilizers in market economy countries anywhere in the world. Rock of this grade would produce a SSP of approximately 14% P_2O_5 analysis. Approximately 15%-20% more sulfuric acid would be required to effectively acidulate the more reactive calcite component and eventually acidulate the apatite component of the ore. For SSP production at Lac, the Gusmare phosphate rock has been mixed with Egyptian rock (≈28% P_2O_5) at a ratio of four parts Egyptian rock to one part Gusmare rock (25% P_2O_5). Low analysis raw materials result in

low analysis products that are difficult to economically produce and transport when compared to high analysis products such as MAP, DAP, and TSP.

Beneficiation

Calcination—Calcination of phosphate rock is usually practiced to remove organic matter and/or relatively minor amounts of carbonates (calcite and dolomite). Calcination and slaking to beneficiate phosphate rock is presently only used in Iraq. The exact details of the Iraqi mining/calcination plant are not known, but apparently very low cost hydrocarbon fuels are involved. The high costs of fuel are a major constant in calcining phosphate rock.

It appears the Fushe Bardhe ore only partially responds to calcination treatment, and higher grade Gusmare ore may also respond to this treatment. A viable flowsheet to industrially process Albanian ores by this method has not been developed. However, the following calculation is offered to indicate the potential costs involved when calcination is employed to process, or partially process, these ores.

Assumptions

1. 200 kg coal (4,500 kcal/kg) per mt of feed is required to reach a calcination temperature of 950°C (indicated by Mineral Processing Research Institute data).
2. Cost of coal (as extrapolated from Lac SSP factory data) = $32.80/mt. This coal would be obtained from a mine near Memaliaj.
3. Fushe Bardhe ore analysis = 16% P_2O_5. This is the analysis of the ore used for the calcination tests.
4. A modified calcination flowsheet is devised that produces a 30% P_2O_5 product at 80% overall recovery. This is not a proven technology.
5. Coal is brought by truck to a calcination plant at the intersection of the road to the main highway (35 km). Rock is brought to the plant from the mine by truck (20 km). The cost of truck transport on the main highway is $0.12/mt/km. The cost is $0.24/mt/km on the mine road.

$$\text{Coal required} = \frac{30\%\ P_2O_5\ \text{product}}{16.0\%\ P_2O_5\ \text{ore} \times 0.80\ P_2O_5\ \text{recovery}} \times 200\ \text{kg/mt ore}$$

$$= 469\ \text{kg/mt product}$$

Cost of coal to processing plant per mt = \$32.80 + (35 km x \$0.12/km/mt) = \$37.00

Cost of coal per mt of product = \$37.00 x 0.469 kg/mt product = \$17.35

Cost of rock to processing plant per mt of product =

$$\frac{30\%\ P_2O_5\ \text{product}}{16.0\%\ P_2O_5\ \text{ore} \times 0.80\ P_2O_5\ \text{recovery}} \times 20\ \text{km} \times \$0.24/\text{km/mt} = \$11.25$$

The cost of coal and phosphate rock per mt of product is therefore estimated as \$28.60. Transport costs to Lac (85 km by truck at \$0.12/km/mt and 130 km by rail from Ballsh at \$0.045/mt/km) are estimated at \$16.05. The cost for coal and transportation of phosphate rock and coal to the processing site per mt of product and transportation of product to Lac is therefore estimated as \$44.65.

This estimate does not include mining costs or the capital investment costs associated with designing and constructing a calcination plant. It also does not consider production costs related to ore preparation or the operation of the calcination plant. At the relatively low requirements for phosphate rock to keep the No. 1 SSP operating at maximum capacity (≈75,000 mtpy), it is conceivable that the cost of phosphate rock produced by this method might approach or exceed double this figure.

Calcination of phosphate rock is used to treat a portion of the production from Nauru Island (South Pacific) (100,000-200,000 mtpy) in large fluid bed calciners. Calcination adds approximately \$40/mt to the cost of rock prepared by this method.

The cost of the Egyptian rock to the Lac SSP plant was quoted as \$22/mt plus \$20 shipping and handling. It is obvious calcination is not a viable option in this situation.

Flotation

Flotation of carbonates to upgrade phosphate ores is practiced on a limited basis throughout the world. Flotation of carbonates is mainly utilized on igneous phosphate ores

where the apatite occurs as discrete grains that can be effectively liberated from a calcite or dolomite matrix. Flotation is used to process carbonate-containing phosphates in Brazil and Finland. Special amphoteric reagents are utilized. Dolomitic ores respond better to flotation treatments.

Flotation of sedimentary ores containing dolomite is used in China. These sedimentary ores are largely of Precambrian age, and the apatite particles are well crystallized. Very fine grinding is required to liberate the phosphate grains from a dolomitic matrix. Phosphate losses are very high in China, reported to be over 50%. Flotation of dolomite has also been attempted in India. A pilot plant was constructed; however, commercial production has not been achieved.

Flotation of calcite and dolomite is being considered in the development of the Al-Jalamid deposit, Saudi Arabia. In this case the phosphate occurs as discrete grains, and the carbonates occur as cement. The phosphate grains are readily liberated from the carbonate matrix. The silica content of the ore is low, and one stage of flotation is utilized to produce a product.

Flotation of carbonates is generally very expensive and practiced under specific socio-technoeconomic conditions. The phosphate industry in Brazil was protected for many years by tariffs on imported fertilizers. At the present time these tariffs have been lifted and many of the mines in Brazil have closed.

The phosphate rock in Finland is very low grade (4%-5% P_2O_5). The ore is mined by relatively low cost, large-scale mechanized open-pit methods. The first stages of beneficiation mainly involve low cost physical separation methods (screening and hydrocycloning) to remove mica from the ore to produce flotation feed. Roughly subequal amounts of carbonates and apatite are separated during flotation. The Finnish company producing the concentrate (Kemira Oy) is highly integrated. The phosphate concentrate is used to produce phosphoric acid-based high-analysis fertilizers. Byproducts include cement, clean gypsum suitable for construction, phlogopite mica, and pigments. The actual cost of phosphate concentrate production has been estimated by various sources as $55 to over $80/mt (38%-40% P_2O_5). The viability of this operation is mainly determined by the downstream production of high-analysis fertilizers and byproducts.

The situation in China is largely determined by the fact that dolomitic phosphate resources are the only indigenous source of phosphate and the fact that China has a centrally planned economy. The costs of production are unknown. The quality of phosphate rock products produced in China is not suitable for world trade. In order to meet the gap between phosphate rock and fertilizer production and needs, China is heavily involved in buying fertilizer on the world market. China has also invested in a phosphate rock mine in Florida.

The other cases where carbonate flotation is used or is being considered have not been proven commercially.

Flotation of Fushe Bardhe ore containing approximately 11% P_2O_5 resulted in a concentrate with 19.43% P_2O_5 at 77.4% overall recovery. The entire chemical analyses were not provided for this product. However, a rough calculation indicates the composition of this concentrate would be 52% apatite, 11% silica, and 37% calcite. Calcination would be required to further remove calcite. The costs of calcination, as previously discussed, are prohibitive. Calcination would also result in increased phosphate losses.

Flotation of higher grade ore using different techniques might result in higher grade concentrate or preconcentrates. However, the highly interlocked microcrystalline nature of the apatite and gangue minerals in Albanian phosphate ores would limit the grade and amount of impurities that could be removed. Tests by the Mineral Processing Research Institute confirm this observation. If a 30% P_2O_5 grade could be achieved, a rough calculation indicates the concentrate would contain 80% apatite, 11% silica (assumed from previous calculations), and 9% calcite. This calcite could be removed by calcination or the cost of acidulating the calcite component would be absorbed by the Lac SSP factory.

No attempt is made here to estimate the cost of developing a flotation beneficiation plant other than it might cost on the order of $10-$15 million or more at the scale needed to produce concentrates sufficient to provide feed to Lac.

Mining

The mining techniques utilized in Albania in underground mining of phosphate rock are not used to any great extent in the modern world. Mining techniques such as these may be employed in mining thin veins of precious metals or metal ores (gold, silver) and/or

gemstones. Limited applications of these techniques applied to phosphate mining may be found in India, where very low cost labor is available and a direct application product is produced. This type of mining may also be practiced in Asian centrally planned economy countries, although these countries are making increased use of mechanized and open-pit methods.

It would be very difficult to economically justify and implement mechanized mining considering the structural conditions (dip = 45°-50°) and relatively thin beds of the Albanian deposits. Furthermore, the overall low grade, mineralogic, and textural characteristics of the ore indicate only the highest grade ore is usable, or has been used, in fertilizer manufacturing. The amount of reserves of this high-grade ore are very limited. There are only 200,000 mt of >25% P_2O_5 rock that has been delineated. Perhaps more is available.

At the 1:4 ratio of Albanian rock to imported rock that has been traditionally used and assuming about 76,000 mt of rock would be used at Lac every year, about 15,000 mtpy would be required and the mine would be in operation slightly over 13 years. To achieve production the mine would have to be evaluated and refurbished.

The costs of mining at Gusmare are not known. Lac SSP plant personnel indicated the cost of Gusmare rock under the previous system was $9/mt plus $3 shipping. Lac SSP plant personnel estimated a revised cost might be $19 without shipping. This cost seemed reasonable to an expert from the Mineral Processing Research Institute. These costs did not include crushing and grinding. Gusmare rock was brought directly to the storage shed at Lac. Uncrushed ore, with fragments up to 30-40 cm in dimension, was mixed with the Egyptian rock with overhead cranes. This appears to have resulted in a very uneven mixing. At minimum, the Gusmare rock should have been jaw crushed before introduction to the storage shed.

Estimations of the Potential Costs of Producing Albanian Phosphate Rock

Table 5 illustrates several scenarios for Albanian phosphate rock production. Scenario I indicates the potential costs of mining assuming no crushing and shipping. All calculations were performed using mining costs of $9/mt and $19/mt as assumed for the Gusmare mine. A detailed mine study would be needed to determine if these costs are realistic. Scenario I does not consider any probable capital investment required to re-establish the mine. The cost of $9/mt was the reported cost to the Lac factory and is assumed to be the mining cost, without profit.

Scenario II indicates the mining, crushing and handling, and transportation costs of directly producing 25% P_2O_5 ore from the Gusmare mine and shipping the ore to Lac. The crushing cost of $3/mt is totally arbitrary and might be a reasonable estimate under Albanian conditions. Shipping costs include $0.24/mt/km for the 25 km from the mine to a crushing plant on the main road. The decision to locate the crushing plant at this site was mainly due to the condition of the road and a lack of data to estimate the cost of improving the road. This road is said to be in very poor condition, and it was considered that commercial truck companies would probably be reluctant to contract for this haulage. Thus, the freight rates for trucks were simply doubled. The mine might have to buy trucks for this purpose. A normal freight rate of $0.12/km/mt was considered for the 60 km to Ballsh and $0.045/km/mt was the assumed freight rate for the 130-km rail haulage to Lac.

Using these assumptions the calculated cost of producing crushed phosphate rock (25%) and delivering the rock to Lac would be $31.05/mt ($9/mt mining cost) or $41.05/mt ($19/mt mining cost). Scenario II does not consider any potential capital investment required to develop a crushing facility or investment to re-establish the mine.

Scenario III considers mining, crushing, and hand sorting of 20% P_2O_5 Gusmare ore to produce a 27.5% P_2O_5 concentrate and shipment of the product to Lac under the conditions of Scenario II. It should be mentioned in this case that it might be more economical to develop the crushing/hand sorting facility directly at the mine site and improve the road to the mine. Mineral Processing Research Institute data indicate 2.5 mt of 20% P_2O_5 ore must be mined to produce 1 mt of 27.5% product. Mining costs are

therefore expressed as per mt of product. No credit is given for offgrade byproducts for direct application.

Under Scenario III the cost of the 27.5% P_2O_5 product would be $53.55/mt at a $9/mt mining cost and $78.55/mt at the $19/mt mining cost. These costs do not include any costs incurred in developing a crushing and hand sorting facility, production costs, and additional potential costs that might be incurred in Scenarios I and II.

Scenario IV lists flotation. Flotation is not considered a technically viable beneficiation alternative without further development and/or calcination.

Scenario V indicates the estimated costs of mining, crushing, calcination, and transportation of a hypothetical 30% P_2O_5 product to Lac. The processing scheme to produce such a product entirely by calcination does not exist at this time.

This estimate does not include any possible additional costs as mentioned in Scenarios I and II and does not include the costs of an ore grinding facility or a calcination plant. The estimate also does not include estimates of production costs. This scenario is included mainly to give an illustration of high costs of beneficiation by calcination.

Mineral Processing Research Institute data indicate 2.3 mt of 16% Fushe Bardhe ore is required to produce 1 mt of 30% P_2O_5 concentrate by a combination of calcination, removal of silica, and extraction of remaining CaO by two methods. It is assumed in these calculations that calcination is the only method used to process the ore. Additional processing after calcination would only increase the costs. Mining costs are therefore expressed as per mt of product. Costs for coal are expressed as per mt of phosphate product. Transport costs to a hypothetical processing plant on the main road are also expressed in terms of per mt of product. Approximately 2.3 mt of ore must be hauled to the processing plant to produce 1 mt of product.

Using all of these assumptions and factors, the cost of a 30% P_2O_5 calcined product produced at a $9/mt mining cost is estimated to be $68.35/mt. At a mining cost of $19/mt, the estimated cost is $91.35/mt.

Tables 6-8 compare the potential costs of producing Albanian phosphate rock under Scenarios II, III, and V (Table 5) to the costs of importing the Egyptian phosphate rock (28% P_2O_5, $42/mt, including shipping) previously utilized at the Lac SSP factory and an unspecified high-grade phosphate rock (32% P_2O_5, $60/mt, including shipping) obtained on

the world market. In each case the competitive cost of each potential Albanian phosphate rock product was calculated based on P_2O_5 content, and a penalty based on the amount of extra sulfuric acid required for acidulation was subtracted from this value. The amount of extra sulfuric acid required was determined by production requirements based on estimates of the grade and potential carbonate contents of the various Albanian phosphate rock products compared to Tunisian rock (30% P_2O_5). Tunisian rock has one of the highest carbonate contents (≈15% $CaCO_3$) of phosphate rocks available on the world market. Comparative calculations utilizing phosphate rocks available on the world market with lower carbonate contents would serve to increase the apparent penalty for extra sulfuric acid consumption. The cost of sulfuric acid was based on production costs from the Lac Sulfuric Acid Plant No. 1. These figures should be considered estimates since the actual extra sulfuric acid requirement would have to be determined by comparative testwork. In these calculations, no penalty is assumed for low-grade products. The crushing and transportation costs for Tables 6-8 are based on the rationale and costs developed in Table 5.

The total breakeven mining and production cost is estimated by subtracting crushing and transportation costs and other known factors such as cost of coal for calcination from the competitive cost of the various potential Albania phosphate rock products. Where appropriate, the total breakeven mining and production cost per mt of product is further reduced according to the amount of ore required to produce 1 mt of phosphate rock concentrate.

The use of the term "total breakeven mining and production cost" indicates no profit is assumed from the mining, processing, and selling of phosphate rock. The total breakeven mining and production cost can be viewed as all the potential costs to be incurred in producing the various Albanian products compared to the Egyptian and high-grade phosphate rocks. In order to be competitive with the Egyptian and high-grade phosphate rock, the following cost factors additively must be at or below the total breakeven mining and production cost for each scenario:

1. Capital costs of developing a mine
    a. Mine site buildings
    b. Mining equipment

c. Loading and haulage vehicles

d. Cost of developmental mining

2. Capital costs of processing equipment and storage

a. Plant site buildings

b. Ore crushing and/or grinding equipment

c. Beneficiation plants

d. Product storage buildings

e. Material handling, equipment, and vehicles

3. Variable costs of mining and processing

a. Consumables (water, electricity, fuel, chemicals, etc.)

b. Labor

4. Fixed and semi-fixed costs of mining and processing

a. Operations, maintenance, and administrative personnel

b. Maintenance materials

c. Overhead (nonpayroll)

d. Fixed capital recovery

e. Taxes

f. Insurance

This is not a detailed list but is only an indication of the depth of analysis needed to make an estimate of what the costs of producing Albanian phosphate rock might be. The performance of a detailed technoeconomic study (prefeasibility study) would require the services of several specialists and a significant amount of time depending on the depth of study required.

A detailed technoeconomic study would also require a market analysis and establish a projection of required production. The production level requirements would determine the sizing of equipment and facilities and costs. A detailed technoeconomic study would also address the reserves available and establish a life for the mine. Various stages of mining or sectors of the mine could be further broken down in terms of the potential costs of mining. The calculations presented in Tables 6-8 do not consider market requirement or reserve factors. In a detailed technoeconomic study these factors would be the prime determining

factors in sizing facilities and equipment, life of the installation, and ultimately the production costs. The type of detailed analysis was far beyond the scope of this study.

Table 6 shows the calculation of the total breakeven mining and production cost under Scenario II that considers mining, crushing, and direct shipment of Gusmare rock (25% P_2O_5) to Lac. The total breakeven mining and production cost calculated in comparison to the Egyptian rock is $6.45/mt. The total breakeven mining and production cost calculated in comparison to the imported high-grade rock is $15.80/mt.

Table 7 shows the calculation of the total breakeven mining and production cost of Scenario III which considers mining, crushing, and hand sorting to produce a 27.5% P_2O_5 product and shipment to Lac from Gusmare. The total breakeven mining and production cost per mt of ore calculated in comparison to Egyptian rock is $2.48/mt. The total breakeven production cost per mt of ore calculated in comparison to the imported high-grade rock is $6.60/mt.

Table 8 shows the calculation of the total breakeven mining and production cost of Scenario V which considers mining, crushing, calcination, and transportation of 30% P_2O_5 concentrate product to Lac from Fushe Bardhe. The total breakeven mining and production cost per mt of product calculated in comparison to Egyptian rock is minus $2.65/mt. The total breakeven production cost per mt of ore calculated in comparison to imported high-grade rock is $3.74/mt.

Summary and Conclusions–
Potential Production of Albanian Phosphate Rock

Without a detailed technoeconomic study evaluating the potential of Albania phosphate rock production, there are two possible ways of judging if production would be profitable. One way is to use the given cost of Gusmare rock (25% P_2O_5) under the old system ($9/mt without shipping) or the proposed cost under the new system ($19/mt without shipping). The other way is to compare known production costs from other phosphate rock-producing operations around the world to potential costs developed for various Albanian phosphate rock products.

Considering the calculations of Table 5, the only apparent economically viable options would be to produce direct shipping 25% P_2O_5 Gusmare phosphate rock ($31/mt at $9 mining cost or $41.05/mt at $19 mining cost) when compared to imported Egyptian rock ($42/mt). However, when considering the competitive cost of Albanian rock based on P_2O_5 content and the cost of increased sulfuric acid consumption (Table 5) ($28.50/mt), even a mining production cost of $9/mt ($31.05/mt cost shipped to Lac) does not appear to be economically viable when compared to Egyptian phosphate rock. With any type of beneficiation (Scenarios III and V), the situation becomes more economically unfavorable.

Phosphate rock production costs vary substantially around the world. The Florida producers are some of the lowest cost producers in the world. Phosphate rock from Florida is produced by large-scale dragline methods (at an overburden/ore ratio of perhaps 1:1), and beneficiated by size separation methods and flotation. For all mines in Florida under 3,000,000-mt capacity (8), the production cost per mt f.o.b. mine in 1992 was $20.86. For mines over 3,000,000-mt capacity (8), the production cost per mt in 1992 was $14.73.

In Togo, open-pit methods are also employed. Overburden is stripped at ratios of 6 or 7 to 1 by large bucket wheel excavators. Ore is mined by bucket wheel excavators and transported about 25-35 km to the coast by conveyor belts and unit trains. The ore is beneficiated by very low cost hydrocycloning techniques, dewatered by centrifuges, and dried. Production costs have been indicated as $9-$10/mt (35%-36% P_2O_5 product) at a production level of about 3,000,000 mtpy.

Underground mining is substantially more expensive than open-pit methods. Underground mining may cost from 1.25 to over 2 times typical open-pit costs. An underground phosphate mine in Mexico currently produces over 200,000 mtpy of 30% P_2O_5 concentrate for approximately $24/mt. The mine utilizes continuous miners, shuttle cars, and a belt conveyor system to move ore to the beneficiation plant. Beneficiation is by size separation methods and one stage of flotation. Drying of the concentrate is not required.

The exact breakdown of the production costs of the Florida, Togo, and Mexico examples is not known. However, a broad statement can be made that the lowest cost producers are generally older mines where original capital recovery costs have been satisfied, mining lands were relatively inexpensive or owned by the government, highly mechanized open-pit methods are used, the mines and beneficiation plants are located with

200 km of a coast, and the mines have a relatively high volume when compared to the potential production needed in Albania (perhaps 75,000 mtpy).

The calculations of Tables 6-8 indicate the only possible economically viable option may be Scenario II involving production of direct shipping Gusmare phosphate rock (25% P_2O_5) at $15.80/mt compared to imported high-grade rock. The limited amount of resources (200,000 mt known) indicates substantial investment in mechanized mining equipment would be difficult to justify. Also, the thin nature of the bed (2-6 m thick) and structural attitude (45°-50° dip) are conditions that would make a low cost mechanized mining plan difficult to develop. Perhaps the best option would be to utilize the methods traditionally used at Gusmare employing low cost labor. A detailed technoeconomic study would be required to fully assess the viability of this option. However, personnel at the Lac SSP plant indicate they do not want to use this rock, even if blended with higher grade imported rock.

The calculations of Table 7 indicate there may be some possibility of producing a hand sorted Gusmare concentrate when compared to high-grade imported rock ($16.51/mt per mt product). However, when considered in terms of potential cost per mt of ore ($6.60/mt) this option does not appear feasible. This potential cost is well below the quoted cost of $9/mt to produce direct shipping rock under the old system. The potential cost per mt product ($16.51/mt) is well below the known cost for a highly mechanized mine producing at a much higher level (Mexico).

Further development and production of Albanian phosphate rock are not suggested due to the following reasons:

1. The beds are relatively thin and the deposits are structurally complex, making underground mechanized mining difficult to implement and potentially very costly.
2. The physical characteristics of the ore, highly intergrown microcrystalline phosphate grains with calcite gangue, are not conducive to developing a viable beneficiation plan. After years of research a simple viable beneficiation flowsheet has never been developed to produce high-grade and quality concentrates. The lack of a viable beneficiation plan is not due to a lack of research, but rather is the result of the characteristics of the phosphate ore.
3. The calculations developed in this report, based on the best available data, indicate that possibly the only way to economically produce Albanian phosphate rock is by

labor intensive methods previously used. The rock produced by this method is low grade (25% P_2O_5), contains significant amounts of carbonates consuming excessive sulfuric acid in SSP manufacture, and would produce a low-grade SSP product. The small amount of reserves available (≈200,000 mt at >25% P_2O_5) would make justifying investment in mechanized mining equipment difficult. The fact that the SSP plant at Lac does not want this low-grade phosphate rock means there is no market.

4. All other scenarios considered do not appear to be technically or economically feasible when considered in terms of previous mining production costs for direct shipping phosphate rock of $9/mt at 25% P_2O_5 ($31/mt cost shipped to Lac) or when compared with typical phosphate rock production costs around the world.

4. Production History

The Lac complex was originally known as the metallurgical and phosphate complex since copper as well as phosphate fertilizer was produced. In 1991, the Government of Albania (GOA) divided the management into a metallurgical complex (copper and No. 2 sulfuric acid) and a phosphate complex (SSP).

In recent years, three of the production units, SA-1, ROP-SSP-1, and SSP granulation, have operated reasonably well in spite of many problems. Details of the production history of all the units at the Lac complex are provided in Appendix C. A summary of the last 5 full years of operation is given below:

Production Unit	Design Capacity	Actual Production, '000 mt				
	('000 mt)	1986	1987	1988	1989	1990
SA-1	40	45.1	52.1	50.3	50.6	45.8
SA-2[a]	45	33.9	28.2	31.0	31.6	22.2
SA-3[b]	60	-	-	-	-	-
SSP-1	110	167.5	174.8	165.0	165.2	141.5
SSP-2[c]	110	-	-	-	-	-
SSP-Gran	60	68.9	60.5	60.9	55.0	42.2
Sodium fluosilicate	-	0.9	0.8	0.6	0.7	0.6

Notes:

a. SA-2 production depends on the availability of SO_2 off-gases from copper smelting. In recent years, there have been severe corrosion problems in SA-2.

b. The SA-3 unit was built in 1987 but has never operated due to design errors.

c. SSP-2 was built in 1988 to use sulfuric acid from SA-3. The unit was operated a total of 5 months in 1988/89 to produce about 80,000 mt of ROP-SSP.

The SSP granulation unit is capable of producing at rates higher than the design rate. However, the actual rate depends on the demand for granular SSP versus demand for ROP-SSP.

The amount of sodium fluosilicate production is a function of the amount of ROP-SSP production and the fluorine content of the phosphate rock.

Over the years, the quality of ROP-SSP produced at Lac has deteriorated with respect to the P_2O_5 content and moisture content. For example, from 1967 to 1990; available P_2O_5 content has decreased from about 18.5% to about 15.5% and moisture content has increased from about 10% to about 12.5%. In addition to a lower P_2O_5 content, the granular SSP produced in recent years also has higher moisture content and poorer size distribution than the granular SSP produced during the early years of operation.

The overall deterioration in quality of the SSP products can be attributed mainly to the use of significant quantities of poor-quality Albanian phosphate rock (about 25% of total) and the failure to maintain the instruments which measure and control the critical process parameters.

Historical data related to the quality of products and the raw materials used are given in Appendix D.

5. Plant Problems

The following discussions of the plant problems at the Lac SSP factory have been separated into three categories; Technical, Mechanical, and Environmental.

Technical

The main technical problems that were identified for the Lac factory are itemized below:

No. 1 Sulfuric Acid Plant–The only major technical problem is the non-operation of the electrostatic dust precipitator. This unit has only operated for 9 months in the 27-year life of the plant and has effectively been used as a dust settling device to remove gas-borne cinders. This in turn has placed an increased dust burden on the remaining gas cleaning equipment in the plant. Whether the failure of this unit is a result of a design problem or lack of expertise on the part of the plant personnel is not clear.

No. 2 Sulfuric Acid Plant–The gases leaving the copper smelting section are at too low a temperature causing condensation and subsequent corrosion of steel equipment up to the gas heating section. This has led to the corrosion of the internals of the baghouse filter unit making the unit inoperable. In principle this plant is designed as a hot gas plant, but in sections the gas temperature falls below the sulfuric acid dewpoint.

No. 3 Sulfuric Acid Plant–The main problem areas in this plant are:

- Waste Heat Boiler–This plant is fitted with a fire tube waste heat boiler that is totally unsuitable for an operation with dust-laden gases. The tubes block and effectively shut down the plant operation after only 4 hours of running time.
- The fluid bed furnace will not effectively handle pyrites at the design moisture content of 10%-12% H_2O, and even when this moisture level is reduced to 5%-6% the furnace will not effectively operate.
- It was reported that the electrostatic mist precipitator operated below design conditions. As the plant did not achieve steady state operating conditions, the below design operation may or may not be a technical problem. It may only be a case of insufficient operational expertise.

- Design acid circulation rates over the absorbing and drying towers could not be achieved.

No. 1 Superphosphate Plant–This plant has three technical problems, namely:

- All fugitive dust collection systems have failed to operate effectively apparently because of incorrect design.
- The method of manually controlling the acid feed to the mixer to match an unmetered flow of ground phosphate rock by observation of the condition of the slurry entering the den is unsatisfactory and leads to inefficient use of costly raw materials. This will assume greater significance when SSP is sold with definite total and available P_2O_5 content and not just as a quantity of SSP.
- The manual dilution of the sulfuric acid at the mixing area from approximately 76% to 68% unnecessarily complicates the control of the sulfuric acid quantity to the mixing operation.

No. 2 Superphosphate Plant–Since this plant is practically a duplicate of the No. 1 plant, the fugitive dust collection systems do not work. Even though the acid flow to the mixer can be measured and controlled by a magnetic flowmeter, this has never been persevered with and mastered, instead the manual acid flow control was used. The ground phosphate rock dust weigher appears to be an unsatisfactory installation and would be of doubtful reliability.

Granulation Plant–The only problem in this plant is the low heat quantity delivered by the coal furnace because of the low calorific value of the local coal.

Mechanical

Inspection of Plant Equipment–From the technical information supplied by the Lac complex personnel, lists were prepared of all equipment by plants and these were used during the detailed inspection of each plant. A typical completed inspection sheet is attached in Appendix E. All other sheets are retained in the IFDC working files.

From a visual inspection of each piece of equipment and discussion with accompanying Lac engineering personnel, the condition was categorized into one of the following:

- Good–Operable, no obvious maintenance requirements.
- Fair–Operable with routine maintenance requirements.
- Poor–May be operable but requiring immediate maintenance.
- Not Operable–Requires repairs before it can be operated.
- Unserviceable–Nonrepairable requires replacement.
- Not Required–In original design but not installed or removed from use.

The results of the equipment inspection are summarized below by plant.

Plant Equipment–Lac Complex

Plant	Number of Items Inspected	Condition (%)					
		Good	Fair	Poor	Not Operable	Unser-viceable	Not Required
No. 1 SSP[a]	133	11	66	9	1	9	4
No. 2 SSP[b]	103	10	80	3	2	0	5
Granulation[c]	68	0	53	13	6	28	0
No. 1 Acid[d]	109	3	61	32	2	2	0
No. 2 Acid	29	0	10	48	21	21	0
No. 3 Acid[e]	96	19	70	5	5	1	0

a. Includes No. 1 Sodium Fluosilicate Plant and No. 1 effluent neutralization.
b. Includes No. 2 Sodium Fluosilicate Plant and No. 2 effluent neutralization.
c. Includes bagging unit.
d. Includes No. 1 acid storage area and No. 1 acid dilution system.
e. Includes No. 3 acid storage area and No. 3 acid dilution system.

During the inspection it was observed that in all plants except the No. 3 Acid Plant and the No. 2 Superphosphate Plant, there was almost a total absence of guards on mechanical drives thus exposing the work force to serious hazards. The electrical switching equipment could not be considered up to modern standards of safety. Maintenance of the plant has been greatly hampered by a lack of spare parts. Almost all parts could not be imported and consequently had to be made in Albania or made or assembled from local castings, etc., at the Lac plant.

The following general comments are made on the condition of unreliable or worn out equipment in each plant.

No. 1 Sulfuric Acid Plant–The following items of equipment need replacing or repairing in this plant:

- **Pyrites Crushing and Drying**–The pyrites vibrating screen and roll crusher both suffer frequent bearing and bearing housing failures. The drying vacuum fan casing and drier shell are corroded and are in need of replacement sections. The two pyrite batch bin weighers are unreliable and consequently of little use in providing accurate material consumption control.
- **Roasting, Waste Heat Recovery, and Dust Removal**–The fluid bed roaster, hot cinder conveying system, waste heat boiler, and associated water treatment facilities are at the end of their life, and replacement equipment from China is onsite. The electrostatic dust precipitator has not effectively operated throughout the plant's life and is due for replacement with the roaster and boiler. Equipment for this unit will also come from China.
- **Mist Precipitators**–These units are not operating efficiently because of some total and partial collapse of the lead tubes on the gas inlet side of the first stage. There is a significant lead creep and subsequent cracking in the lower section of the precipitators. The units are beyond repair and need replacement.
- **Gas Drying System**–Both the drying tower and drying acid pump tank are leaking from the base and because of the design permanent repairs are practically impossible. For extended operation of the plant these units would need replacement.

  To reduce the frequency of strong acid leaks and maintenance costs, the cast iron serpentine cooler should be replaced.
- **Sulfur Trioxide Absorbing System**–The same comments as those for the gas drying system apply in that both the absorbing tower and absorbing acid pump tank would need replacement for extended operation of the plant together with the absorbing acid cast iron coolers.

- **Handrails, Platforms, Etc.**–In many areas of the plant the handrails, stairs, and platforms are corroded and/or damaged and are in an unsafe condition, exposing personnel to unnecessary hazards.
- **Control Room Instrumentation**–The control room instrumentation needs some replacement and upgrading in order to provide facilities to adequately control the plant operation.
- **Sulfuric Acid Storage Tanks**–Although the storage tanks appear to be in fair condition, because of the age of the tanks and temperature of product acid coming from the plant, there would have been some corrosion of the steel from the tank walls and floor.

No. 2 Sulfuric Acid Plant–The following items of equipment in this plant need a major overhaul or complete replacement:

- **Hot Gas Fans**–Five of the six were dismantled at the time of the inspection.
- **Baghouse Filters**–Internals corroded and unit not operating as a filter.
- **Converter System**–There are signs of gas leaks and the insulation is in a dilapidated condition.
- **Strong Acid Tower System**–This system would be hazardous to run in its present condition and must be considered at the end of its life.
- **Mist Eliminators**–The teflon packing has been partially replaced with crushed coal.

No. 3 Sulfuric Acid Plant–The two items of equipment that have caused this plant not to operate other than for short periods (up to 4 hours) are the fluid bed furnace and the waste heat boiler. The furnace needs a design check and possible modification and the boiler needs replacement with a water tube boiler.

Other sections of the plant require immediate attention to prevent costly further deterioration. The following suggestions are made:

- Pyrite bins and furnace table feeder that still contain pyrites should be emptied to reduce corrosion.
- Fluid bed furnace should be emptied of pyrites and cinders.
- Control and switch rooms should be sealed and vacuum cleaned and should be pressurized with filtered air before the plant is run.

- The strong acid pumps need to be removed, stripped, and re-assembled and installed only when required to operate. The acid lines should be blocked off at the pumps.
- The leak in the acid exhaust line should be repaired.
- Painting is required for the steel work and platforms around the strong acid pump tanks and the converter insulation cladding.

As well as the above, before the plant can be restarted it will be necessary to repair the conveyor belts that have been cut and replace all the electrical stop-start buttons and other small items of equipment that have been removed for security reasons.

Since the commissioning runs on this plant only lasted for 4-5 hours, steady state operating conditions were not achieved and therefore there could be other sections of the plant that may require modifications to achieve optimum operating performance.

Because of the construction of the cast iron serpentine cooler, i.e., 1-m lengths of pipe bolted together, there is great potential for acid leaks. If this becomes excessive there would be a good justification to replace these cast iron coolers with plate coolers to save not only maintenance costs but reduce environmental problems and damage to the cooling water system from acid leaks.

No. 1 Superphosphate Plant–

- **Phosphate Rock Handling and Grinding**–The fugitive dust collection systems are unserviceable mechanically and when working were inefficient because of design faults. The water scrubber on the exhaust gases from the ball mill grinding circuit is inefficient.
- **Mixing, Denning, and Fluorine Gas Recovery**–The fluorine scrubbing section items of pumps and fan impellers suffer frequent failure from corrosion. They are apparently made from unsuitable materials for the duty involved.
- **Sodium Fluosilicate Production**–As a result of corrosion, repairs are required to the fluosilicic acid and mother liquor storage tanks and the agitator in one reactor.

- **Effluent Treatment Plant**–The lack of spare parts has led to a run down in operational capabilities of the lime slurry pumps, two are unserviceable, and the third is in need of major maintenance.

No. 2 Superphosphate Plant–As this plant has only been running for a short period of time, the plant is generally in a reasonably good condition. However, some design deficiencies of the No. 1 plant have been carried over to this plant; namely, the fugitive dust collection system and the water scrubber for the exhaust gases from the ball mill grinding circuit.

The short running period has highlighted the deficiencies in the Albanian-produced gearboxes. The units were copied from the original Chinese boxes installed in the No. 1 plant, but poor quality of castings and gear wheel heat treatment has led to premature failure of the boxes. The item of major concern is the ball mill inlet trunnion-bearing casting that is severely cracked.

Superphosphate Granulation Plant–

- **Coal Furnace System**–Parts of the coal feeding system need rebuilding due to corrosion.
- **Hygiene Air System**–The five fugitive dust collection systems do not work because of design faults and mechanical failure of equipment.
- **Exhaust Gas Scrubbing System**–The scrubbing tower is leaking through the base and needs replacing as do the scrubber circulation pumps. The droplet eliminator at the base of the stack and the stack itself both need steel and rubber lining repairs.

Environmental Considerations

The environmental aspects will cover the following areas:

- Working environment for employees.
- Emissions to the atmosphere.
- Discharge of liquid effluents.

The information received from Lac factory on these topics was generally the annual average of measurements taken in the period 1975 to 1985 and in some

instances up to 1992 (information in Appendix F). These data are summarized and presented in the following tables with relevant comments.

Employee Working Environment–

(a) Dust Levels in No. 1 Superphosphate, Granulation, and Sodium Fluosilicate Plants

The results of measurements in this plant are summarized below.

Superphosphate and Granulation Plant--Dust Level Measurements in Plant From 1975 to 1985

Plant Section	Measurement Range	Average	Type of Dust	Allowable Limit
	(mg/m^3)	(mg/m^3)		(mg/m^3)
Phosphate rock crushing	4.5-84.0	48.6	Phosphate rock	15
Phosphate rock grinding, ground floor	76.0-170.0	101.3	Phosphate rock	15
Phosphate rock grinding, first floor	16.5-21.7	18.9	Phosphate rock	15
Phosphate rock grinding, second floor	18.5-53.0	44.0	Phosphate rock	15
Phosphate rock grinding, third floor	34.0-64.5	47.9	Phosphate rock	15
Phosphate rock grinding, fourth floor	29.5-88.0	54.8	Phosphate rock	15
Mixing and denning, first floor	27.0-53.0	38.6	Phosphate rock + SSP	15
Mixing and denning, second floor	22.5-95.0	36.8	Phosphate rock + SSP	15
Sodium fluosilicate plant, first floor	4.0-8.7	5.8	Sodium fluosilicate	1
Sodium fluosilicate plant, second floor	5.1-10.3	7.5	Sodium fluosilicate	1
Granulation plant, first floor	2.4-28.0	20.1	Coal	10
Granulation plant, second floor	17.0-35.0	21.6	SSP	15
Granulation plant, third floor	16.0-40.0	25.0	SSP	15
Granulation plant, fourth floor	14.7-37.3	21.1	SSP	15
Limestone grinding, first floor	14.5-35.5	21.4	Limestone	2
Limestone grinding, second floor	8.5-32.0	18.5	Limestone	2
Limestone grinding, third floor	12.0-50.1	22.9	SSP	15

As can be readily seen, there are no plant areas where the average dust levels are equal to or less than the allowable limit. They exceed in some cases the allowable limit by a factor of 7-10. It should be noted that individual levels rather than averages would be much higher.

(b) Fluorine Levels in No. 1 Superphosphate and Granulation Plants

The results of measurements in this plant are summarized below.

No. 1 Superphosphate and Granulation Plant–Fluorine Level Measurements in Plant From 1975 to 1985

Plant Section	Measurement Range	Average	Allowable Limit
	(mg F/m^3)	(mg F/m^3)	(mg F/m^3)
Phosphate rock crushing	1.5-11.7	2.8	1.0
Mixing and denning, second floor	1.3-5.7	2.0	1.0
Mixing and denning, third floor	1.2-2.3	1.7	1.0
Mixing and denning, control room	0.9-1.3	1.1	1.0
Granulation scrubber	1.1-2.2	1.6	1.0
Granulation drum granulator	0.8-2.9	1.7	1.0
Sodium fluosilicate reactor	0.8-2.3	1.5	1.0
Effluent neutralization, first floor	0.5-1.2	1.0	1.0

Even though the average figures consistently exceed the allowable limit, in-plant emissions of this gas appear to be in reasonable control except for two high readings in 1975 from the phosphate rock crushing and mixing and denning areas. However, some action is needed to reduce these levels to below the allowable limit.

(c) Dust Levels, No. 1 Sulfuric Acid Plant

The results of measurements in this plant are summarized below.

No. 1 Sulfuric Acid Plant–Dust Level Measurements in Plant From 1975 to 1988

Plant Section	Measurement Range	Average	Type of Dust	Allowable Limit
	(mg/m^3)	(mg/m^3)		(mg/m^3)
Pyrites roll crusher	18.4-30.9	25.0	Pyrites	15
Pyrites jaw crusher	7.5-65.7	26.3	Pyrites	15
Pyrites screen	5.6-61.0	26.1	Pyrites	15
Furnace feed bin	11.8-46.7	28.8	Cinders	15
Waste heat boiler	7.2-69.7	38.5	Cinders	15
Cinders conveying system	18.3-71.0	44.0	Cinders	15
Cinders bin	17.0-150.0	66.0	Cinders	15
Electrostatic dust precipitator	22.0-149.4	78.0	Cinders	15

This is another area of operation where the in-plant dust levels far exceed the allowable limit and would make working conditions extremely unpleasant and hazardous.

(d) Sulfur Dioxide Levels, No. 1 Sulfuric Acid Plant

The results of measurements in this plant are summarized below.

No. 1 Sulfuric Acid Plant–Sulfur Dioxide Level Measurement in Plant From 1975 to 1990

Plant Section	Measurement Range	Average
	(mg/m^3)	(mg/m^3)
Pyrites roasting, ground floor Pyrites roasting, first floor	6.1-13.4 11.0-46.8	8.7 22.2
Acid pump room	9.4-37.2	22.9
Weak acid lead coolers	32.0-210.0	112.2
Absorbing tower	13.0-70.0	29.3
Converter area I	7.8-38.4	16.1
Absorbing acid pumps	7.6-39.0	24.7
Heat exchanger area	15.0-67.6	37.5
Converter area II	23.5-100.0	42.0
Acid sump	25.0-80.0	58.4
Mist electrostatic precipitators	25.0-51.0	35.8
Strong acid coolers	52.0-220.0	122.8
Acid storage I Acid storage II	5.2-54.0 7.8-39.6	27.0 23.7
Acid dilution	10.4-39.0	22.1

These in-plant levels are extremely high and when considered against the statement "Concentrations of sulfur dioxide in excess of 27 mg/m^3 are known to be a strong irritant, and the maximum safe concentration for industrial hygiene exposure generally is considered to be half this value...", the plant levels would be intolerable and unsafe.[1] The sulfur dioxide would be coming from leaks in the positive pressure

[1]International Fertilizer Development Center. 1979. *Fertilizer Manual*. IFDC-R-1, p. 320 (also available from the United Nations Industrial Development Organization, Vienna, Austria), Muscle Shoals, Alabama 35660 U.S.A.

relative to atmospheric sections of the plant and being evolved from the weak acid coolers and the strong acid pump tanks.

(e) Asbestos

In many of the plants the gas mains are insulated with a glass fiber type of material and this is covered and held in place by a coating of a cement asbestos mixture. This occurs in No. 1 and No. 2 acid plant and No. 1 and No. 2 phosphate rock grinding mill circuits.

(f) Spent Vanadium Catalyst

Stored in a very unsatisfactory manner in No. 2 acid plant in the base of the baghouse filter building are many mt of spent catalyst and filler media from the two preconverters.

Emissions to the Atmosphere–

(a) Plant Stack Emissions Measurements

The results of measurements from the various plant stacks are summarized below.

Plant Stack Emission Measurements, Lac Complex

	No. 1 Acid Plant		No. 1 SSP Plant		No. 1 Sodium Fluosilicate	Granulation
Year	SO_2, %	SO_3, %	F, g/m^3	Ball Mill Dust, mg/m^3	Dust, mg/m^3	F, g/m^3
1981	0.24	0.0025	0.28	2,610	556	0.65
1982	0.45	0.0044	0.24	2,755	444	0.58
1983	0.24	0.0020	0.23	1,798	-	-
1984	0.18	0.0069	0.25	1,813	165	-
1985	0.20	0.0053	0.30	2,288	671	-
1988	0.21	0.0030	0.17	2,108	470	-
1990	0.19	0.0048	0.18	1,159	221	-
1992	-	0.0091	0.14	-	247	-

Emission levels from No. 1 acid plant and No. 1 SSP plant for sulfur dioxide, sulfur trioxide, and fluorine appear satisfactory. The emissions of dust from the rock grinding mill and the sodium fluosilicate plant are excessive, particularly from the rock grinding section.

There have been no measurements from the granulation plant since 1982, and the figures given for 1981 and 1982 are high and excessive. In considering the plant conditions, current results from this plant could be equal to or greater than those of 1981/82.

(b) Sulfur Dioxide Levels in Lac Township

The results of monthly measurements from 1982-89 are summarized below.

Sulfur Dioxide Level Measurements in Lac Township

Year	Range of Month Measurements	Average	Allowable Limit
		($\mu g/m^3$)	($\mu g/m^3$)
1982	53-262	182	150
1983	76-335	193	
1984	115-334	200	
1985	77-295	188	
1986	96-260	169	
1987	126-214	164	
1988	70-186	140	
1989	96-205	142	

The annual arithmetic average levels are generally greater than the stated allowable limit. They would be considered well in excess of the U.S. EPA proposed national air quality standard limit of an annual arithmetic mean of 80 $\mu g/m^3$.

(c) Nuisance Dusts

While no specific measurements have been made for the windblown dust from the cinders stockpile (some 300,000 mt), this is obviously a problem as some 34 million

leks is being spent in relocating a village downwind from the stockpile.

Liquid Effluent Discharges—The analysis of liquid effluents discharging from the Lac factory are summarized below.

Average Analysis, Liquid Effluent Discharge, 1974-92

Impurity	Units	Range	Average	Nominal Limit
Acid	pH	4.5-6.2	5.5[a]	6.5-8.5
Arsenic	mg/L	0.01-0.95	0.32	0.1
Fluorine	mg/L	32.1-152.0	78.4	15.0
Sulfate	mg/L	223-721	525	500
Chloride	mg/L	175-734	447	500
Suspended solids	mg/L	200-563	369	10

a. Numerical average.

Comparing these results to the nominal limit, they must be considered unsatisfactory except for the Cl' and SO_4'' levels. As the system settling dams are inoperable, their repair and correct operation would no doubt improve these results.

6. Solutions to Problems

Technical

No. 1 Sulfuric Acid Plant–The planned replacement of the hot gas precipitator with the installation of the other Chinese equipment should solve the problem. Some training of key personnel on the unit's correct operation would be desirable. Cost estimates are included in later discussions of the mechanical problems.

No. 2 Sulfuric Acid Plant–The proposal to use oxygen enrichment in the copper smelter operations and replacement of the acid plant with a conventional cold gas plant would effectively solve this plant's problems, both technical and mechanical. Estimates for this work provided by the Director of the Copper Smelter Complex were $10-$15 million.

No. 3 Sulfuric Acid Plant–To overcome the roasting and waste heat boiler problems requires the engagement of a competent engineering firm with pyrites roasting and sulfuric acid experience. Their task should be to redesign the furnace and boiler system, engineer the changes, and commission the plant.

The lack of design flow of strong acid circulating over the drying and absorbing towers can be overcome with installation of new pumps. Estimates for this work are as follows:

Cost Estimates for No. 3 Acid Plant Work to Overcome Technical Problems

Item	Estimated Cost, US $	Remarks
Noncapital Expenses		
Investigation Study, Phase 1	30,000	Est. by Simon Carves
Investigation Study, Phase 2	100,000	Est. by Simon Carves
Cleaning out vessels	2,000	
Cleaning, sealing, and providing pressurized air for control and switch rooms	10,000	
Painting	10,000	
Contingency (20%)	30,000	
Subtotal—Noncapital Expenses	**182,000**	
Capital Expenses		
Replacement boiler	1,500,000	Est. by Simon Carves
Engineering, installation, and commissioning	300,000	
Redesign of pyrites furnace	250,000	
Spare parts (mostly electrical and instruments)	100,000	
New strong acid circulating pumps	40,000	
Contingency (20%)	438,000	
Subtotal—Capital Expenses	**2,628,000**	
Total	**2,810,000**	

No. 1 Superphosphate—Redesign and replacement of the fugitive dust collection systems would greatly improve the in-plant working conditions.

The flows of ground phosphate rock and sulfuric acid to the mixer must be metered and controlled by reliable instrumentation.

The secondary dilution of sulfuric acid from 76% at the mixing area places an unnecessary variable into the correct metering of acid and should be eliminated. The necessary dilution water added, as required, via a metering device to the mixer. Cost estimates for this work are as follows:

Cost Estimates for No. 1 Superphosphate Plant Work to Overcome Technical Problems

Item	Estimated Cost, US $
Fugitive dust collection systems (2)	130,000
Phosphate rock dust weigh feeder	40,000
Sulfuric acid magnetic flow metering system	30,000
Dilution water metering	10,000
Instrumentation to control flows of materials	30,000
Contingency (20%)	56,000
Total	334,000

No. 2 Superphosphate Plant–The same solutions to No. 1 plant apply to the No. 2 plant with the exception that a magnetic flow meter and control valve for acid to the mixer already exist together with some instrumentation. The magnetic flow meter needs relocation from a horizontal section of pipe to a vertical section to ensure correct operation. Cost estimates for this work are as follows:

Cost Estimates for No. 2 Superphosphate Plant Work to Overcome Technical Problems

Item	Estimated Cost, US $
Fugitive dust collection systems (2)	130,000
Phosphate rock dust weigh feeder	40,000
Overhaul acid magnetic flow meter system	10,000
Dilution water metering	10,000
Instrument modifications	20,000
Contingency (20%)	42,000
Total	252,000

Granulation Plant–The replacement of coal with fuel oil in the drying furnace not only will provide the additional quantity of heat required but effectively half the cost of fuel based on the following supplied information:

- Coal–Calorific value 3,500 kcal/kg and cost 6.5 L/kg
- Fuel Oil–Calorific value 9,500 kcal/kg and cost 8.7 L/kg

Cost estimate is as follows:

Cost Estimates for Granulation Plant Work to Overcome Technical Problems

Item	Estimated Cost, US $
Remove coal storage and feeding equipment	5,000
Remove coal burning and ash removal equipment	10,000
Oil burning equipment, oil tank, pump, burner, and control systems	80,000
Installation of oil burning equipment	20,000
Contingency (20%)	23,000
Total	138,000

Mechanical

No. 1 Sulfuric Acid Plant–The suggested solutions to this plant's problems will be covered under two different operating modes: (a) the plant operates for a limited period of time until No. 3 plant is operational and (b) the plant operates for an extended period of time.

- **Limited Operation**–Under this mode only limited repairs would be made to the plant by patching and utilizing some of the equipment from China already onsite, e.g., the hot cinders conveying equipment and furnace table feeder.
- **Long-Term Operation**–This mode of operation requires considerable capital expenditure and involves the replacement of the following items:
  - Pyrites roll crusher
  - Pyrites hygiene dust collection system
  - Fluid bed roaster

- Waste heat boiler and ancillaries including water treatment plant
- Cinders conveying system
- Electrostatic dust precipitator
- Electrostatic mist precipitators
- Drying tower and drying acid pump tank
- Absorbing tower and absorbing acid pump tank
- Strong acid coolers
- Control room instrumentation

As well, it is proposed to install a 1-mW turbo alternator to utilize the energy from the waste heat boiler.

Extensive repairs would be required to:

- Pyrites dryer shell and exhaust fan
- Lead weak acid coolers
- Converter ducting and lagging
- Stairs, handrails, walkways, and machine guards generally throughout the plant
- Replacement of most of the electrical switchgear and plant lighting

Cost estimates are tabulated below:

Cost Estimates to Overcome No. 1 Sulfuric Acid Plant's Mechanical Problems

Item	Estimated Cost, US $
Pyrites roll crusher	75,000
Pyrites hygiene air dust collection system	65,000
Fluid bed roaster[a] Waste heat boiler and ancillaries including water treatment plant[a] Cinders conveying system[a] Electrostatic dust precipitator[a] Turbo-alternator[a]	1,792,000
Electrostatic mist precipitators	250,000
Drying tower and drying acid pump tank[b]	500,000
Absorbing tower and absorbing acid pump tank[b]	500,000
Drying and absorbing acid coolers	150,000
Control room instrumentation[c]	100,000
Repairs to dryer shell	20,000
Repair dryer exhaust fan	5,000
Repairs to lead weak acid coolers	30,000
Repairs to stairs, handrails, walkways, and machine guards	30,000
Repairs and replacement of electrical switchgear	100,000
Contingency (20%)	723,000
Total cost, $'000	4,340,000

a. This equipment is free of cost and estimated costs only relate to installation costs.
b. Assumed tower packing and acid pipework from present towers reused.
c. Includes:
   (1) Strong acid pump tank level indicator/recorders.
   (2) Absorbing tower acid strength indicator/recorder/controller.
   (3) SO_2 inlet and exit indicator/recorders.

No. 2 Sulfuric Acid Plant—Because of the process technology and the very poor condition, it would not be practical nor economical to repair the plant. This is recognized

by the plant management and they have a tentative proposal to replace the plant with a conventional cold gas plant design utilizing the converters from the present plant.

The estimated cost of this reconstruction is $10-$15 million and includes providing oxygen enrichment to the copper smelter. Claimed benefits were:

- A 30% increase in copper output.
- A greater than 30% increase in sulfuric acid output up to 60,000 mtpy.
- An increase in the SO_2 content of gas fed to the acid plant.

No. 3 Sulfuric Acid Plant–To make this plant operational the actions described earlier in section 6 need implementation and to prevent unnecessary deterioration of the plant in the interim, the suggestions listed in section 5 should be carried out. Estimated costs for this work are US $2,810,000.

No. 1 Superphosphate Plant–To improve the working conditions and make the plant more reliable, the following work is necessary:

- **Phosphate Rock Grinding and Handling**–The fugitive dust collection systems need redesigning, and most of the associated equipment, fans, etc., will need replacement. The water scrubber for the exhaust gases from the ball mill circuit should be replaced with a suitably sized baghouse unit. Particular attention needs to be paid during the design exercise in maintaining the air circuit above the dewpoint.
- **Mixing, Denning, and Fluorine Gas Recovery**–The den and mixer exhaust gas fans need the fan impellers replaced in a more suitable material such as an alloy steel resistant to H_2SiF_6 and HF. Likewise, the scrubber liquor circulation pumps need replacing with a pump of internals resistant to the fluorine scrubber liquor.
- **Sodium Fluosilicate Production**–There are signs of leakage at the base of the fluosilicic acid and mother liquor storage tanks. These leaks should be repaired before serious damage occurs to the steel shell.
- **Effluent Treatment Plant**–Acquire sufficient spare parts to enable normal maintenance demands to be met.
- **General**–Throughout the plant almost all guards covering exposed moving equipment are not present or of an unsatisfactory type. All moving equipment must be adequately guarded to protect operating personnel. Estimated costs for the above work in this plant are tabulated below:

Cost Estimates to Overcome No. 1 Superphosphate Plant's Mechanical Problems

Item	Estimated Cost, US $
Baghouse filter ball mill exhaust system	150,000
Exhaust fan impeller (2)	50,000
Scrubber liquor pumps (4)	60,000
Repairs to tanks	20,000
Repairs to lime slurry pumps	20,000
Installation/replacement of machine guarding	50,000
Contingency (20%)	70,000
Total	420,000

No. 2 Superphosphate Plant—As this plant is a virtual copy of the No. 1 plant, the replacement of the fugitive dust collection systems and exhaust gas scrubber for the ball mill circuit required in the No. 1 plant need to be repeated for the No. 2 plant.

There are some 12 Albanian-made gear boxes in this plant that will need replacement because of high rates of wear and failures of castings. Cost estimates for these items are tabulated below:

Cost Estimates to Overcome No. 2 Superphosphate Plant's Mechanical Problems

Item	Estimated Cost, US $
Baghouse filter for ball mill circuit	150,000
Replacement gear boxes (12)	100,000
Contingency (20%)	50,000
Total	300,000

Superphosphate Granulation Plant—If the coal-fired dryer is replaced with a fuel oil system, then there is no need to carry out repairs to the coal-fired system.

Items that do require replacement or repairs are:

- The five fugitive dust collection systems need redesigning and replacing since most of the equipment in the present systems is unserviceable.
- The exhaust gas scrubber and the four (4) scrubber liquor circulation pumps need replacement.
- Steel and rubber lining repairs are required to the droplet catcher at the base of the stack as well as to the stack itself.

Cost estimates for this work are tabulated below:

Cost Estimates to Overcome Granulation Plant's Mechanical Problems

Item	Estimated Cost, US $
Redesign and replacement of five (5) fugitive dust collection systems	323,000
Replacement of exhaust gas scrubber	205,000
Replacement of scrubber liquor circulation pumps (4)	40,000
Repairs to droplet catcher and stack	15,000
Contingency (20%)	117,000
Total	700,000

Spare Parts–The fertilizer plants that have recently been operating have very few spare parts and the following list of requirements was prepared by the Lac factory personnel for these plants.

Value of Additional Spare Parts Required

Plant and Area	High Consumption	Medium Consumption	Low Consumption	Total
	(Estimated Cost, US $)			
No. 1 Sulfuric Acid				
(i) Mechanical	33,740	17,190	605,100	656,030
(ii) Electrical & instrument	8,720	15,230	93,750	117,700
(iii) Acid handling	5,300	17,350	150,000	172,650
Subtotal	47,760	49,770	848,850	946,380
No. 1 SSP + Sodium Fluosilicate				
(i) Mechanical	19,860	24,050	283,800	327,710
(ii) Electrical & instrument	5,700	10,020	54,350	70,070
(iii) Acid handling	3,000	9,500	72,500	85,000
Subtotal	28,560	43,570	410,650	482,780
Granulation & Effluent Treatment				
(i) Mechanical	12,510	31,000	120,000	163,510
(ii) Electrical & instrument	6,300	12,000	63,500	81,800
(iii) Acid handling	2,700	7,500	66,300	76,500
Subtotal	21,510	50,500	249,800	321,810
Total	97,830	143,840	1,509,300	1,750,970

This total of 175,097,000 leks is additional to the following stores of 684,700 leks already held as listed below.

Value of Spare Parts in Store at Lac

Spare Parts	Value
	('000 leks)
No. 1 store–Equipment spares	5,459
No. 4 store–Fabrication stores	745
No. 4 store–Equipment spares	628
No. 5 store–Fabricated for No. 1 AP	15
Total	6,847

No. 3 sulfuric acid plant has no spares for the control room and if this plant is to be operated, an estimated US $100,000 will be required to purchase instrument spares.

As No. 2 SSP plant is virtually a duplicate of No. 1 SSP plant, then any spares for No. 1 could be used as spares for No. 2 plant.

Environmental

- **Employee Working Environment**
  - **Dust Level**—Installation of redesigned fugitive dust collection systems in the pyrites crushing and drying area, phosphate rock grinding and handling areas, and in the granulation plant should produce acceptable working conditions in these sections.

    Dust levels in the roasting and gas cleaning areas of the No. 1 acid plant will not be effectively controlled until the major items of the plant are replaced as proposed for the extended operation of this plant. Short-term improvements can be achieved by utilizing the Chinese replacement equipment for the cinders conveying system which is the major source of dust generation.
  - **Sulfur Dioxide and Fluorine Levels**
    - **Sulfur Dioxide**—To reduce the sulfur dioxide levels in the plant, the following steps will be required:
      - Seal all gas leaks from the gas train.
      - Install a sulfur dioxide stripper on the drying tower acid cross bleed stream to the absorbing tower acid pump tank.
      - Investigate the necessity to install some form of ventilation from the weak acid coolers and sludge settling tanks.
    - **Fluorine Levels**—An investigation is required into the source of fluorine gases causing the excessive in-plant levels and the action necessary to reduce the in-plant level to less than the allowable limit.
  - **Asbestos**—Extreme care will be required when the asbestos-cement coating is disturbed that the workers are not exposed to asbestos fibers. The eventual plan should be to remove this material and replace it with metal cladding.

- **Vanadium Catalyst**–The spent catalyst in No. 2 acid plant baghouse building should be removed and stored in sealed containers until satisfactory disposal can be arranged.

- **Emissions to the Atmosphere**
  - **Phosphate Rock Dust**–If the water scrubber in the exhaust gases from the ball mill is replaced with a baghouse filter, this excessive emission would be eliminated.
  - **Sodium Fluosilicate Dust**–A more efficient baghouse dust collector is required on the exhaust gases from the plant drying circuits to reduce these emissions to below the allowable limit of 1 mg/m^3.
  - **Sulfur Dioxide Levels in Lac Township**–The source of sulfur dioxide in the Lac township would be from a number or all of the following:
    1. Fugitive emission from the copper smelter.
    2. Fugitive emission from No. 1 sulfuric acid plant.
    3. Stack emission from the copper smelter.
    4. Stack emission from No. 1 sulfuric acid plant.
    5. Stack emission from No. 2 sulfuric acid plant (if run).

    If the recommended action to control fugitive sulfur dioxide emissions is implemented, then the SO_2 levels in the Lac township should be reduced. However, if the copper smelter is operated with its sulfur dioxide emitted directly to the atmosphere, this reduction may not occur.
  - **Nuisance Dust From Cinder Stockpile**–While this stockpile is in a static situation attempts should be made to seal the heap with, say, a bituminous compound or lime slurry. This could significantly reduce the amount of windblown material from this stockpile.

- **Discharge of Liquid Effluents**

  Besides the overhaul of the pumps already mentioned in section B.4.d the installation of pH control instrumentation and equipment is required together with repairs to the settling dams to make them operable.

  Cost estimates for this work are tabulated below.

Cost Estimates to Overcome the Effluent Neutralization System's Problems

Item	Estimated Cost, US $
Installation of pH instruments and control system	50,000
Repairs to settling dams	10,000
Contingency (20%)	12,000
Total	72,000

Summary of Expenditures

Tabulated below is a summary of the expenditures required to overcome the plant problems in the technical, mechanical (including spare parts), and environmental areas.

Summary of Expenditures by Plant

	Expenditure, US $			
	Technical	Mechanical[a]	Environmental	Total
No. 1 acid plant	-	5,376,380	[b]	5,376,380
No. 3 acid plant	2,810,000	-	[b]	2,810,000
No. 1 SSP	334,000	902,780	[b]	1,236,780
No. 2 SSP	252,000	300,000	[b]	552,000
Granulation	138,000	1,021,810	[b]	1,159,810
General	-	-	72,000	72,000
Total	3,534,000	7,600,970	72,000	11,206,970
No. 2 acid plant	Total Replacement			15,000,000
Grand Total				26,206,970

a. Includes spare parts.
b. Included in technical and mechanical.

7. Alternative Operating Schemes

As previously discussed, the Lac SSP Factory Complex has the following primary production units.

- Three sulfuric acid units; 2 units operated by the SSP factory, and 1 unit operated by the metallurgical complex.
- Two ROP-SSP units.
- One SSP granulation unit.

The combined installed production capacity is 145,000 mtpy of 100% sulfuric acid, 220,000 mtpy of ROP-SSP of which 60,000 mtpy could be converted to granular SSP.

Projections of the demand for P_2O_5 for the period 1994-99 are given in Section 10, marketing of Lac SSP in the Albanian market.

Assuming that all of the 10,000 mt of P_2O_5 projected to be consumed in Albania in 1994 is supplied as SSP produced at Lac, demand for SSP (18% P_2O_5) in 1994 would be about 55,600 mt. The projected demand in 1999 would be about 71,000 mt, based on a 5% per annum compounded growth rate. Obviously, production of these quantities of SSP would not require operation of all of the units in the Lac complex. Thus, the operating scheme chosen for economic analysis should be the one which would supply the required quantities of SSP product with optimum costs for new investments and at the lowest ex-factory price. The scheme chosen should provide the flexibility to produce more than the projected quantities of SSP in the event that actual demands exceed the projected demands. The following discussion provides the basis for selection of a "best case" possible operating scheme.

Selection of "Best Case" Operating Scheme

The original SSP plant, SSP-1, at Lac began operation in 1966 and was designed to produce 110,000 mtpy of run-of-pile single superphosphate (ROP-SSP). SSP-2 was constructed in 1988 by Albanian engineers and is a duplicate of SSP-1 which was based on technology and equipment imported from China. SSP-2 was operated for 5 months during 1988/89 to prove the plant. Approximately 80,000 mt of ROP-SSP was produced.

Beginning in 1968 and through 1990, the ROP-SSP-1 unit has consistently produced close to or above the design rate of 110,000 mtpy. Annual production tonnages are given in Appendix C. In recent years until the shutdown in 1991 caused by political upheaval in Albania, ROP-SSP-1 produced at rates significantly above the design capacity as shown below:

SSP Production			
Year	ROP-SSP	Granular SSP	Total
	(mt)	(mt)	(mt)
1986	98,560	68,918	167,478
1987	114,241	60,531	174,772
1988	104,113	60,887	165,000
1989	110,152	55,035	165,187
1990	99,342	42,183	141,525

Further, SSP-2 has been proven at a rate exceeding the design capacity. Thus, it can be concluded that either one of the SSP units could alone be capable of supplying Albania's total P_2O_5 requirements for several years into the next century. One unit would have the flexibility to produce up to two times the projected demand in 1999 in the event that actual demand exceeds the projected demand.

The annual requirement of sulfuric acid (100% basis) would be 26,600 mtpy for producing 70,000 mtpy of ROP-SSP. Therefore, operation of only one of the three sulfuric acid (SA) units would provide more than enough sulfuric acid to produce the required 70,000 mtpy of ROP-SSP.

The SA-1 unit is designed to use mined pyrites as a source of sulfur. The unit is 27 years old and is in poor condition due to age, corrosion, and less than adequate maintenance. The plant contains 109 numbered equipment items which were inspected during the plant visits. Of the 109 items, 3 items were rated as good and the remaining

106 items were rated as either fair, poor, not operable, or unserviceable, see Section 5. Prior to 1991, there were plans to renovate SA-1, and about US $2.5 million worth of new equipment was ordered from China. This equipment has been brought into Albania and is paid for. Lac factory engineers estimate that an additional US $1.8 million is needed for erection and installation of the new equipment.

The new Chinese equipment would replace most of the equipment in raw materials handling, pyrites roasting, steam generation, and dry electrostatic precipitation. All of this equipment is located in the front-end section of the unit.

The equipment in the remaining downstream sections is also in poor condition and must be replaced or repaired if the plant is to be successfully operated. Renovation of these remaining downstream sections is estimated to cost in excess of US $2.5 million. Therefore, in addition to the US $2.5 million already spent for the new Chinese equipment, a total additional expenditure of about US $4.3 million is needed to complete renovation of the unit.

In spite of the fact that the Chinese equipment is onsite and already paid for, installation of the equipment and renovation of the remaining plant sections is not recommended since the reserves of the pyrite ore used by the plant as a raw material are about 226,000 mt as seen in Table 2, Section 3, Raw Materials Resources. This amount of pyrite ore is only sufficient for about 5-6 years of operation.

The No. 2 sulfuric acid unit (SA-2) is designed to use off-gases for an adjacent copper smelter as a source of sulfur dioxide (SO_2). The existing SA-2 unit belongs to the copper enterprise and is not operable as discussed in Section 5. The copper enterprise has estimated that a minimum of US $15.0 million would be required to renew SA-2. This would be approximately 80% of the cost of a new replacement unit since all equipment would be replaced with the exception of the two catalytic converters.

The SA-3 unit was new in 1987 and has never been operated (except for six test runs of 4-6 hours' length each). The reason this plant has never operated is thought to be due to serious design errors in the pyrite roaster and associated waste heat boiler. The design capacity is 60,000 mtpy of sulfuric acid (100% H_2SO_4) produced by roasting of fine flotation pyrites (60%-85% minus 74 microns) from beneficiation plants used for upgrading of copper ore. The future availability of the flotation pyrites should greatly exceed the requirements

of SA-3 provided the copper plants resume operation in the future. However, the use of these fine pyrite concentrates has not been technically proven in the existing processing plant nor has the future of the copper plants been determined. Although SA-3 has never operated successfully, the sections downstream of the pyrites roaster and waste heat boiler were designed by Albanians by scaling-up the SA-1 unit design which is well-proven.

Below is a summary of the estimated capital investment needed to modify SA-3 such that the unit can be successfully operated:

Item	Estimated Capital Investment (US $)
New boiler	1,500,000
Redesigning pyrites furnace	250,000
Engineering, installation, and commissioning	300,000
New acid circulation pumps	40,000
Spare parts (mostly electrical and instruments)	100,000
Total	2,190,000

A Best Case Operating Scheme—About $26 million would be required to fully restore all of the operating units at the Lac factory. Since it would not be necessary to operate the entire factory to supply Albania's need for phosphate fertilizer, a possible operating scheme was devised to facilitate analysis of the operation of the Lac factory under the "best case" conditions. In determining the best case operating scheme, the following assumptions were made:

1. The maximum demand for P_2O_5 into the early 2000s would be about 12,800 mt. This is equivalent to about 70,000 mtpy of ROP-SSP (18% P_2O_5).
2. The total future demand in Albania for P_2O_5 would be satisfied by ROP-SSP produced at the Lac factory; imported phosphate such as DAP would not be considered.
3. DAP or other phosphate-based fertilizers would not be imported. However, costs for Lac-produced ROP-SSP would be compared with imported DAP to determine the competitiveness of the Lac product in the Albanian market.

4. The indicated future demand for P_2O_5 in Albania (12,800 mt annually) could be supplied by operation of one SA unit and one SSP unit.

The following is the operating scheme proposed on the basis of the above "best case" assumptions.

1. Operate SA-1 as is, with the exception of providing some spare parts, until SA-3 can be evaluated, modified, and placed into operation. Use the new equipment from China that is already onsite as needed for spare parts for SA-1. As soon as operation of SA-3 is proven, discontinue operation of SA-1.
2. Engage an experienced engineering firm to redesign the SA-3 pyrites roaster furnace and waste heat boiler and engineer, procure equipment, oversee installation and startup of the modified unit.
3. Operate SSP-2 to produce ROP-SSP from imported phosphate rock and sulfuric acid produced in SA-1 and later in SA-3. Use SSP-1 as a source of spares for SSP-2.
4. Ship the ROP-SSP from the plant in bulk for handbagging as necessary by dealers. Do not operate the granulation unit because producing granular SSP adds about US $16/mt to the production cost. Since the average landholding per family is only 1.2 ha, and Albanian farmers have long experience with using ROP-SSP, the additional cost for granular SSP cannot be justified.

8. Production Costs

Raw Materials Supply

The two major inputs for producing SSP are sulfuric acid and phosphate rock and these account for about 81% of the cash production cost of bulk ROP-SSP (Table 10). According to the "best case" operating scheme, sulfur for producing sulfuric acid at the Lac factory could be obtained from the following two sources:

- Natural pyrites.
- Flotation pyrites from beneficiation of copper ore.

Natural Pyrites–Sulfuric Acid No. 1 is designed to use natural pyrites containing 35%-40% sulfur. These pyrites are mined at Spac which is located about 66 km from Lac. The pyrites are transported to the Lac factory by truck at a current delivered price of 3,190 leks/mt or about 8,860 leks/mt of sulfur (S). The remaining natural pyrite reserves at the Spac Mine and three other mines are estimated to be about 240,000 mt which is only sufficient for about 5-6 years' operation of SA-1 at its design capacity.

Flotation Pyrites–Albania mines considerable quantities of copper-bearing ores that are usually beneficiated to increase the concentration of copper. Flotation byproducts from the beneficiation of copper ore can be further processed to yield a high-grade (40%-45% sulfur) pyrite. Sulfuric Acid No. 3 at Lac is designed to use these very fine-sized (60%-80% minus 74 microns) pyrites.

Assuming that copper ore continues to be mined and beneficiated, more than sufficient quantities of flotation pyrites would be available for SA-3. It is reported that a minimum of 1.5 million mt of flotation pyrites may be available. The current price of flotation pyrites delivered to the Lac factory is 2,400 leks/mt or about 5,580 leks/mt S.

Phosphate Rock–A low-grade phosphate rock is available from the Gjirokastra district in southern Albania. However, use of this rock is not recommended considering the condition of the mine, the low grade of the ore, transport cost to Lac, and the additional processing costs in the factory (high usage of additional sulfuric acid and a low P_2O_5 grade SSP product). Thus, the only realistic source of phosphate rock is from import. The current price of a good-quality phosphate rock (32%-33% P_2O_5) imported from North Africa and delivered to the Lac factory is about 5,000 leks/mt (about US $60/mt or US $185/mt P_2O_5).

Production Economics of Lac SSP Factory

At the time of the team's visit to Lac, ROP-SSP from storage was being hand bagged at the factory and shipped to dealers and consumers. There was approximately 19,000 mt of bulk ROP-SSP in storage and about 1,000 mt of bulk granular SSP. These products had been produced using raw materials and intermediates that were on hand at the time the units were shut down in 1991.

As discussed in Section 10, Marketing, the plant is experiencing difficulty in selling these products under the following price policy:

Product	Current Selling Price Ex-Factory (August 1993)	
	Leks/mt Product	Leks/mt P_2O_5
1. ROP-SSP, bagged (15% P_2O_5)	5,000	33,330
2. Granular SSP, bagged (15.8% P_2O_5)	7,700	48,730

As shown below, these prices are considerably lower than the cash cost of producing the products when the costs of the raw materials and intermediates are considered even if all previous capital investments are not considered.

Product	Production Cash Cost Ex-Factory	
	Leks/mt Product	Leks/mt P_2O_5
1. ROP-SSP, bagged (15% P_2O_5)	6,256	41,710
2. Granular SSP, bagged (15.8% P_2O_5)	7,930	50,190

Calculations of the above estimated production costs were based on operation of the plants "as is" with no capital improvements and on outdated (low) costs of raw materials and intermediates. Details of the calculations for producing sulfuric acid, ROP-SSP, and

granular SSP are given in Tables 9, 10, and 11. More realistic production cost estimates for future operation of the factory must include updated higher costs for raw materials and intermediates and the costs of capital investments.

Projected Production Costs

Investment Estimates—Based on the assumption that the Lac factory would operate according to the "best case" operating scheme, estimates were made of preliminary investments required to operate the Lac factory according to this scheme. The total estimated investment is US $3,168,000 as shown in Table 12.

Production Costs for "Best Case" Operating Scheme—Assuming a new investment total of US $3,168,000, annual loan amortization and interest would be US $58,425 million leks assuming loan interest as 10% per year with 20 equal semiannual principal payments over a 10-year period.

Given the low analysis (18% P_2O_5) of the ROP-SSP product and the resulting high distribution cost per mt of P_2O_5 as compared to higher analysis products such as DAP, the ex-factory price from Lac must be as low as possible.

As shown in Table 10, costs of the two major raw materials, phosphate rock and sulfuric acid, account for about 81% of the cash cost of production of bulk ROP-SSP; 37,700 leks/mt P_2O_5. The price of phosphate rock used in the calculations was based on a 4-year-old price for Egyptian rock of 4,250 leks/mt. A more realistic current rock price would be about 6,000 leks/mt. The price increase for rock would add about 1,090 leks/mt to the cost of producing bulk ROP-SSP. Use of this better grade of phosphate rock (32%-33% P_2O_5) would increase the P_2O_5 content of the SSP from 15% to about 18%, and the cash cost of production would then be 37,500 leks/mt P_2O_5. Therefore, the only opportunity of making a meaningful decrease in the production cash cost of ROP-SSP would be to decrease the production cost of sulfuric acid.

Pyrite ore for SA-1 currently costs 3,190 leks/mt and this cost accounts for about 63% of the current cost of producing sulfuric acid (Table 9). The remaining variable costs and the fixed costs are relatively low as compared to international standards for plants of this type. Therefore, decrease in the cost of pyrites is the only means for making a significant decrease in the cost of producing sulfuric acid. The SA-3 plant which would be operated

according to the "best case" operating scheme is designed to use flotation pyrites as a raw material. This material currently costs 2,400 leks/mt. Using this cost for pyrites and 6,000 leks/mt for phosphate rock, projected costs were estimated for sulfuric acid and ROP-SSP produced according to the "best case" operating scheme (see Tables 13 and 14).

A summary of these costs follows:

	Leks/mt
Production Cash Cost for Sulfuric Acid (36,600 mtpy of 100% H_2SO_4)	
Cost of pyrites @ 2,400 leks/mt	2,100.0
Other variable costs	453.8
Fixed costs	1,533.2
Subtotal	**4,087.0**
Production Cash Cost for ROP-SSP (70,000 mtpy)	
Cost of sulfuric acid @ 4,087 leks/mt	1,553.0
Cost of phosphate rock @ 6,000 leks/mt	3,744.0
Other variable costs	102.1
Fixed costs	1,167.0
Subtotal	**6,566.1**
Bags and bagging	600.0
Capital charges (loan and interest payments)	832.0
Margin (5% of production cash cost)	328.3
Less credit for Na_2SiF_6 (sodium fluosilicate)	-450.9
Plant-gate cost for bagged ROP-SSP (18% P_2O_5)	**7,876**
Plant-gate cost for bagged ROP-SSP/mt P_2O_5	**43,753**

Note: Numbers may not add due to rounding.

Lac ROP-SSP Versus Diammonium Phosphate (DAP)—The projected plant-gate price for bagged ROP-SSP (18% P_2O_5) is estimated to be 7,876 leks/mt product which is equivalent to 43,753 leks/mt P_2O_5.

For comparison, the free-on-truck (f.o.t.) cost at Durres Port of imported diammonium phosphate (DAP) in bags after taking a credit for the nitrogen content of 18% is shown below:

	Leks/mt Product (After Nitrogen Credit)[a]	Leks/mt P_2O_5 (After Nitrogen Credit)[a]
Bagged DAP (without import duty)	13,737	29,863
Bagged DAP (with import duty and surtax)[b]	20,057	43,602

a. Credit for the nitrogen content of DAP was calculated based on a plant-gate price of urea of US $130/mt at the Fier Nitrogen Fertilizer Factory as calculated by IFDC and based on natural gas priced at international levels. (Refer to "Technical and Economic Evaluation of the Fier Nitrogen Fertilizer Factory in Albania," July 1993).
b. Import duty is 30% of c.i.f. value. A surtax of 5% on c.i.f. value is levied on products subject to the import duty.

The above cost comparisons do not take into account the additional costs on a delivered P_2O_5 basis associated with transporting SSP versus DAP. For example, assuming a production rate of 70,000 mtpy of ROP-SSP and a transport distance of 100 km, the delivered costs would be as follows:

	Delivered Cost, leks/mt P_2O_5 (After Nitrogen Credit)	
	Truck	Rail
	(12 leks/mt/km)	(4.5 leks/mt/km)
Bagged DAP (no import duty)	31,787	30,615
Bagged DAP (with import duty and surtax)	45,477	44,305
Bagged SSP (ROP)	50,420	46,253

Based on the above comparison, ROP-SSP produced at Lac could not compete with DAP on a nutrient basis, even with the existing 30% import duty and 5% surtax levied on the c.i.f. value. Furthermore, this comparison does not consider the superior quality of the DAP versus SSP, and the better quality of the bags that would be used for imported DAP.

Also, no consideration is given for the shorter distance from Durres as from Lac to high fertilizer use areas such as Lushnja.

The plant-gate price of the bagged ROP-SSP must be less than 6,986 leks/mt (38,810 leks/mt P_2O_5) in order to be competitive with DAP subjected to the import duty and surtax at a transport distance by truck of 100 km. Tables 15 through 17 contain calculations of the estimated cash production costs of ROP-SSP at the Lac factory at annual production rates of 60,000, 70,000, and 80,000 mt with assumed prices of flotation pyrites of 2,400, 1,000, and 0/mt. The results of the calculations are summarized below.

	Plant-Gate Price, ROP-SSP		
	Leks/mt	Leks/mt	Leks/mt
	ROP-SSP Production Rate, mtpy		
	60,000	70,000	80,000
Cost of pyrites: 2,400 leks/mt	8,353	7,876	7,612
1,000 leks/mt	7,866	7,389	7,126
0 leks/mt	7,515	7,038	6,774

If it is assumed that the flotation pyrites are delivered to the plant at no cost, the plant-gate price of ROP-SSP would still be 7,038 leks/mt (39,100 leks/mt P_2O_5) at a production rate of 70,000 mtpy as shown above.

Therefore, it can be concluded that ROP-SSP produced at Lac cannot be competitive with imported DAP at today's prices even under the most favorable circumstances.

Today's prices of DAP are very low compared to historical prices as shown on Table 18 and Figure 9. The above comparisons have been based on DAP imported into Durres from a North African Source as follows:

	Cost of Bagged DAP (Product Basis)	
	$/mt	Leks/mt
Bagged product (f.o.b.)	150	15,000
Shipping	25	2,500
Port fees	15	1,500
Total Cost (f.o.t. Durres)	**190**	**19,000**
Cost/mt P_2O_5 after credit for nitrogen (f.o.t. Durres)	**299**	**29,900**

Assuming a production rate of 70,000 mtpy and that the flotation pyrites can be delivered to the Lac factory for 1,000 leks/mt, the plant-gate price for bagged ROP-SSP (18% P_2O_5) would be 7,389 leks/mt (41,050 leks/mt P_2O_5). The cost delivered at a location with a truck transport distance of 100 km would be 8,589 leks/mt or 47,716 leks/mt P_2O_5. Based on this cost, ROP-SSP produced at Lac would be competitive with DAP in the event that future DAP prices f.o.t. Durres rise above US $260/mt. This would be equivalent to an increase in the bagged price f.o.b. North Africa from $150/mt to $220/mt. It is not likely that such a price increase will be encountered in the near- to medium-term future.

Thus, ROP-SSP produced at Lac will not be competitive with imported DAP even if DAP prices increase substantially in the future as shown on Figure 10.

Future Costs–For the most part, the cost calculations for SSP (except for raw materials costs) have been based on current actual costs. These are likely to be higher in the future and as this happens cost reduction measures would be necessary to offset the increases such that the overall production cost does not increase. For example, the number of people currently employed at the factory is much higher than is normal in similar facilities elsewhere. As wages increase in the future the number of people must be decreased to contain costs. Similarly, improvements in efficiency of the use of raw materials, energy, and utilities must be made as costs of these items escalate.

Granular NPKs

Consideration was given to producing granular NPK grades using the existing granulation unit at the Lac factory. The production of multinutrient (NPK) fertilizers was

considered as a way of providing an agronomically balanced fertilizer while at the same time adding value to the SSP. Multinutrient (NPK) products normally sell at a premium over straight materials such as urea, DAP, SSP, and potash. With the NPK production scheme, ammonium phosphates (DAP or MAP) and potash would be imported at Durres and transported to Lac where they would be cogranulated with ROP-SSP produced at Lac. Most of the NPK grades would be sold in areas around Tirana and in the prime agricultural areas south of Durres.

Although the SSP granulation unit at Lac is 27 years old, most of the equipment is in fairly good condition. Based on this, consideration was given to producing NPK grades using the granulation unit. The production of multinutrient (NPK) fertilizers was considered as a way of providing an agronomically balanced fertilizer while at the same time adding value to the SSP.

There are several advantages of using multinutrient (NPK) products as compared to use of straight materials such as urea, DAP, SSP, and potash including reduced handling (one product versus two or three products), single application versus multiple applications at the farm level and more uniform distribution of the fertilizer nutrients. A major disadvantage is additional processing costs at the factory. For all of these reasons, multinutrient (NPK) products normally sell at a premium over straight materials.

For purposes of evaluating production of NPKs, it was assumed that ammonium phosphate (DAP or MAP) and potash would be imported in bulk at Durres and transported to Lac where they would be cogranulated with ROP-SSP produced at Lac. Most of the NPK grades would be sold in areas around Tirana and in the prime agricultural areas south of Durres.

In the past, use of NPK fertilizers in Albania has been very limited. Prior to beginning the study, the Lac factory had assembled information on the NPK grades used in countries bordering Albania–Macedonia, Greece, and Yugoslavia. Data were not available on the consumption of each of the grades. The N-P-K ratios included 1-2-3; 1-3-2; 1-3-1; 1-2-0; 1-4-4; and 1-3-3. Some of the NPK fertilizers also contained MgO, B_2O_3, and K_2SO_4.

All of the above N-P-K ratios could be produced in the Lac factory granulation unit provided that the necessary equipment is installed and modifications are made for receiving, storing, handling, and feeding of the additional raw materials and for bagging and storage

of the various products. Also, modifications would be necessary for transferring the ROP-SSP from SSP-2 to the SSP granulation unit. A package steam boiler would be needed to provide steam for granulation.

In addition to the above expenditures, about US $700,000 (see Section 6) would be required to restore the existing granulation plant to sound operating and environmentally acceptable condition.

The previous cost calculations have shown that ROP-SSP produced at the Lac factory is not competitive on a P_2O_5 basis with DAP imported in bags.

It is certain that multinutrient (NPK) grades cannot be produced at Lac based on locally produced ROP-SSP, imported DAP, and imported muriate of potash (MOP) at costs which are competitive with imported straight materials such as urea, DAP, MAP, and MOP. This is particularly the case if consideration is given to the capital investments required to renovate and modify the existing SSP granulation unit. It can be readily concluded that NPK grades, thus produced, cannot compete in the market on a nutrient basis against imported straight materials.

9. Organization

Description

The level of manning at the Lac phosphate complex is exceedingly high by comparison with similar facilities elsewhere. A breakdown of the work force is shown in the following table.

Lac Phosphate Fertilizer Complex Work Force

Section	Number		
	Administrative	Workers	Total
No. 1 SSP plant	4	86	90
No. 2 SSP plant	0	12[a]	12
Granulation plant	2	45	47
Sodium fluosilicate plant	0	16	16
No. 1 sulfuric acid	3	118	121
Oleum	0	8	8
No. 3 sulfuric acid	0	20[a]	20
Maintenance	3	107	110
Maintenance planning	2	35	37
Nitric acid	2	34	36
Transport	2	25	27
Laboratory	1	23	24
Receival and dispatch	0	34	34
Administration	23	45[b]	68
Total	42	608	650

a. Security guards.
b. Includes additional 33 guards.

Approximately 45% of the work force is female with representation in most sections except some maintenance areas, transport, and security. In some areas they represent the majority of the work force, e.g., laboratory.

Analysis

The following observations were made during the visits to the Lac complex:

Communications–There appears to be reasonable communication at the senior level of management, including the head of the syndicate (formerly union). The head of the syndicate sat in on most of the meetings at the Lac office and accompanied the party on the plant inspections. How well information is disseminated throughout the work force is not known.

Knowledge of Operations–The chief engineer appeared to have an outstanding knowledge of the details of operations from both a process and engineering aspect. Other engineering staff seemed very competent. There did not appear to be the same level of expertise in the process personnel but this may have been clouded by translation problems in that the translator was a chemical engineer with a number of years of experience in the plant.

Change of Procedures and Attitudes–After so many years of operation under the centrally planned economy system it will take considerable training and time before the market economy approach becomes automatic, e.g., under the centrally planned regime a government regulation required a comprehensive investigation before any item of plant equipment could be replaced. This investigation would be carried out by the maintenance planning department and the recommendation signed by the chief mechanical engineer and his accountant and would then be sent to the chief engineer where the replacement, if deemed necessary, would be endorsed by the chief engineer and his accountants and it would then be submitted to the plant director for his approval. Only after this could the piece of equipment be replaced. This government regulation has been repealed and no longer applies.

Engineering Maintenance History and Records–All of this information is manually recorded and lends itself to computerization and a subsequent reduction in manpower.

Future Manning–As wages increase with time it will be necessary to contain costs by reducing the work force. While wage costs are low the opportunity should be taken to initiate training programs to facilitate an orderly reduction in the work force. Computerizing a number of areas such as accounting, production records, and maintenance planning and history would facilitate a reduction in the work force after

suitable training of personnel. The laboratory is another area where, with the introdution of instrumental method of analysis, the work force could be reduced while at the same time providing much quicker analytical results.

Recommended Training and New Technical Equipment

New Technical Equipment–To improve general operation, the following new equipment should be installed:

- Instrument calibration equipment for the Kent-Tiegi instrument in No. 3 acid and No. 2 SSP plants.
- Ultrasonic thickness measuring equipment for acid storage tanks and lines.
- Laboratory equipment as follows:
  - Colorimetric equipment for P_2O_5 determination.
  - pH meter.
  - Instrumental equipment for H_2SO_4 determination.
  - Sieve shaker for material sizings.
  - Shaker for water-soluble P_2O_5 determination.

Computers for accounting, maintenance planning and records, and production records.

Training–Besides training appropriate personnel in the specific use of the equipment listed in C.1 above, the following general training is recommended:

- **Senior Management**–Principles of a market economy and modern management and organization procedures.
- Process personnel both administration and operating be given practical experience in the operation of similar plants in a market economy situation.
- Maintenance personnel, both mechanical and electrical, be given practical experience in the maintenance and maintenance planning functions in similar operating plants in a market economy situation.
- Accounting personnel will require considerable training in market economy accounting principles.

10. Marketing of Lac Factory SSP in the Albanian Market

The Situation Prior to Economic Reform in Albania

Prior to the reform period which began in 1991, fertilizer was produced and distributed according to a central plan as developed by government ministries in Tirana. Fertilizer production at both factories was based not on response to market factors but rather on limitations of raw materials and the general condition of fertilizer production facilities. Such fertilizer as could be produced was distributed to state and cooperative farms according to their central plan allocation. This distribution was coordinated by the Directorate Furnizimi Bujqesor (DFB) and transported through the railway system.

Under the planned economy, the bulk of resource transfers were not financial. The DFB, its institutional customers, and agents (transport) worked under a centrally determined schedule, and all shortfalls from the target were adjusted within the state annual budget. Failure of any enterprise to achieve a production or service target meant that it went into deficit, a situation that was rectified in the next annual budget cycle when the State formally absorbed the losses. Under this system, there existed no market response and no concept of marketing. More fundamentally, there was no concept of supply and demand with price and firm activity as determining factors of production and consumption.

The Lac Single Superphosphate Factory (LSSPF) until recent economic reforms operated under the Central Plan and its present possibilities will reflect the historical impact of this system on its development, particularly the condition of its production facilities. Any attempt to develop a marketing approach for the factory will rest fundamentally on its economics of production as determined by its technology, plant efficiency, and cost and availability of raw materials.

The Situation in January 1992

At the beginning of January 1992, three government reforms had set the stage for a transition in fertilizer marketing in Albania. First, the all-powerful DFB responsible for planning and distribution of fertilizer had been divided into 27 district parastatals (Agrotregtare-ACE) which by legislation were held financially responsible for all costs and salaries connected with their activities. The new ACE had to support themselves or die. Second, the system of "cooperative" farms (peasant farms forced into joint production by Stalinist ideology) had been disbanded and land distributed to "cooperators" who became for the first time in their lives individually responsible for production decisions. These small-holders faced the daunting responsibility of supporting their families without recourse to state salaries or safety nets; meanwhile, harvest time for their first crop of wheat was several months away. Third, a rudimentary beginning of commercial law had been passed that allowed Albanian citizens to buy and sell for a profit.

None of these individuals or firms had ever bought or sold fertilizer. The ACE had no system to receive cash; all trades were book transfers arranged according to procedures set down previously by the Central Planners in Tirana. The private farmers had never bought a bag of fertilizer and had been told by the new political parties and their leaders that fertilizer would be distributed to them free. Most importantly, the agronomists and "economists" who had been retrenched by the defunct cooperatives and who hoped to enter the new economy had never engaged in any commercial activity.

Another important constraint to the development of a private marketing system for fertilizer, the Bank of Agriculture and Development (BAD) had never given commercial loans for agricultural inputs.

Coincident to these factors, both fertilizer factories had stopped producing at the very moment their new autonomous status required them to financially support all production and staffing costs. Unlike the Fier Nitrogen Fertilizer Factory (FNFF), the LSSPF had significant inventory. However, this inventory was not much help to the factory in generating desperately needed cash flow because the LSSPF had been made financially responsible during the off-season for phosphate, and the small quantity of sales that could be made to the newly privatized and cash poor farmers were at low prices fixed by the government.

Another major constraint inhibiting SSP sales was the near total breakdown in the transport system. The railways, because of strikes, the 80% assistance program (where workers who did not report to work received 80% of their normal salary), vandalism, and theft were not working. The ancient trucking fleet consisting mostly of vintage Soviet and Chinese models was in the process of being transferred/sold by government transport enterprises to the private sector. For a low concentrate fertilizer sold in bulk like single superphosphate (SSP), the transport problem was particularly critical as its distribution in the past had been based on bulk transport and warehousing through the railway system.

Some idea of the major reduction in SSP distribution/sales can be had by comparing the distribution of SSP from the plant during the first four months of 1989 and 1992.

First Quarter Distribution/Sales of SSP: 1989 and 1992

	Year	
Month	1989	1992
	(mt)	
January	18,258	955
February	13,284	1,135
March	19,788	189
April	14,421	318

In addition to the above delineated constraints to LSSPF effectively entering the market economy, the LSSPF had almost immediately to compete with the strong marketing efforts of the USAID Emergency Fertilizer Project which "seeded" DAP–a competing product–into Albania.

The USAID Emergency Fertilizer Supply Project

The Emergency Fertilizer Supply Project, conceived by USAID to supply fertilizer during the economic transition and administered by IFDC, fundamentally changed the

prospect for marketing SSP from the LSSPF in two ways. First, it created a national network of fertilizer dealers which replaced the old "market" of state and cooperative farms with a privatized marketing system. Second, the project introduced diammonium phosphate (DAP) as a competing fertilizer to SSP.

Creation of National Network of Private Fertilizer Dealers

The Emergency Fertilizer Supply Project had two goals: (1) provide fertilizer for Albanian agricultural production (urea for spring topdressing of 1992/93 wheat and for 1992 summer crops and DAP for fall basal dressing of 1992/93 wheat) and (2) catalyze the development of a private marketing system by obliging that such fertilizer only be available through free market activity. IFDC conceptualized an approach to catalyzing entrepreneurial response based on holding "auctions" (sealed bid tenders) open to all with proof of financial capability.

In April/May 1992, 20,000 mt of urea was "auctioned" to individuals and firms having both the interest and drive to arrange credit (generally with the Bank of Agriculture and Development–BAD), transport, and warehousing necessary to buy and sell urea. No reserve price was set for urea and competitive bidding, given existing economic conditions, resulted in an average price much below world market (15%-20%).

At the end of the urea auctions, there were over 150 winners. Of this number, 115 were private firms or individuals, another 25 were ACE, and the rest were state farms (which continued to exist through the beginning of 1993). Over 60% of the fertilizer went to the private sector, and private dealers covered approximately two-thirds of the districts and more than 85% of the high agricultural potential areas.

This dealer network was extended further. First, 10,000 mt of DAP was imported and "auctioned" in the fall of 1992 which resulted in new entrants to the fertilizer marketing business. The introduction of DAP will be discussed subsequently. Second, beginning in December of 1992, IFDC became directly involved with marketing FNFF urea inventory buildup (approximately 20,000 mt) to the newly created dealer network. At the end of the three initial phases of this project, i.e., (1) urea auctions, (2) DAP auctions, and (3) New Marketing Policy for the FNFF, the number of private dealers had increased from the original 115 to well over 250. Importantly, these dealers had developed their market areas

and were selling DAP at about 85% of world market price and urea at world market or higher.

Introduction of DAP Into the Albanian Fertilizer Market

The auctions of DAP went quite differently than those of urea. The most important factor impacting these auctions was the reserve price approximating 85% of world market that was set for all bidding. This resulted in prices–on a product basis–six times higher than any previous fertilizer prices in Albania. Thus not only was DAP completely new to the market, but it was only available at prices seemingly exorbitant to new smallholder farmers. Three factors made it possible to send DAP into the Albanian market such that within less than a year it was Albania's premium fertilizer.

The first factor was the dealer network. Dealers after the successes and profits of the urea auctions ventured into the DAP project with enthusiasm, albeit only after an initial boycott of the auctions to drive down the reserve price. There were 88 DAP auction buyers of which more than 60 were private. They took almost 70% of the DAP auctioned in the fall (3,500 mt). These dealers covered most of the high potential agricultural areas and as a result farmers in those areas were sold DAP for their 1992/93 wheat.

The second factor that facilitated the entry of DAP into the Albanian fertilizer market was IFDC's extensive use of the media. Four major commercials were placed on Albanian National Television in addition to several advertisements broadcast on National Radio and the Regional Radio Stations: Korce, Shkoder, and Kukes. According to IFDC surveys of dealers, television advertisements had the strongest impact on farmer purchases. These advertisements targeted the newly privatized farmers that were not only conservative about the new product but were unhappy with its higher price. The four TV commercials had the following messages.

Commercial One–A comparison between DAP and SSP. The advantages of DAP in terms of balanced nutrient were emphasized as well as the reduced transport cost and ease of farmer application. Additional advantages emphasized were the quality of bagging and granular condition which compared favorably with the dust-like quality of SSP run-of-pile (ROP). Competitive advertising was new to Albanian media and resulted in much criticism by agencies and political parties supporting state-owned production of fertilizer.

Commercial Two—An "Infommercial" supporting the importance of phosphate as a basal dressing for wheat. This advertisement supported use of either DAP or SSP (along with some application of nitrogen fertilizer) as a basal dressing and gave recommendations for rates and timing of application for both DAP and SSP.

Commercial Three—An "Infommercial" supporting the use of phosphate for winter vegetables and forage crops. This advertisement, later considered a classic for its imagination and creativity, emphasized to farmers the importance for use of phosphate for crops that otherwise would not have been targeted for phosphate fertilization use by farmers. Among the crops targeted were: alfalfa, trefoil, sugar beets, potatoes, and sunflower. Recommendations for DAP and SSP were given for each of these crops.

Commercial Four—An "Infommercial" supporting the use of phosphate as basal dressing for spring planting of maize.

In addition to TV and radio advertisements, brochures giving recommendations for both DAP and SSP were distributed in the thousands directly to dealers and farmers, and posters were put up in dealer's villages in local meeting places of farmers such as coffee bars and local wheat and maize mills. IFDC personnel also went to locations where dealer DAP sales were in trouble directly selling to farmers.

Finally, farm demonstrations were arranged in several geographically dispersed locations to show the response of DAP on wheat compared to fertilizer treatments utilizing only nitrogen fertilizer (urea and ammonium nitrate).

Initially, dealer sales to farmers in certain areas achieved considerable success while in others sales experienced difficulties. Farmer sales in Berat and Lushnja districts went well, while in the major urea-consuming district of Elbasan significant problems developed. Often, local agricultural "experts" were resistant and advised farmers against use of DAP. Rumors were spread about DAP, i.e., that it resulted in female infertility and was a source for various pests. In underdeveloped districts, in the northeast and south, sales of DAP were extremely limited, some districts not having any DAP.

Unlike urea sales, which went fairly easily despite the fact that retail prices were double government fixed rates, DAP sales struggled until agronomic response began to be seen by farmers.

DAP sales slowed during the spring but as the 1993/94 wheat season began to approach, farmer demand surged resulting in completion of IFDC sales of DAP in July, some months before the farmer usage period. Sales by month for the period of IFDC DAP sales give an indication of both dealer and farmer acceptance of DAP.

DAP Sales by Month

Month/Year	Metric Tons	Percent DAP Sales
1992		
September	1,000	10.24
October	2,000	20.48
November	475	4.86
December	50	0.51
1993		
January	50	0.51
February	130	1.33
March	320	3.28
April	280	2.87
May	40	0.41
June	890	9.12
July	3,750	38.40
August	780	7.99
Total	**9,765**	**100**

The impact of DAP's introduction into the Albanian market on LSSPF SSP sales was negative. Total sales of SSP in terms of P_2O_5 was only 1,323 mt or about 29% of DAP in the same period (Table 19). Analysis of SSP sales shows that the bulk (81%) of LSSPF SSP sales during the 1992 season took place before DAP's introduction. In short, DAP took the critical basal dressing market in the fall of 1992.

DAP has become a major challenge to LSSPF SSP in the Albanian fertilizer market.

The third factor that supported the development of DAP was availability of credit for its purchase from IFDC. Early on, IFDC was active in development of credit for dealers purchasing its DAP and subsequently from the FNFF under the New Marketing Policy. Development of this credit facility from the banks was a major achievement of IFDC/Albania and made possible the risk-taking that dealers took in trying the new product DAP. Subsequently, credit was arranged with both banks and the FNFF to support factory sales of urea with similar success in its sales of nitrogenous fertilizer. IFDC's efforts in this area had a spill-over effect on Lac factory sales because banks became willing to loan to dealers for SSP purchases.

There are many technical questions associated with DAP's success. Some of the most important follow:

1. *Phosphate Response.* Prior to the introduction of DAP, it had been assumed that the noneconomic application of SSP by the former communist governments had left a residual amount of P_2O_5 in the soil which would be sufficient for some time in the future. There was thus the question of whether there would be a phosphate response to DAP application. DAP was in the fall of 1992 in direct competition (as a basal dressing for wheat) with FNFF nitrogen, particularly AN. The excellent wheat response to DAP application and dramatically increased farmer demand for DAP indicate the possibility of a phosphate response. This should also support positively the marketing of SSP.
2. *Sulfur Response.* Because sulfur was not tested for in 1992/93 dealer/farmer demonstrations, it is not clear if there is a need for the sulfur in SSP.
3. *Ammonium Nitrate Preference by Farmers.* Despite the growing preference of DAP over its competitors, some farmers still prefer to use AN as a basal dressing in preference to DAP or urea. The question remains what additional benefit AN provides and how it may be sustained by combination with SSP (as a phosphate source) in basal dressing of wheat. Availability of AN to be used in conjunction with SSP may help the latter's sales.

As of late summer 1993, DAP is the preferred fertilizer by both farmers and dealers. This is a major marketing challenge for LSSPF SSP.

The Albanian Fertilizer Market for P_2O_5

General Problems in Estimating Nutrient Demand

The total market for P_2O_5 in any form (DAP or SSP) is not clear. Distortions in the market coming from various impacts of the economic transition cloud estimates of farmer demand for fertilizer. Much of this distortion comes from previous and present government involvement in fertilizer production and distribution. Previous governments produced and distributed fertilizer without any market response to fix real economic demand. Because of this there are no baseline figures for demand upon which to project future consumption given fertilizer prices in Albania near world markets.

The present government has at times a noneconomic agenda that militates against efficient development of its fertilizer market. An undeveloped or virtual lack of government policy in respect to fertilizer has created great volatility in fertilizer supply which also distorts demand. For instance, in the case of FNFF nitrogen, government's erratic and parsimonious allocation of scarce natural gas needed for ammonia production is a clear indication of the low priority government presently gives fertilizer even though it espouses programs that emphasize farmers and agriculture. In the nitrogen market, the decision by government to supply natural gas to marginal productive activities (soda and brick production facilities) and as heating gas for two small communes ensures that there will not be enough gas to allow the FNFF to fully produce nitrogen requirements for Albanian farmers. The FNFF is fully capable of meeting Albanian's nitrogen fertilizer needs but is presently prevented from doing so by this government policy in a vacuum. This policy or lack of policy is made further dysfunctional by the imposition of a 30% duty on imported fertilizer.

In summary, not only is government not allowing the FNFF to produce Albania's fertilizer needs, but is also taxing any attempt by the newly privatized marketing system to make up the nutrient deficit. It is an unusual situation in that typically the problem with government's policy on fertilizer is market-distorting subsidies. In Albania, the problem is just the opposite. Government is insisting on its farmers' paying 30% more than world market price.

Demand Estimate for P_2O_5: 1994/95

For the purposes of this study, a demand of 10,000 mt of P_2O_5 is assumed as a base case for analyzing the economics of Lac factory production. This figure is a conservative estimate given previous levels of usage (26,121 mt in 1987). However, it implies that farmer demand presently is almost twice that of 1992/93 P_2O_5 sales (5,185 mt). It is difficult to factor into a fertilizer demand estimate the consequences of a newly developing private fertilizer marketing system as well as the first response of newly privatized farmers. The difficulties the LSSPF has had in making the transition to a commercial basis and the introduction of DAP only complicate the estimation process.

The Institutional Market

In the new rural market economy, the institutional market is well-defined. The dealers created by the Emergency Fertilizer Supply Project and its integration with FNFF marketing activities have now both knowledge and finance to buy and sell fertilizer to private farmers. Referring to Appendix G (Agricultural Input Dealers Albania: 1992-93), it is possible to see that this market is significant and geographically disperse. Presently there are over 250 private dealers in the market. This market that includes the ACE (which are soon to be privatized in one form or another) took the bulk of 20,000 mt of urea and 10,000 mt of DAP "auctioned" by IFDC, as well as most of the urea sold under the New Marketing Policy at FNFF. Many took what small sales the LSSPF made in its competition with IFDC DAP. They have an excellent credit record with the Bank of Agriculture and Development achieving repayment records that make them customers of choice with such institutions as the banks and the European Commission-Phare Finance Program. In the periods of the auctions, they took 307 loans, all of which has been paid in full and continue to access the credit system.

The national dealer network has developed parallel with the development of the agricultural economy. They sell seeds and pesticides and have a desire to move into other agricultural inputs such as animal feed and bulk construction materials. These dealers have developed their own trade association, the Albanian Fertilizer and Agricultural Inputs Dealers Association (AFADA), that negotiates directly with IFDC, EC-Phare, and FNFF and has begun to negotiate with the LSSPF. They are trying to work with the National Seed

Organization (which is reluctant to give up its seeds monopoly) and have contacts with the IBRD Critical Inputs Programme (CIP) as well as the EC Food Aid Program that is interested in distributing/selling through these dealers some part of 400,000 mt of wheat and flour to villages. These dealers are the market that the LSSPF must sell to if they are to achieve success in reviving their role in the agricultural economy.

A recent survey of dealers indicates that the bulk of these dealers are willing to sell SSP if the price is right. The market for SSP is strong in as much as private farmers, formerly cooperators in their market area, are well acquainted with SSP and urea/AN. The question remains for both dealers and farmers: Is SSP an economical approach to supplying phosphate given the prospect for nitrogen production at FNFF and phosphate supply through importation of DAP?

Marketing Prospects of the Lac Factory SSP

From a marketing point of view, the important question is whether the factory can produce SSP economically, at a price competitive with imported DAP. This question is complicated by the significant amounts of inventory now resting with the factory, that inventory which is now SSP product and that inventory represented by the inventory of acceptable phosphate rock and sulfuric acid which can be used to make additional SSP. At present there is about 17,000 SSP product and enough raw materials and production capacity to increase this product inventory to an amount approximating 50,000 mt of SSP product.

Stated differently, the question becomes whether any marketing strategy developed for the factory will be oriented to selling residual inventory in expectation that the factory will have to be shut down because of production inefficiencies or whether it will be oriented to marketing SSP for some years to come.

In short, should the marketing strategy assume a one-time sell off of residual inventory or should it concentrate on developing a marketing program within the factory that will enable it to be competitive in the long run.

In the context of this report, it will be assumed that there is potential for the LSSPF to produce needed phosphate for the foreseeable future at a demand level of about 10,000 mt P_2O_5 initially but rising with increasing farmer technical capability at a rate of about 5% per annum. This reflects farmer willingness to purchase fertilizer at higher prices consistent with liberalization of farm product prices.

Total Demand for P_2O_5 in the Albanian Market

As noted previously, demand for phosphate fertilizer is distorted by two factors. First, the P_2O_5 distributed and applied to state and cooperative farms in the past does not reflect demand as determined by market forces. It is assumed for the purpose of this report that applied P_2O_5 was probably in excess of what would be sold if market factors were in effect. Second, the sales of P_2O_5 in the transition period reflect distortions of unsure land ownership and the precarious financial position of newly privatized farmers.

The following projection for the next 5 years is made based on: (1) the increasing ability of farmers to pay the full cost of nutrient P_2O_5, (2) successful efforts by the LSSPF to commercialize their operations, and (3) production costs of P_2O_5 are competitive with imported DAP.

Projected SSP Demand, 1994-99 (No DAP Imports)

Year	P_2O_5	SSP Product (18% P_2O_5)
	(mt)	
1994	10,000	55,550
1995	10,500	58,330
1996	11,025	61,250
1997	11,575	64,300
1998	12,155	67,530
1999	12,763	71,000

The amounts of SSP needed to be produced under this conservative demand projection are significantly under what has been applied in Albania in the past. However, they are much above the sales achieved in the first year of the market economy. Below are production figures for 3 years under the Centrally Planned Economy:

P_2O_5 Production Under Centrally Planned Economy

Year	SSP	P_2O_5
	(mt)	
1985	156,974	23,546
1986	167,478	25,122
1987	174,772	26,216

Geographic Markets for P_2O_5

A significant change in geographic distribution resulted from the "auctioning" of DAP to the dealer network. DAP sales gives a better understanding of where P_2O_5 (SSP included) is likely to be marketed in a free economy. The 1992/93 sales of P_2O_5 show major differences in demand as compared to plans as formulated under the previous system. A complete breakdown of P_2O_5 distribution/sales is given in Table 19 (Seasonal Distribution/Sales of Phosphate Fertilizer). However, some representative districts demonstrate this impact of the free economy on fertilizer markets:

	1987		1992/93	
District	P_2O_5 (mt)	Percent P_2O_5	P_2O_5 (mt)	Percent P_2O_5
Shkoder	1,576	6.0	168	3.0
Durres/Kavaja	2,224	8.5	581	10.0
Tirana	1,361	5.2	478	8.2
Lushnja	2,393	9.2	1,117	19.2
Berat	1,298	5.0	1,018	17.5
Korce	2,194	8.4	122	2.1

Much of these changes reflect the additional cost of transport to distant districts. If transport was decisive in marketing of DAP, it will be even more a constraint for a low concentrate product like SSP. Because of this factor, transport is likely to become a critical factor in the competitiveness of local SSP vis-a-vis imported DAP. Eastern Albania will continue to be at a disadvantage to other regions of Albania because of transport distance. This disadvantage is accentuated in the case of SSP. Southern districts have had a major advantage vis-a-vis DAP sales because of their proximity to Durres Port and IFDC warehouses in Durres and Kavaja districts.

Seasonal Markets for P_2O_5

An analysis of the distribution of SSP from Lac during the Centrally Planned Period indicates that product was more or less sent out according to production schedule at the factory. This is reflective of the lack of financial costs associated with holding product in a nonmarket economy. Much of SSP distribution took place in periods that were nonmarket sensitive or more precise noncrop sensitive. In general, more SSP was distributed in the spring nonseasonal period than in the summer/fall wheat season. This pattern probably reflects more the production schedule of the factory than seasonal nutrient need. This distortion seems to have been rectified by the introduction of DAP. However, there may be some distortion because the knowledge by farmers and dealers that DAP supply was limited resulted in a surge of 1993 summer sales well in advance of seasonal need. Comparing 1987 with 1992/93 gives the following seasonal consumption patterns. These provide an insight into seasonal demand as based on phosphate requirements for wheat.

Season	1987	1992/93
	Percent P_2O_5	Percent P_2O_5
Summer/fall (phosphate basal dressing for wheat)	47	87
Winter/spring (phosphate for minor crops such as vegetables and maize)	53	13

Dealer and Farmer Acceptance of SSP

A recent survey of 151 important dealers (August 1993) showed that though most (92%) dealers preferred DAP as product source for P_2O_5. However, all but two of these dealers said that farmers would buy SSP if DAP was not available. The problems associated with marketing SSP as identified by dealers were price (ex-factory), bagging, and transport cost. Effectiveness of product was not thought to be a problem. The following table gives some idea of those areas thought most problematic by dealers according to level of importance:

SSP Problems (Percent of Respondents According to Each Importance Level)

Importance Level	Effectiveness of SSP (%)	Cost of Transport (%)	Bagging Quality (%)	Cost of SSP (%)
1	5	20	30	45
2	13	38	23	26
3	16	31	33	20
4	62	12	20	6

Price was thought high by dealers and based on this the LSSPF has recently lowered prices significantly. Bagging followed price in percentage of farmers considering it the most important problem. Cost of transport was emphasized as the second most important problem by the highest percentage of dealers, but bagging continued to be an important concern of

dealers and the third level of importance took rank over other concerns. Effectiveness of SSP as measured by dealer attitudes was the least important problem in its effectiveness.

Cost Comparison: Locally Produced SSP Versus Imported DAP

Ultimately, the fate of the Lac Factory will depend on the cost per nutrient P_2O_5 of SSP compared to DAP. Based on marketing advice by IFDC, the Lac Factory has recently revised its price schedule for the months of September, October, and November. The following cost comparisons are based on August prices that have been revised downwards for the September-December period. Additionally, price discounts have been given for large quantity purchases and transport by rail.

Cost Comparison of SSP and DAP at Albanian Source

Cost of DAP: On Dealer Truck-Durres Port (Assume importation of 10,000 mt DAP from N. African Source)	Dollars	Leks/kg ($1/100 leks)
Cost (DAP bagged product basis)		
F.o.b. mt bagged DAP*	150.00	15.0
Shipping	25.00	2.5
Port fees	15.00	1.5
Cost (without 30% import duty and 5% surtax)	190.00	19.0
Import duty and surtax on c.i.f. value	61.25	6.1
Cost with 30% import duty and 5% surtax	251.25	25.1
Cost/mt P_2O_5 after credit for nitrogen (f.o.t. Durres)		29.9
Cost (SSP ex-factory Lac)		
Bagged ROP-SSP/kg		5.0[a]
Cost/kg P_2O_5		33.3
Bagged granular SSP/kg		7.7[a]
Cost/kg P_2O_5		51.3

a. These prices are the August 1993 selling prices that are for SSP currently in stock. The prices are lower than current production costs of 6,256 leks/mt of bagged ROP-SSP and 7,930 leks/mt of bagged granular SSP.

* The international prices based on *Fertilizer Week*, June 28, 1993.

This cost comparison does not take into account the additional cost associated with transporting SSP versus DAP. Another cost comparison based on transport to the dealer warehouse indicates the cost of SSP versus DAP once transport is factored in. A transport distance of 100 km is assumed for both products. However, given that Durres Port is more central to major consuming areas–the south central districts–transport of DAP is probably overestimated.

Cost Comparison DAP and SSP: Dealer Warehouse in District

Product	Delivered Costs, Leks/mt P_2O_5	
	Truck	Rail
Bagged DAP (after nitrogen credit)	31.79	30.62
SSP bagged ROP (P_2O_5)[a]	41.3	36.3
SSP bagged granular (P_2O_5)[a]	59.3	54.3

a. These prices are the August 1993 selling prices that are for SSP currently in stock. The prices are lower than current production costs of 6,256 leks/mt of bagged ROP-SSP and 7,930 leks/mt of bagged granular SSP.

This comparison does not take into account quality factors, the most important of which is the quality of bagging of imported DAP and the advantageous physical condition of the imported product. On a nutrient basis, imported DAP is very competitive and has better bagging and physical condition. This must be compensated in the market by a low SSP price. Transport cost also begins to assume major importance in SSP competitiveness and a marketing program for LSSPF SSP must focus on reducing this cost, a reduction that can only be accomplished by use of rail. Ideally, SSP should be transported in bulk by rail to the districts where because of the quality of local bags it should be locally bagged by dealers or sold in bulk form to retail dealers or farmers.

Quality Problems Associated With Lac SSP

The major problems with marketing SSP are bagging and physical conditions of the product. DAP is a much more convenient product for dealers to supply and farmers to apply than SSP. The bagging problem was evident in the IFDC dealer survey where about 30% of dealers identified it as the most difficult problem in marketing SSP. With the recent significant reduction in prices by the LSSPF, this problem will assume more importance as an area where the LSSPF can improve its products's competitiveness.

The LSSPF uses polyethylene bags produced by the Lushnja Bagging Enterprise (state-owned) and which at a bag weight of 40 kg tends to break after one or two handlings. This problem not only provides a logistical limitation, in that there is significant breakage and losses by the time it gets to retail outlets but also discourages farmers who get the bagged product in its worst condition. DAP, as presently sold in Albania, is double bagged with woven polypropylene outer bag and polyethylene inner. These bags because of their durability have developed a secondary market. They can be used by farmers for various purposes after DAP application and are a major consideration in farmer purchase. Presently there are some dealers planning to sell large amounts of SSP that are arranging better bagging either by import from Turkey or by local purchases from the FNFF which has significantly better quality bagging stock on hand.

The bagging problem looked at from another perspective is a transport problem. In the past, SSP has been transported in bulk to districts by rail. However, because of the breakdown in discipline within the railway system, dealers are reluctant to use this mode because of inefficiency and product theft. A marketing plan based on use of rail would not only save on transport cost but (assuming bagging in the districts) would reduce loss and wastage due to the poor bagging available. This requires that the LSSPF has a logistical strategy that can meet this challenge.

The second major problem is physical quality of product. The LSSPF produces a dust-like SSP that is less convenient for farmers to handle than imported granular DAP. The LSSPF has attempted to meet this problem by granulating its SSP. However, because of the additional production costs involved (detailed in the cost comparison between DAP and SSP) that must be passed on to farmers, the granular product is not competitive with

imported DAP. Farmers, most of which worked either for cooperative or state farms, are familiar with Lac SSP and will use it, but its physical condition must be taken into account in product pricing. SSP can be sold to Albanian farmers if LSSPF price fixing factors in the additional problems associated with its handling and application.

Marketing Recommendations for the Lac Single Superphosphate Factory

Organizational Challenges

The LSSPF has had, for the period since Albania's political and economic reforms, a progressive management. In addition, there is considerable cooperation between management and labor. Perhaps the cooperative relationship between the two reflects mutual understanding of the precarious position of the enterprise. Presently, unlike the FNFF, the Marketing Manager is a member of the Board of Directors. There is, in general, an understanding of the importance of marketing to organizational survival. Should the factory stand up to the stiff competition of imported DAP, this is a positive factor in future LSSPF operations. There are four areas, however, where factory marketing can be strengthened.

Support Staff to Marketing Management–At present, there are only two staff that support the activities of the Marketing Manager. Given the need for the LSSPF to maximize the use of rail, there needs to be an individual, manager, or supervisor status to coordinate rail movement as encouraged under the recent LSSPF marketing policies. This manager should also be responsible for transport of raw materials to factory site and arranging truck distribution of SSP.

Field Marketing Staff–Presently, the LSSPF hopes that IFDC or AFADA (Albanian Fertilizer and Agricultural Input Dealers Association) will sell its products. In the long run, there is a need for Albanian factories (the FNFF included) to develop a field sales organization that can reach directly to dealers. This is a significant problem because LSSPF staff are located in Lac, and it is difficult under existing conditions to post-out staff to important regions. The LSSPF, if it is to succeed, needs to locate sales personnel in critical locations to sell products and ensure product delivery, particularly if it is transported by rail.

AFADA Representation on LSSPF Board of Directors–AFADA (Albanian Fertilizer Dealers and Agricultural Inputs Dealers Association) dealers take the bulk of LSSPF sales and will only increase in importance in the future. As of September 1993, the major purchasers of Lac SSP and FNFF urea and ammonium nitrate are AFADA members. It would be useful if the President of AFADA was on both FNFF and LSSPF Board of Directors. Such representation would inform the LSSPF as to the realities of the market in the districts. Some idea of the number and geographic distribution of AFADA is given in Appendix H (AFADA membership list).

Recruitment of Staff Agronomist for Marketing Unit–The LSSPF does not now have an agronomist to give it advice on the agronomic aspects of its products. At present there are many unemployed, university-qualified agronomists and at existing low salary levels, it would be a good investment for the LSSPF to hire one to give the Marketing Unit advice on agronomic needs of farmers for P_2O_5 for various crops, seasons, and regions.

Product Physical Condition and Logistical Strategy

Lac SSP will have a difficult time competing with DAP imports unless there is logistical strategy that reduces the cost of transporting phosphate to the districts. Transport costs will likely be critical in determining whether dealers can sell SSP at competitive prices to farmers. SSP is a good source of phosphate for farmers, but the Lac product has three limitations that exacerbate the transport problem:

1. A low P_2O_5 content–about 15%, resulting in a relatively high production cost per mt of P_2O_5.
2. Poor quality of bagging.
3. Dust-like condition that makes it difficult to transport in bulk by trucks.

Previously, the LSSPF transported all its product to the districts through the rail system in wagons specially constructed for this purpose. Bulk receiving warehouses were built at major rail terminis to receive SSP shipments. The short distance transport from rail terminis to cooperative and state farms was then effected by their own trucks or trucks of the state transport enterprises.

An inventory of SSP bulk rail wagons follows:

Type	Capacity (mt)	Number	Location
SN4	60	50	Lac
VS	35	80	Lac
FAL	60	10	Lac
ZR	20	20	Lac

Unit trains of SSP are capable of carrying 700-850 mt.

Bulk receiving warehouses that are presently owned and under the control of the railways are located at the following railheads:

Location	Storage Capacity (mt)
Shkoder	1,500
Kavaja	1,000
Lushnja	3,000
Fier	3,000
Elbasan	2,000
Librazd	1,000
Pogradec	3,000
Ballsh (Mallakaster District)	1,000
Rrogazina (Kavaja District)	500
Peqin	400
Prenjas (Librazhd District)	1,500
Vlore	500
Durres	3,000

The logistical strategy that the factory should undertake is to the extent possible activated by this existing system of distribution. The primary problem constraining LSSPF and dealer utilization of this system is the breakdown of discipline within the railways. At

present, the railways refuse to take responsibility for any loss or theft in transit. Additionally, the bulk receiving warehouses are not easy to secure and the railways will not guarantee SSP product stored there.

These security problems associated with the railways mean that the LSSPF and dealers will have to undertake the security of bulk transport and warehousing. This will mean additional staffing costs for wholesale dealers or redeployment of underutilized factory personnel. Two options for activating this system will be discussed later.

The LSSPF should encourage dealers to utilize the rail system by providing price discounts for rail transport (particularly for large purchases) that can compensate for possible transit and warehousing losses. This is to the long-term advantage of the factory in that it will result in reactivating rail transport of SSP. Dealers at the present time are reluctant to use rail. IFDC transport of USAID urea to Vlore, however, shows that rail can effectively carry fertilizer if sensible measures are taken against theft and loss. Dealer use of rail will reduce the price of SSP to farmers and begin the hard work required to "reseed" the market for SSP. Dealers once having seen the benefits of rail transport will not only use rail for fertilizer (also for FNFF urea and AN) but also for various other bulk commodities that they may trade in including animal feed and grains. This logistical project also gives the railways an opportunity to re-enter a business that is likely to be important to them in years to come.

Factory Relations With Fertilizer Dealers

The development of a privatized marketing system for fertilizer in Albania can be a major asset to the LSSPF. The LSSPF with the assistance of IFDC should be connected with the dealer network. This may be accomplished through orientations to LSSPF product and marketing policies either at an IFDC/AFADA arranged venue in Tirana or at the factory. Additionally, the newly created sales staff should reach out directly to dealers in their districts. Factory relations with AFADA leadership should be developed. This can best be achieved, as mentioned previously, through AFADA representation on the LSSPF Board of Directors.

LSSPF Pricing Policy

Fall is the most important season for P_2O_5 sales. Presently, in the important districts, there are significant amounts of DAP. To "reseed" its market, the LSSPF, under IFDC guidance, has established a pricing policy similar to that of the FNFF. Under this policy, there are monthly price increases with the highest product price coming in peak season. Additionally, the LSSPF has instituted significant price discounts for quantity purchases and a discount for transport by rail. This pricing policy emphasizes bulk sales of nongranular SSP, and prices have been brought down so as to be competitive with DAP.

Factory Trade Credit

The LSSPF recently established a trade credit policy similar to that at the FNFF that was based on IFDC recommendations. These recommendations resulted in the FNFF having sold somewhat more than it has produced in a period which in the previous year experienced massive factory inventory buildup.

Bank interest rates presently are extremely high in Albania approximating 25% per annum. Trade credit by the LSSPF to dealers could greatly help this situation for its dealers. The LSSPF is in effect wealthy in product having about 18,000 mt in storage at the factory, but not having sold its SSP, it is cash poor. In as much as it has no financial obligations either to the government or the Banks, it is in a strong position to offer credit terms to dealers. Given the need to "reseed" SSP in the Albanian market, LSSPF provision of trade credit to dealers to counteract the high cost of finance prevailing will help sell its product. Dealer credit repayment of bank loans supports factory (FNFF and LSSPF) trade credit policies. Dealer repayment of bank loans approximate 100%. They have established a good credit reputation that has made dealers customers of choice for the Bank of Agriculture and Development (BAD) and the EC-Phare loan program.

All DAP sales are cash based-wholesalers who purchased from IFDC in large amounts selling to retailers on a cash basis. The LSSPF should continue to offer as an incentive to dealers, credit terms that reduce exorbitant dealer financial costs. This is the major competitive advantage it has over DAP. It could usefully follow the Trade Credit Policies established by the FNFF under IFDC guidance. The FNFF offers two credit programs:

Trade Credit of 75% of Purchase—This credit program offered in July and August 1993 to stimulate off-season sales allowed 3 months for repayment. Repayment within the 3-month period is made by dealers at the low prices offered in July and August. There are no interest charges under this policy. The bulk of recent FNFF successful sales were made under this policy. A similar program was earlier instituted in December 1992, and repayment was excellent there being only one defaulter who is expected to repay shortly the remaining 20% unpaid amount.

Trade Credit "Consignment" of 95% of Purchase—For large credit purchases, dealers are only required to make a down payment of 5% of purchase, the residual to be repaid within 6 months at the prevailing price for month of repayment. As prices under the FNFF price policy are increased significantly (at a rate approximating bank interest rates) over the 6-month period, dealers have an incentive to repay this credit as soon as possible. This policy was instituted instead of an initial FNFF proposal to pay dealers to store expected inventory buildup. It was thought better to sell the product (urea) than pay dealers to store it. The expected inventory buildup never materialized and only a small portion of FNFF's July and August sales was made under this policy. This facility was only extended to dealers with good credit records.

Recently, the LSSPF established a trade credit policy similar to the FNFF 25% policy. In the future, this trade credit policy may be reconsidered once LSSPF cash flow is sustained, however, because of the need for the factory to re-enter the market for the 1993/94 wheat season, this policy is an important advantage the LSSPF can have over imported DAP.

LSSPF Promotional Activities

The LSSPF must learn to sell its product to Albania's newly privatized farmers. In the past, the government determined district needs based on cooperative and state farm projected consumption and subsequently transported estimated requirements to the districts. There was no need to promote fertilizer, farmers took what the government gave them. The most effective way to reach the LSSPF's new customer is mass media advertisements.

The progressive management of the LSSPF has accordingly begun to use media to sell SSP. However, much more is required to develop its market. Advertising through national

TV and radio has a major impact on farmer purchases. In the very important 1993/94 season, the LSSPF must convince its farmer consumers that despite SSP's disadvantages in terms of product condition and bagging that it is good product, competitive with imported DAP. The LSSPF must convince both dealers and farmers that Lac SSP, despite its disadvantages, is an economical alternative to DAP. Advertising in Albania is relatively inexpensive. The LSSPF has begun to develop a recommendation of nutrient application (a combination of Lac SSP and FNFF urea or AN) that is expected to succeed with farmer wheat production. Based on these recommendations the LSSPF has planned under IFDC guidance a mass media promotional campaign to support the 1993 "reseeding" program.

Marketing Channel Options for the LSSPF

There are three approaches that the LSSPF must consider in marketing SSP both in the critical 1993 season and in the future. These options should be used in combination to adjust to the varying dealer development and transport constraints in the different regions. These options, which emphasize utilization of the existing private dealer network, are summarized below.

Direct Factory Sales From District Bulk Warehouses

Where dealer development is weak and transport costs are high such as in the eastern districts of Albania–Pogradec, Korce, and Erseke–the LSSPF should consider establishing a sales presence based on use of rail and bulk receiving warehouses. This is an important market which because of transport costs has not been fully integrated with the newly privatized marketing system for fertilizer. In 1987, these districts took 20,695 mt of SSP or about 12% of total SSP distribution. This compares negatively with this region's percentage of P_2O_5 in 1992/93 of less than 3.5%.

Under this approach, the LSSPF would arrange rail transport to district bulk warehouses and take control of regional sales to dealers and farmers. SSP would be transported in bulk by rail to district bulk receiving warehouses and arrange for bagging on location. The LSSPF would make arrangements with the railways (on purchase or rental

basis) for transport and warehousing, posting out its own LSSPF staff (or making new hires as necessary) as salesmen and workers as required to bag and sell SSP. The LSSPF would sell either to local dealers or direct to farmers willing to come to the Pogradec railhead which is the furtherest extension of rail in this region.

Presently, the LSSPF will not consider this approach because of problems of posting out LSSPF staff. One dealer from Pogradec has purchased SSP to be transported by rail, but the amount contracted for 300 mt does not meet the probable P_2O_5 demand by local farmers. However, for the long term, this approach must be seriously considered by the LSSPF.

Dealer Sales From District Bulk Warehouses

Where dealer development is strong in such regions as southwestern Albania–Kavaja, Lushnja, Berat, and Fier Districts–the LSSPF and dealers should make an arrangement where dealers take control of local bulk receiving warehouses. Dealers would receive bulk SSP and arrange bagging for sales to retail dealers or farmers. Rail transport would be arranged either by the LSSPF or by dealers (under concessionary price terms given by the LSSPF).

Presently, one dealer in Lushnja is expected to contract for a significant amount (thousands of mt) to bag and sell in his area.

Bulk and Bagged Product Sales From LSSPF

In the initial phases of LSSPF marketing development, this approach will be very important. The perceived difficulties by dealers of bulk rail SSP transport are constraining. However, because of the limited supply of DAP, some dealers are becoming active in SSP. They are afraid of problems associated with rail transport. The LSSPF, until it is able to provide attractive bagging, will probably need to make sales directly from factory site either in bulk or bag to be transported by truck.

Presently a dealer from the Fier district has purchased 500 mt of bagged material that has been transported by truck to his warehouse in Fier city.

The bagging capacity of the factory is limited not only because of quality of bagging but also because presently all bagging is done by hand. Monthly bagging capacity of the

factory as estimated by the Marketing Manager is between 520-650 mt per month. Assuming maximum bagging capacity, bagged SSP will only reach 2,600 mt in the peak season (wheat) if the season extended through December. If the season is defined as through the middle of November the amount of bagged material for sale is significantly reduced to 1,625 mt. Even assuming a higher bagging rate of 1,500 mt per month as made possible by reassignment of workers from other parts of the factory, total bagged SSP available to the market will only be 3,750 mt which is not enough to meet farmer demand and "reseed" the market. This means that the sales needed for LSSPF to re-enter the market will need to be made in bulk SSP.

Some dealers have already contracted for significant amounts of bulk SSP to be transported by truck. One, from Tirana district, has contracted for 1,000 mt of bulk ROP to be transported by his own trucks to his warehouse for bagging in FNFF bags. Such arrangements are helpful in the short term, but in the future these may only be considered as temporary, necessary to get SSP back into the market.

11. Conclusions

As a result of this study, it is concluded that continued operation of the Lac SSP factory is not feasible due to:

- The age and generally poor condition of the factory equipment. The current technical and mechanical condition of the Lac SSP factory has deteriorated to the point that:
  - More than US $3.1 million would be required to restore to an acceptable operating and environmentally sound condition the plants essential for production of SSP at a rate of up to 80,000 mtpy according to a "best case" scheme.
  - About US $26 million would be required to fully restore all of the operating units at the lac SSP factory plus the No. 2 sulfuric acid unit.
  - Substantial investment would be required to bring the plant to environmentally acceptable operation.
- The substantial amount of capital funds that no doubt will be needed to restore operation of copper smelting, pyrite mines, and beneficiation plants to an environmentally acceptable level.
- The relatively high cost of sulfuric acid produced by the existing technology based on roasting of pyrites to obtain sulfur dioxide (SO_2).
- The need to import phosphate rock. Further development and production of Albanian phosphate rock are not recommended for the following reasons:
  - The beds are relatively thin and the deposits are structurally complex, making underground mechanized mining difficult to implement and very costly.
  - The physical characteristics of the ore are not conducive to developing a viable beneficiation plan.
  - The Albanian phosphate rock is low-grade and contains significant amounts of carbonates which would consume excessive amounts of sulfuric acid in SSP manufacture, and would produce a low-grade SSP product.
- A relatively high cost of production, i.e., the plant-gate cost for bagged ROP-SSP (containing about 18% P_2O_5) of 7,503 leks/mt product (41,680 leks/mt P_2O_5) versus

a landed cost of imported, bagged DAP of 13,737 leks/mt (29,863 leks/mt P_2O_5) after credit is given for the nitrogen in the DAP.

- High distribution costs (P_2O_5 nutrient basis) resulting from the low P_2O_5 analysis of SSP compared with that of DAP (18% N and 46% P_2O_5).

It is further concluded that:

1. Based on market requirements, the factory should be operated long enough to convert the existing stocks of pyrites, phosphate rock, and sulfuric acid to SSP. With the existing inventory of SSP (about 17,000 mt), a total stock of about 50,000 mt of SSP could be realized containing about 7,500 mt of P_2O_5.
2. Production of granular NPK grades at the Lac factory is not economically feasible.
3. Imported DAP is currently the most cost effective source of P_2O_5 fertilizer for Albania.
4. International bagged DAP prices must increase by about US $70/mt above today's prices (to a level of about US $220/mt f.o.b. producing country) before Lac-produced ROP-SSP can be competitive with imported DAP assuming no import duties.
5. Significant costs will be incurred in terminating the operations and work force at Lac and making the factory site environmentally benign.

Table 1. Single Superphosphate Complex at Lac

Plant	Production Capacity		Year Built	Sulfur Source	Phosphate Rock Source	Age of Plant
	Design	Actual				
	(mtpy)					(Years)
No. 1 sulfuric acid	40,000	35,000 (27,000 for SSP)	1966	Mineral pyrites (FeS_2)		26
No. 2 sulfuric acid[a]	45,000	35,000	1979	SO_2 from copper plant		13
No. 3 sulfuric acid (Polish plant)	60,000	(?) No operation	1987	Iron pyrite concentrate		5
No. 1 SSP plant	110,000	150,000	1966		Egypt, Algeria, Jordan	26
No. 2 SSP plant (same design as No. 1 SSP)	110,000	150,000 (Production test only)	1989		Has not operated	3
SSP granulation	60,000	65,000	1966			26

a. No. 2 sulfuric acid plant now belongs to Metallurgical Complex (division occurred early 1991).

Table 2. Albania–Pyrite Reserves

District/Mine	In Situ Reserves	Mining Recovery (%)	Recoverable Reserves	Product Grade (% S)	Mine Capacity (mtpy)
Mirdita/Spac[a]	120,000	95	114,000	40	40,000
Mirdita/Rrenjoll[b]	50,000	93[c]	46,500	35	10,000
Mirdita/Gurth	20,000	95[d]	19,000	36	5,000-10,000
Puka/Qafe Bari	50,000[e]	93	46,500	35-36	10,000
			226,000	37.7[f]	

a. Approximately 3,000 mt in stockpile at mine.
b. Shut down for 10 years.
c. Assumed similar to Qafe Bari.
d. Assumed similar to Spac.
e. Approximately 1,500 mt in stockpile at mine.
f. Running average according to amounts of available reserves.

Table 3. Albania–Pyrite Concentrate Reserves

Beneficiation Plant/Mine	In Situ Cu Ore Reserves	S Content	Recovery Factory (%)	Recoverable Reserves	Yield Concentrate[a] 100 t Cu Ore	Reserves Pyrite Concentrate	Grade (% S)
Reps/Gurth[b,c]	200,000	20-30 (Average = 25)	95[d]	190,000	25	47,500	40-45
Fushe Aires/Qafe Bari	300,000	15-20	93	279,000	23	64,174	40-45
Lak Roshi	450,000	10-20	93[d]	418,500	23	96,255	40-45
Munella[c]	6,000,000	20-28	93[d]	5,580,000	23[e]	1,283,400	40-45
Rrëshen/Rubik	NA[f]	15-25	NA	NA	NA	NA	>40
Derven	NA	10-15	NA	NA	NA	NA	>40
Kurbnesh Perlati	NA	20-25	NA	NA	NA	NA	>40
Mjeda Karma	NA	20-30	NA	NA	NA	NA	>40
						>1,491,329	

a. Metric tons of pyrite concentrate per 100 mt of Cu ore.
b. 10,000 mt of pyrite concentrate in stockpile.
c. Not currently in production for copper sulfides.
d. Assumed similar to Spac.
e. Assumed similar to Qafe Bari.
f. Not available.

Table 4. Lac SSP Plant Average Annual Pyrite Analyses

Year	Acid Insoluble	R_2O_3	Fe_2O_3	Al_2O_3	Fe	Total S	S	SO_4	SiO_2
	(%)								
1967	7.15	64.35	60.17	3.11	42.25	47.47	45.99	.27	
1968	9.85	60.48	57.37	3.09	40.14	45.44	44.35	.20	
1969	14.18	58.08	56.39	1.67	39.46	43.33	42.30	.20	
1970	12.30	59.93	58.24	1.98	40.51	44.26	43.09	.24	
1971	14.05	58.70	56.28	2.32	39.38	43.14	42.11	.21	
1972	13.83	58.30	56.39	1.84	39.35	43.62	42.75	.21	
1973	14.75	59.34	57.21	2.49	40.00	43.88	43.22	.24	
1974	11.37	60.73	56.82	3.95	39.12	44.30	43.68	.42	
1975	10.84	59.93	56.89	3.02	39.20	44.73	44.28	.28	
1976	9.53	61.11	53.37	3.16	40.78	45.73	44.80	.30	
1977	13.59	60.20	55.15	5.04	38.66	43.31	42.72	.28	
1978	11.56	61.25	57.18	4.01	39.98	43.80	43.13	.27	
1979	11.06	59.35	57.57	1.56	40.49	44.28	43.72	.31	
1980	11.67	59.80	57.64	2.09	40.30	43.26	42.91	.29	
1981	17.14	56.86	55.73	1.07	38.99	40.36	38.84	.33	
1982	14.81	56.83	55.97	.90	38.43	40.84	40.28	.44	12.02
1983	16.22	55.23	53.83	2.09	37.68	38.87	38.33	.53	13.44
1984	17.86	55.98	54.20	1.74	38.11	39.05	38.70	.51	14.02
1985	17.37	54.80	50.78	3.50	36.01	38.71	37.99	.43	14.39
1986	17.03	56.50	54.30	2.27	37.48	37.39	36.80	.56	12.62
1987	19.47	56.35	53.78	3.09	37.26	37.21	36.79	.33	15.03
1988	16.07	56.96	54.61	2.15	37.86	39.49	38.97	.42	12.20
1989	14.06	59.35	57.37	1.56	40.00	40.50	40.00	.50	11.10
1990	15.00	56.83	54.91	1.92	38.40	40.70	40.10	.40	13.50
1991	17.00	56.29	54.19	2.10	37.90	39.90	39.50	.31	15.50

Table 5. Potential Costs of Producing Albanian Phosphate Rock[a]

Scenario		(US $)	
I. Mining production costs–Gusmare No crushing or shipping		9.00/mt	19.00/mt
II. Mining, crushing, and direct shipment to Lac from Gusmare	Mining	9.00/mt	19.00/mt
	Crushing	3.00/mt	3.00/mt
	Shipping	19.05/mt	19.05/mt
	Total	31.05/mt	41.05/mt
III. Mining, crushing, and hand sorting of 20% P_2O_5 rock to produce 27.5% P_2O_5 product. Shipment to Lac from Gusmare	Mining	22.50/mt product	47.50/mt product
	Transport ore to plant	15.00/mt product	15.00/mt product
	Crushing	3.00/mt	3.00/mt
	Shipping	13.05/mt	13.05/mt
	Total	53.55/mt	78.55/mt
IV. Flotation[b]		Not estimated	
V. Mining, crushing,[c,d] calcination, and transportation of 30% P_2O_5 product to Lac from Fushe Bardhe	Mining	20.70/mt product	43.70/mt product
	Crushing	3.00/mt	3.00/mt
	Cost of coal	17.35/mt product	17.35/mt product
	Transport ore to plant	11.25/mt product	11.25/mt product
	Shipping	16.05/mt	16.05/mt
	Total	68.35/mt	91.35/mt

a. Using all assumptions discussed in text.
b. Not considered technically viable without further development and/or calcination.
c. Not considered technically viable without further development.
d. Assuming Gusmare mining costs.

Table 6. Calculation of Total Breakeven Mining and Production Cost, Scenario II–Mining, Crushing, and Shipment of 25% P_2O_5 Phosphate Rock to Lac From Gusmare

	Egyptian Rock (28% P_2O_5, $42.00/mt)	High-Grade Rock (32% P_2O_5, $60.00/mt)
	(US $)	
Competitive cost of Albanian rock		
Based on P_2O_5 content	37.50/mt	46.85/mt
Cost of extra sulfuric acid to acidulate 25% P_2O_5 Gusmare rock[a]	9.00/mt	9.00/mt
	28.50/mt	37.85/mt
Crushing and transportation[b]	22.05/mt	22.05/mt
Total breakeven mining and production cost[c]	6.45/mt	15.80/mt

a. Based on a CaO/P_2O_5 ratio of 2.14, comparison with Tunisian phosphate rock (30% P_2O_5), and sulfuric acid from Lac Sulfuric Acid Plant No. 1.
b. From Table 5.
c. This cost per mt must include all capital costs to rehabilitate the mine, working capital, and operating costs.

Table 7. Calculation of Total Breakeven Mining and Production Cost, Scenario III–Mining, Crushing, and Hand Sorting to Produce a 27.5% P_2O_5 Product and Shipment to Lac From Gusmare

	Egyptian Rock (28% P_2O_5, $42.00/mt)	High-Grade Rock (32% P_2O_5, $60.00/mt)
	(US $)	
Competitive cost of Albanian rock Based on P_2O_5 content Cost of extra sulfuric acid to acidulate 27.5% P_2O_5 Gusmare rock[a]	41.25/mt 4.00/mt	51.56/mt 4.00/mt
	37.25/mt	47.56/mt
Crushing and transportation[b]	31.05/mt	31.05/mt
Total breakeven mining and production cost per mt product	6.20/mt	16.51/mt
Total breakeven mining and production cost per mt ore[c,d]	2.48/mt	6.60/mt

a. Based on a CaO/P_2O_5 ratio of 1.87, comparison with Tunisian phosphate rock (30% P_2O_5), and sulfuric acid from Lac Sulfuric Acid Plant No. 1.
b. From Table 5.
c. Production of 1 mt of concentrate requires 2.5 mt of ore.
d. The cost per mt must include all capital costs to rehabilitate the mine, construction of a beneficiation plant, working capital, and operating costs.

Table 8. Calculation of Total Breakeven Mining and Production Cost, Scenario V–Mining, Crushing, Calcination, and Transportation of 30% P_2O_5 Product to Lac From Fushe Bardhe

	Egyptian Rock (28% P_2O_5, $42.00/mt)	High-Grade Rock (32% P_2O_5, $60.00/mt)
	(US $)	
Competitive cost of Albanian rock Based on P_2O_5 content (30% P_2O_5)	45.00/mt	56.25/mt
Crushing and transportation[a]	30.30	30.30
Cost of coal[a]	17.35/mt	17.35/mt
	47.65/mt	47.65/mt
Total breakeven mining and production cost per mt product	-2.65/mt	8.60/mt
Total breakeven mining and production cost per mt ore[b,c]	-	3.74/mt

a. From Table 5.
b. Production of 1 mt of concentrate requires 2.3 mt of ore.
c. The cost per mt must include all capital costs to rehabilitate the mine, construction of a calcination beneficiation plant, working capital, and operating costs.

Table 9. Phosphate Fertilizer Complex Lac–Estimated Cost of Production–Lac Sulfuric Acid, No. 1 Sulfuric Acid Plant (Mid-1993 Leks)-Based on Current Costs of Inputs and Outdated Costs of Pyrites and Phosphate Rock

Annual production, 40,000 mt sulfuric acid (100% basis)

A. Variable Costs					
Item	Unit	Cost/ Unit	Consumption	Cost	% of Total Cost
		(leks)	(mt)	(leks/mt)	
Pyrite Ore	mt	3,190.00	1.00	3,190.00	63.2
Fuel Oil	kg	8.70	4.00	34.80	0.7
Salt (Water Treatment)	kg	10.00	2.80	28.00	0.6
Water	m^3	4.00	52.00	208.00	4.1
Electric Power	kWh	1.80	80.00	144.00	2.8
Lime	mt	3,000	0.013	39.00	0.8
Total Variable Costs	leks/mt			3,643.80	72.2

B. Fixed Costs			
Item	Annual Cost (x 1,000 leks)	Cost leks/mt	% of Total Cost
Operating Wages	5,880.60	147.02	2.9
Annual TA Maintenance Materials[a]	5,292.00	132.30	2.6
Annual TA Maintenance Wages[a]	2,352.20	58.81	1.2
Normal Maintenance Materials	20,000.00	500.00	9.9
Normal Maintenance Wages	863.14	21.58	0.4
Work Unit Supplies	8,000.00	200.00	4.0
Administration and Services[b]	4,117.00	102.93	2.1
Provision-Catalyst Replacement	2,640.00	66.00	1.3
Miscellaneous Expenditure[c]	6,975.74	174.39	3.4
Total Fixed Costs	56,120.68	1,403.02	27.8
Total Cost/mt		5,046.82	100.0

a. TA = Turnaround.
b. Includes transport, laboratory, and shipping/receiving.
c. Calculated at 15% of fixed costs.

Table 10. Phosphate Fertilizer Complex Lac–Estimated Cost of Production–Lac No. 1 ROP Superphosphate Plant (Mid-1993 Leks)–Based on Current Costs of Inputs and Outdated Costs of Pyrites and Phosphate Rock

Annual production, 82,500 mt product

A. Variable Costs

Item	Unit	Cost/Unit	Consumption	Cost	% of Total Cost (Bulk)
		(leks)	(mt)	(leks/mt)	
Phosphate Rock	mt	4,250.00	0.62	2,652.00	46.9
Sulfuric Acid	mt	5,056.70	0.38	1,911.43	33.8
Water	m^3	4.00	16.00	64.00	1.1
Electric Power	kWh	1.80	19.00	34.20	0.6
Limestone	mt	300	0.013	3.90	0.1
Total Variable Costs	leks/mt			4,665.53	82.5

B. Fixed Costs

Item	Annual Cost (x 1,000 leks)	Cost leks/mt	% of Total Cost (Bulk)
Operating Wages	4,374.00	53.02	0.9
Annual TA Maintenance Materials[a]	2,392.50	29.00	0.5
Annual TA Maintenance Wages[a]	1,496.90	18.14	0.3
Normal Maintenance Materials	15,840.00	192.00	3.4
Normal Maintenance Wages	341.70	4.14	0.1
Work Unit Supplies	43,972.50	533.00	9.4
Administration and Services[b]	2,620.30	31.76	0.6
Miscellaneous Expenditures[c]	10,655.69	129.17	2.3
Total Fixed Cost	81,693.59	990.23	17.5
Total Cost/mt Bulk ROP-SSP		5,655.76	100.0
Bags, Bagging, and Loading		600.00	
Total Cost/mt, Bagged ROP-SSP, Ex-Factory		6,255.76	

a. TA = Turnaround.
b. Includes transport, laboratory, and shipping/receiving.
c. Calculated at 15% of fixed costs.

Table 11. Phosphate Fertilizer Complex Lac–Estimated Cost of Production–Lac No. 1 ROP Superphosphate Granulation Plant (Mid-1993 Leks)–Based on Current Costs of Inputs and Outdated Costs of Pyrites and Phosphate Rock

Annual production, 45,000 mt product

A. Variable Costs

Item	Unit	Cost/Unit	Consumption	Cost
		(leks)	(mt)	(leks/mt)
SSP-ROP	mt	5,655.76	1.10	6,221.34
Coal	mt	3,500.00	0.0835	292.25
Water	m^3	4.00	1.70	6.80
Electric Power	kWh	1.80	19.40	34.92
Limestone	mt	300	0.0496	14.88
Total Variable Costs	leks/mt			6,570.19

B. Fixed Costs

Item	Annual Cost (x 1,000 leks)	Cost leks/mt
Operating Wages	4,374.00	97.20
Annual TA Maintenance Materials[a]	1,215.00	27.00
Annual TA Maintenance Wages[a]	695.00	15.44
Normal Maintenance Materials	9,990.00	222.00
Normal Maintenance Wages	233.80	5.20
Work Unit Supplies	12,015.00	267.00
Administration and Services[b]	1,216.50	27.03
Miscellaneous Expenditures[c]	4,460.90	99.13
Total Fixed Cost	34,200.20	760.00
Total Cost/mt Bulk ROP-SSP		7,330.19
Bags, Bagging, and Loading		600.00
Total Cost/mt, Bagged ROP-SSP, Ex-Factory		7,930.19

a. TA = Turnaround.
b. Includes transport, laboratory, and shipping/receiving.
c. Calculated at 15% of fixed costs.

Table 12. Estimated Investment Required for Operation of Lac SSP Factory According to "Best Case" Operating Scheme

Item	Estimated Investment
	(US $)
Sulfuric Acid No. 3 (SA-3)	
a. New boiler	1,500,000
b. Redesign of pyrites furnace	250,000
c. Engineering, installation, and commissioning	300,000
d. New acid circulation pumps (2 sets)	40,000
e. Spare parts (mostly electrical and instruments)	100,000
Subtotal	**2,190,000**
Single Superphosphate No. 2 (SSP-2)	
a. Renovate fugitive dust collection system plus scrubber in rock grinding area (environmental)	400,000
b. Meter for phosphate rock feed to mixer	75,000
c. Meter for acid feed to mixer	40,000
Subtotal	**515,000**
Sulfuric Acid No. 1 (SA-1)[a]	
a. Spare parts	98,000
b. Install portions of new cinder removal section recently imported from China (environmental)	60,000
c. Install sulfuric acid piping to SSP-2	15,000
Subtotal	**173,000**
Additional Environmental	
a. Spare parts and equipment replacement for lime milk unit	150,000
b. Install meters and valves for automatic dosing of lime milk	90,000
c. Repair leak in holding pond	50,000
Subtotal	**290,000**
TOTAL	**3,168,000**

a. The estimated investment of US $173,500 for SA-1 is only what is required for operating the unit temporarily until such time that SA-3 can be started up.

Table 13. Phosphate Fertilizer Complex Lac–Estimated Cost of Production–Lac Sulfuric Acid, No. 3 Sulfuric Acid Plant (Mid-1993 Leks)

Annual production, 40,000 mt sulfuric acid (100% basis)

A. Variable Costs				
Item	Unit	Cost/Unit	Consumption	Cost
		(leks)	(mt)	(leks/mt)
Pyrite Ore	mt	2,400.00	0.88	2,100.00
Fuel Oil	kg	8.70	4.00	34.80
Salt (Water Treatment)	kg	10.00	2.80	28.00
Water	m^3	4.00	52.00	208.00
Electric Power	kWh	1.80	80.00	144.00
Lime	kg	3.00	13.00	39.00
Total Variable Costs	leks/mt			2,553.80

B. Fixed Costs		
Item	Annual Cost (x 1,000 leks)	Cost leks/mt
Operating Wages	5,880.60	147.02
Annual TA Maintenance Materials[a]	5,292.00	132.30
Annual TA Maintenance Wages[a]	2,352.20	58.81
Normal Maintenance Materials	20,000.00	500.00
Normal Maintenance Wages	863.14	21.58
Work Unit Supplies	8,000.00	200.00
Administration and Services[b]	4,117.00	102.93
Provision-Catalyst Replacement	2,640.00	66.00
Miscellaneous Expenditures[c]	12,182.40	304.55
Total Fixed Cost	61,327.34	1,533.19
Total Cost/mt		4,086.99

a. TA = Turnaround.
b. Includes transport, laboratory, and shipping/receiving.
c. Calculated at 15% of fixed costs.

Table 14. Phosphate Fertilizer Complex Lac–Estimated Cost of Production–Lac No. 1 or No. 2 SSP Superphosphate Plant (Mid-1993 Leks)

Annual production, 70,000 mt

A. Variable Costs				
Item	Unit	Cost/Unit	Consumption	Cost
		(leks)	(mt)	(leks/mt)
Phosphate Rock	mt	6,000.00	0.624	3,744.00
Sulfuric Acid	mt	4,087.00	0.38	1,553.06
Water	m^3	4.00	16.00	64.00
Electric Power	kWh	1.80	19.00	34.20
Limestone	mt	300.00	0.013	3.90
Total Variable Costs	leks/mt			5,399.16

B. Fixed Costs		
Item	Annual Cost (x 1,000 leks)	Cost leks/mt
Operating Wages	4,374.00	62.48
Annual TA Maintenance Materials[a]	2,392.50	34.18
Annual TA Maintenance Wages[a]	1,496.90	21.38
Normal Maintenance Materials	15,840.00	226.28
Normal Maintenance Wages	341.70	4.88
Work Unit Supplies	43,972.50	628.18
Administration and Services[b]	2,620.30	37.43
Miscellaneous Expenditures[c]	10,655.69	152.22
Total Fixed Cost	81,693.59	1,167.53
Total Cost/mt Bulk ROP-SSP		6,566.69
Bags, Bagging, and Loading		600.00
Capital Charges (Loan and Interest)		832.00
Margin (5% of Production Cash Cost)		328.30
Less Credit for Na_2SiF_6 (Sodium Fluosilicate)		-450.90
Plant-Gate Cost for Bagged ROP-SSP/mt Product		7,876.09

a. TA = Turnaround.
b. Includes transport, laboratory, and shipping/receiving.
c. Calculated at 15% of fixed costs.

Table 15. Phosphate Fertilizer Complex Lac–Estimated Cost of Production–Lac ROP-SSP Produced From Sulfuric Acid Produced in No. 3 Sulfuric Acid Plant (Mid-1993 Leks)

Annual production, 32,800 mtpy of sulfuric acid and 60,000 mtpy of ROP-SSP

	Cost of Sulfuric Acid (100%)–leks/mt		
	Cost of Pyrites–leks/mt		
	2,400	1,000	0
Production Cash Cost/mt H_2SO_4 (100%)–Production Rate of 32,800 mtpy			
Pyrites	2,100.00	880.00	0
Other Variable Costs	453.80	453.80	453.80
Fixed Costs	1,869.75	1,869.75	1,869.75
Subtotal	4,423.55	3,203.55	2,323.55
Production Cash Cost/mt ROP-SSP	Production Rate of 60,000 mtpy		
Sulfuric Acid	1,680.95	1,217.35	882.95
Phosphate Rock	3,744.00	3,744.00	3,744.00
Other Variable Costs	102.10	102.10	102.10
Fixed Costs	1,361.50	1,361.50	1,361.50
Total Cost/mt Bulk ROP-SSP	6,888.55	6,424.95	6,090.55
Bags, Bagging, and Loading	600.00	600.00	600.00
Capital Charges (Loan and Interest Payments)	970.66	970.66	970.66
Margin (5% of Bulk Cost)	344.43	321.25	304.53
Less Credit for Sodium Fluosilicate	-450.90	-450.90	-450.90
Total Plant-Gate Cost for Bagged ROP-SSP/mt Product	8,352.74	7,865.96	7,514.84

Table 16. Phosphate Fertilizer Complex Lac–Estimated Cost of Production–Lac ROP-SSP Produced From Sulfuric Acid Produced in No. 3 Sulfuric Acid Plant (Mid-1993 Leks)

Annual production, 40,000 mtpy of sulfuric acid and 70,000 mtpy of ROP-SSP

	Cost of Sulfuric Acid (100%)–leks/mt		
	Cost of Pyrites–leks/mt		
	2,400	1,000	0
Production Cash Cost/mt H_2SO_4 (100%)–Production Rate of 40,000 mtpy			
Pyrites	2,100.00	880.00	0
Other Variable Costs	453.80	453.80	453.80
Fixed Costs	1,533.20	1,533.20	1,533.20
Subtotal	4,087.00	2,867.00	1,987.00
Production Cash Cost/mt ROP-SSP	Production Rate of 70,000 mtpy		
Sulfuric Acid	1,553.06	1,089.46	755.06
Phosphate Rock	3,744.00	3,744.00	3,744.00
Other Variable Costs	102.10	102.10	102.10
Fixed Costs	1,167.00	1,167.00	1,167.00
Total Cost/mt Bulk ROP-SSP	6,566.16	6,102.56	5,768.16
Bags, Bagging, and Loading	600.00	600.00	600.00
Capital Charges (Loan and Interest Payments)	832.00	832.00	832.00
Margin (5% of Bulk Cost)	328.30	305.13	288.41
Less Credit for Sodium Fluosilicate	-450.90	-450.90	-450.90
Total Plant-Gate Cost for Bagged ROP-SSP/mt Product	7,875.56	7,388.79	7,037.67

Table 17. Phosphate Fertilizer Complex Lac–Estimated Cost of Production–Lac ROP-SSP Produced From Sulfuric Acid Produced in No. 3 Sulfuric Acid Plant (Mid-1993 Leks)

Annual production, 40,400 mtpy of sulfuric acid and 80,000 mtpy of ROP-SSP

	Cost of Sulfuric Acid (100%)–leks/mt		
	Cost of Pyrites–leks/mt		
	2,400	1,000	0
Production Cash Cost/mt H_2SO_4 (100%)–Production Rate of 40,000 mtpy			
Pyrites	2,100.00	880.00	0
Other Variable Costs	453.80	453.80	453.80
Fixed Costs	1,518.02	1,518.02	1,518.02
Subtotal	4,071.82	2,851.82	1,971.82
Production Cash Cost/mt ROP-SSP	Production Rate of 80,000 mtpy		
Sulfuric Acid	1,547.29	1,083.69	749.29
Phosphate Rock	3,744.00	3,744.00	3,744.00
Other Variable Costs	102.10	102.10	102.10
Fixed Costs	1,021.12	1,021.12	1,021.12
Total Cost/mt Bulk ROP-SSP	6,414.51	5,950.91	5,616.51
Bags, Bagging, and Loading	600.00	600.00	600.00
Capital Charges (Loan and Interest Payments)	728.00	728.00	728.00
Margin (5% of Bulk Cost)	320.73	297.55	280.82
Less Credit for Sodium Fluosilicate	-450.90	-450.90	-450.90
Total Plant-Gate Cost for Bagged ROP-SSP/mt Product	7,612.34	7,125.56	6,774.43

Table 18. Spot Prices of Diammonium Phosphate (DAP) f.o.b. North Africa; January-August 1993

Month	Bulk DAP f.o.b. North Africa	Bagged DAP f.o.b. North Africa
(1993)	US $/mt (Range)	US $/mt (Range)
January	155-158	160-170
February	140-158	155-170
March	125-145	150-155
April	125-135	145-150
May	125-135	145-150
June	125-135	145-150
July	120-135	140-145
August	125-135	140-145

Source: Weekly Telefax Report; FMB Consultants, Ltd.; Middlesex, United Kingdom.

Table 19. Annual Seasonal Distribution/Sales of Phosphate Fertilizers

	1985 (mt)	1985 (%)	1987 (mt)	1987 (%)	1989 (mt)	1989 (%)	1992 SSP (mt)	1992 SSP (%)	1992 DAP (mt)	1992 DAP (%)	1993 SSP (mt)	1993 SSP (%)	1993 DAP (mt)	1992/93 DAP (%)
January	11,403	9.39	13,579	7.74	18,258	11.19	955	12.01			108	4.27	50	0.51
February	12,348	10.17	17,748	10.12	13,284	8.14	1,131	14.23			953	37.70	130	1.33
March	12,012	9.89	17,308	9.87	19,788	12.12	189	2.38			538	21.28	320	3.28
April	16,220	13.36	20,852	11.89	14,421	8.83	318	4.00			308	12.18	280	2.87
May	9,914	8.17	13,718	7.82	9,984	6.12	96	1.21			80	3.16	40	0.41
June	8,262	6.81	10,655	6.08	6,841	4.19	2,220	27.93			141	5.58	890	9.11
July	7,197	5.93	9,614	5.48	13,386	8.20	2,074	26.09			400	15.82	3,750	38.40
August	7,378	6.08	9,610	5.48	14,959	9.16	358	4.50					780	7.99
September	7,967	6.56	13,789	7.86	16,730	10.25	72	0.91	1,000	10.24				
October	9,524	7.84	21,947	12.52	13,420	8.22	304	3.82	2,000	20.48				
November	8,955	7.38	12,578	7.17	10,305	6.31	188	2.37	475	4.86				
December	10,224	8.42	13,956	7.96	11,855	7.26	44	0.55	50	0.51				
Total	121,404	100	175,354	100	163,231	100	7,949	100	3,525		2,528	100	9,765	100

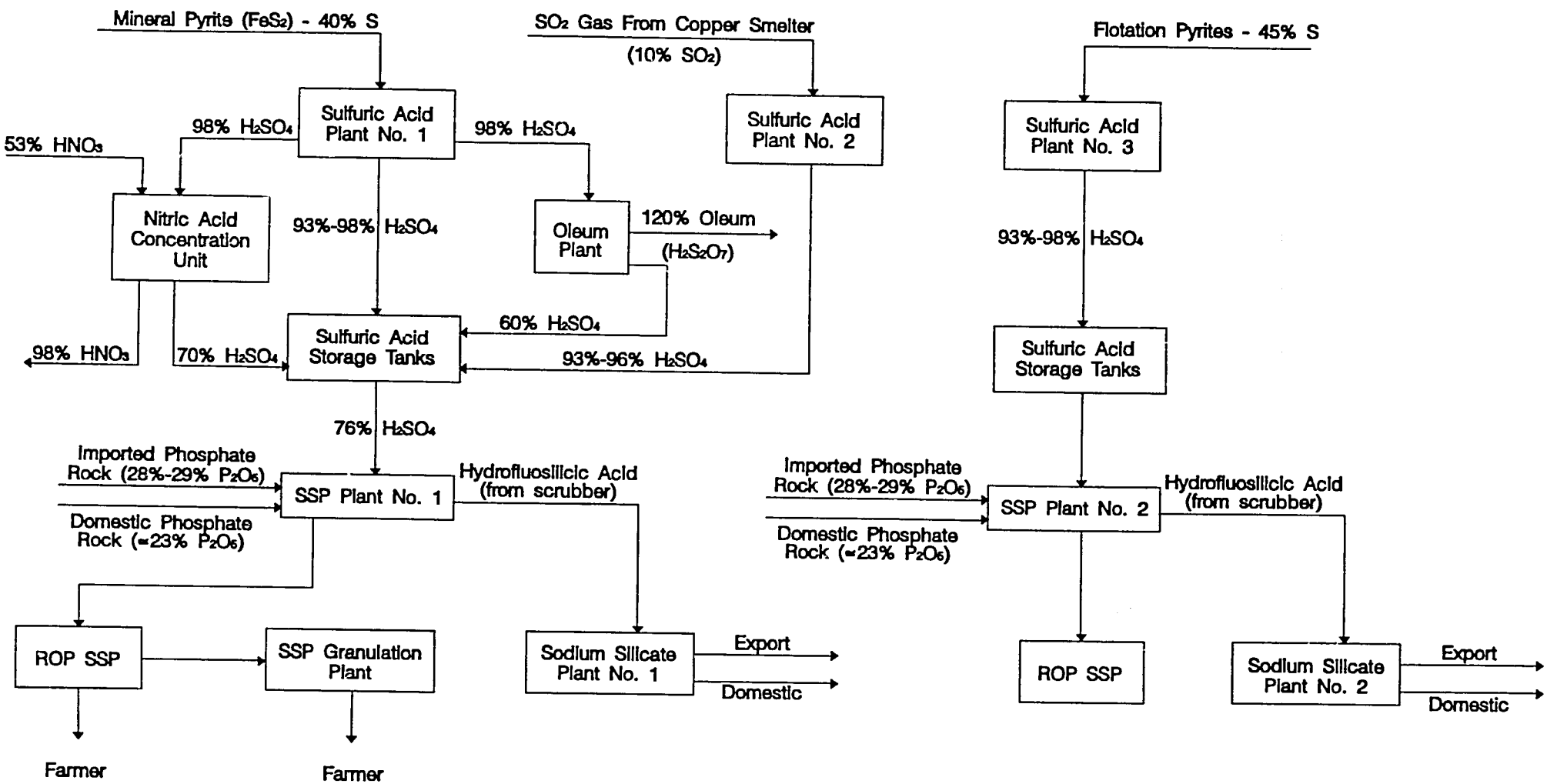


Figure 1. Lac Phosphate Complex Operating Scheme.

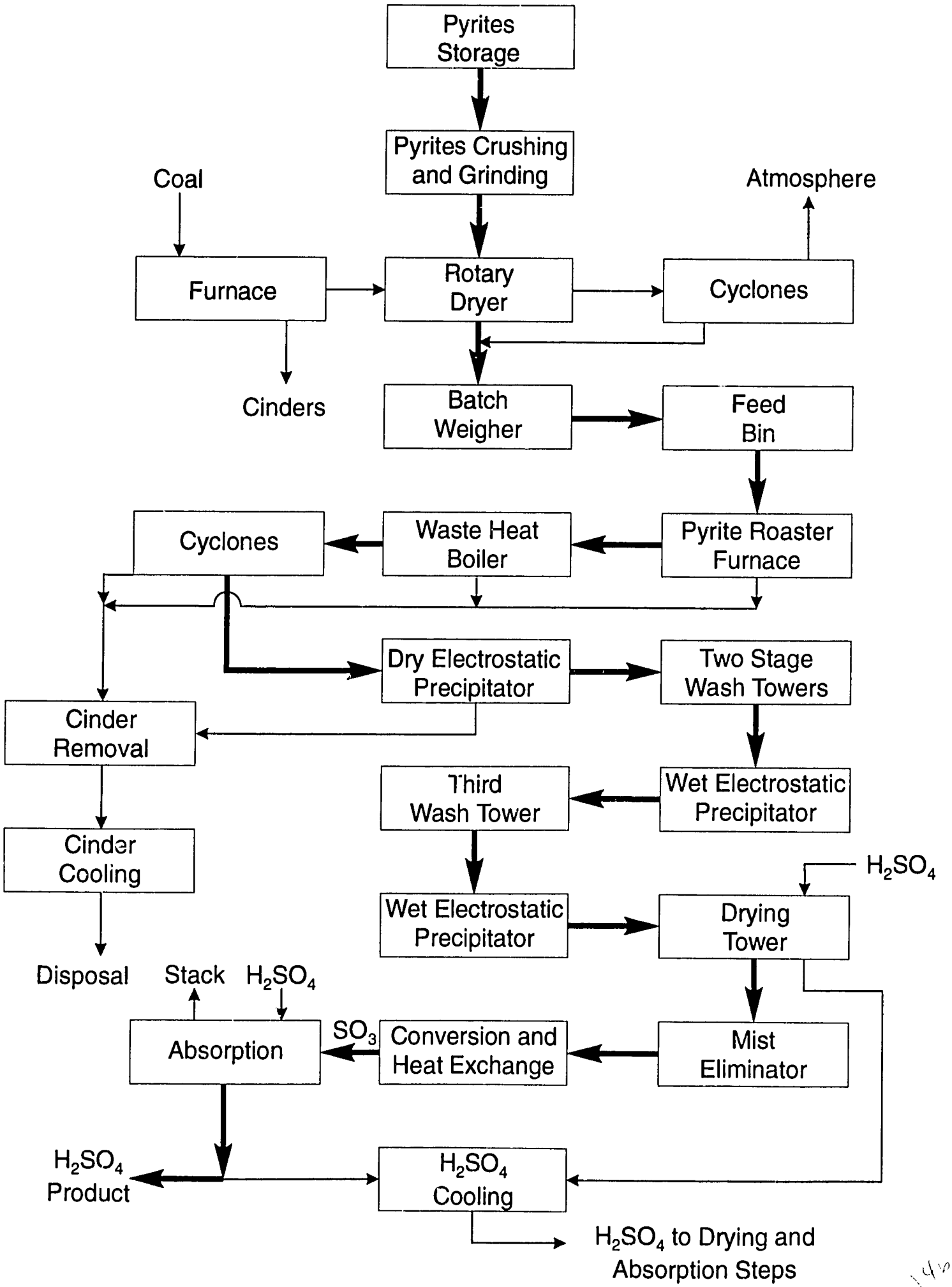


Figure 2. Simplified Flow Diagram: No. 1 Sulfuric Acid Unit.

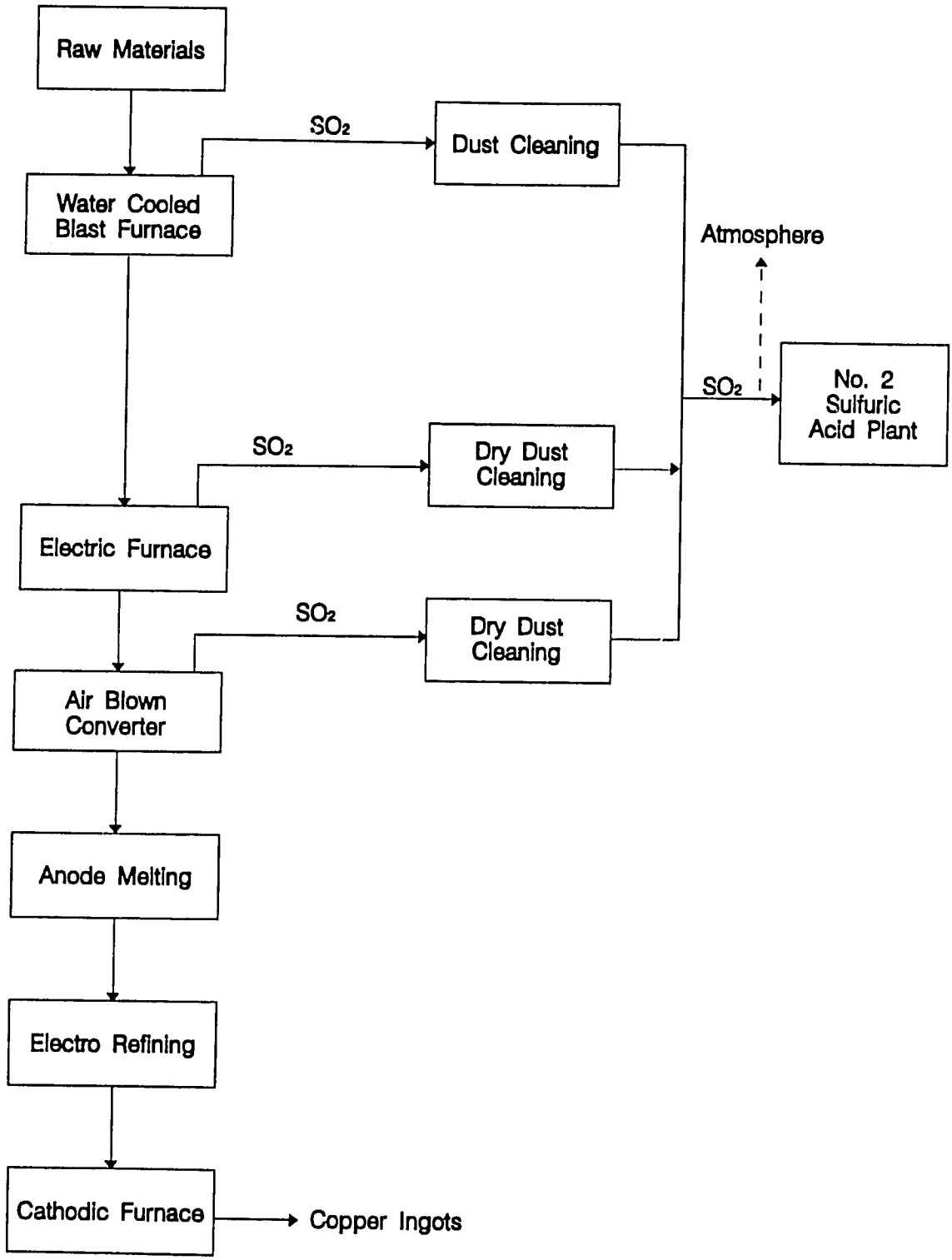


Figure 3. Copper Smelter–SO_2 Feed to No. 2 Sulfuric Acid Plant.

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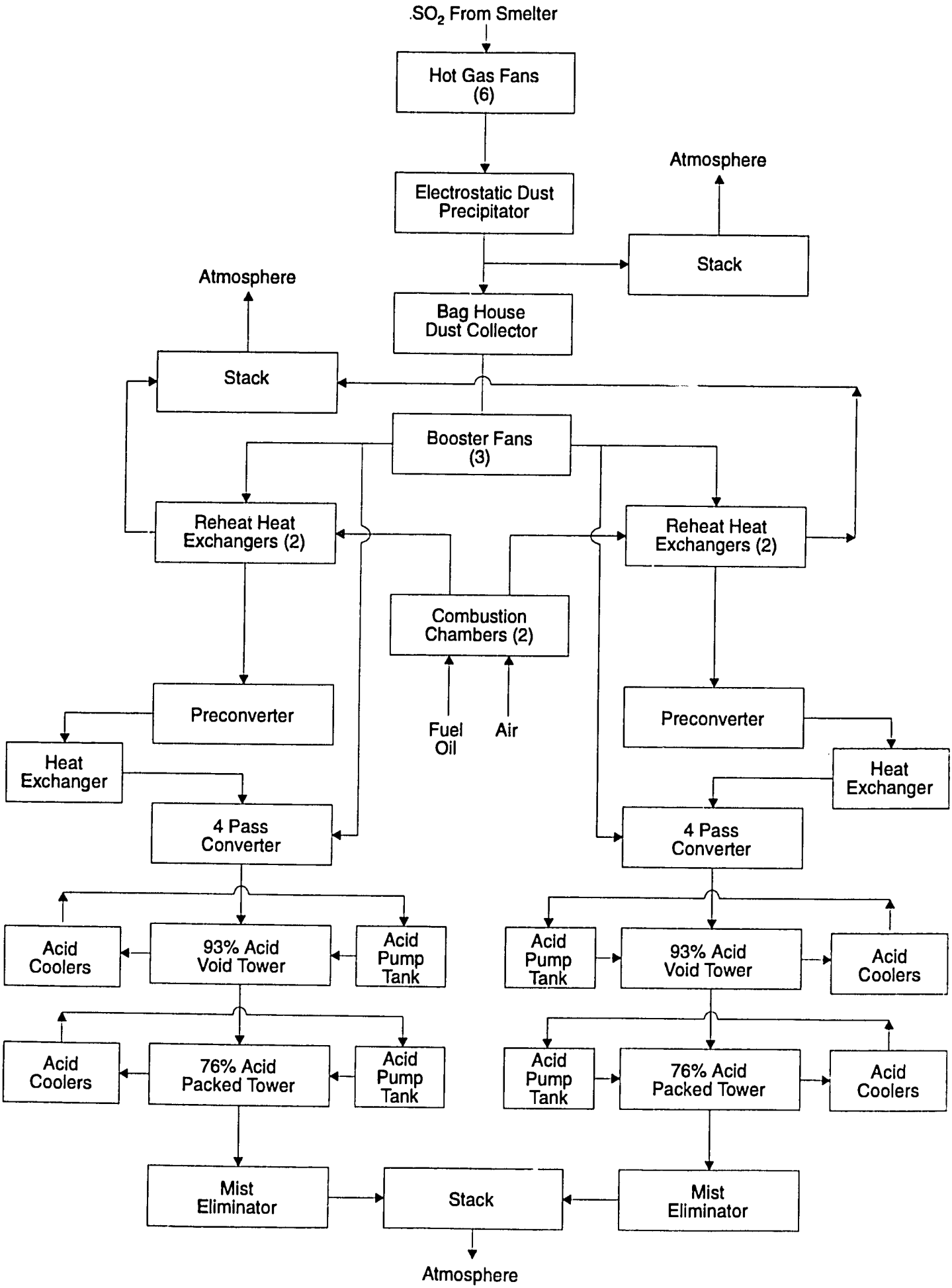

Figure 4. Schematic Flow Diagam of No. 2 Sulfuric Acid Unit (SA-2) at Lac SSP Factory.

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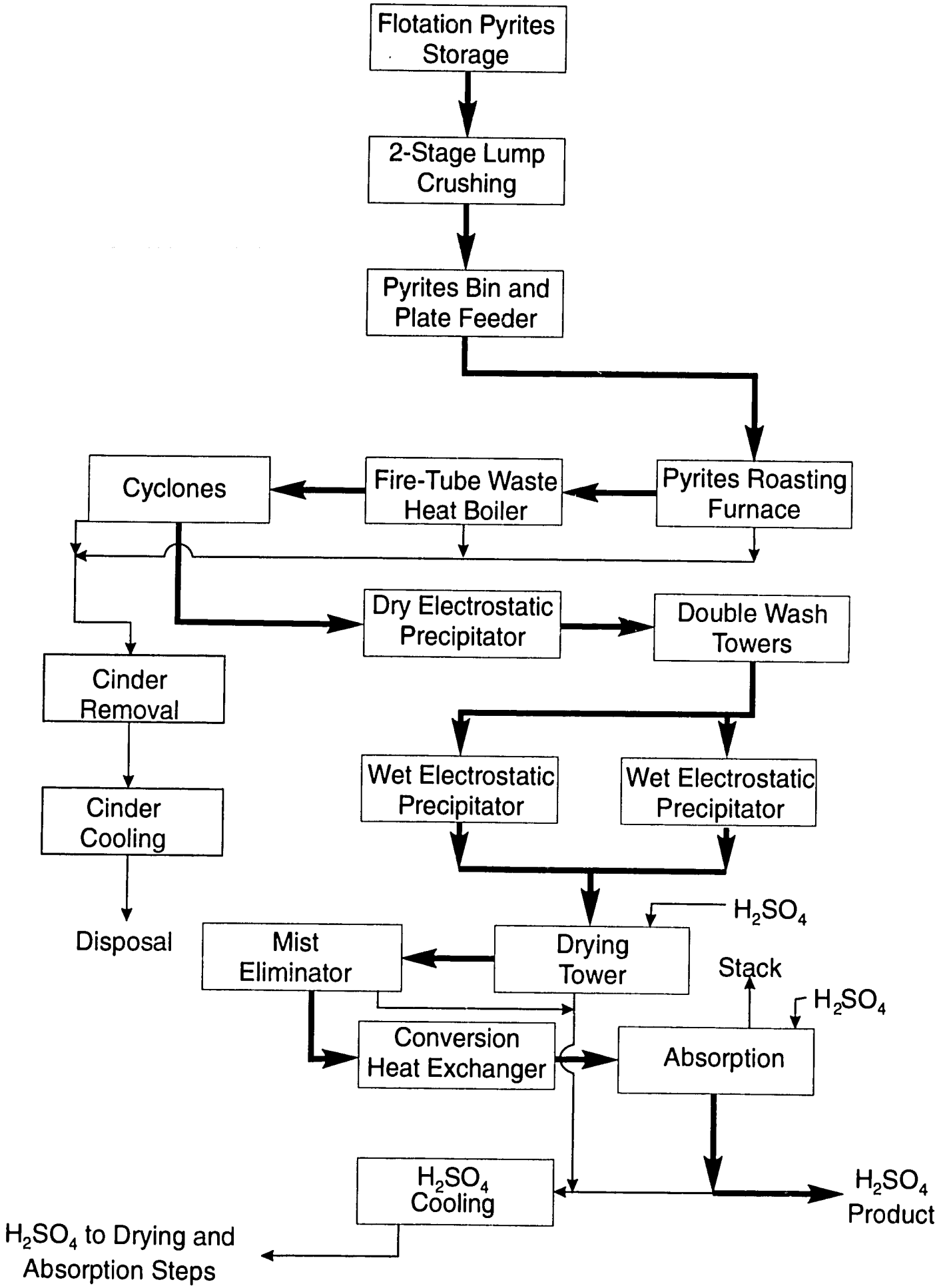

Figure 5. Simplified Flow Diagram: No. 3 Sulfuric Acid Unit.

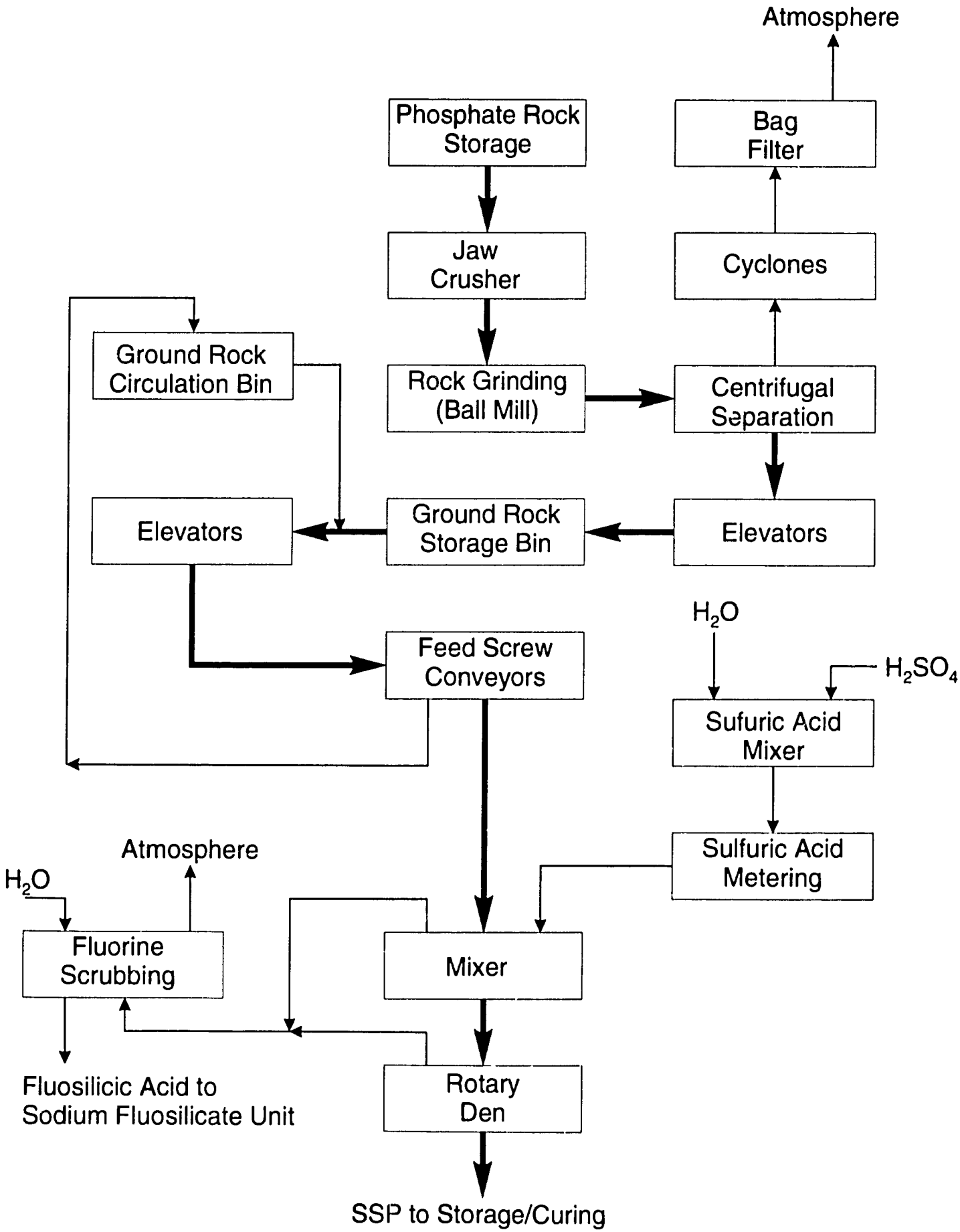

Figure 6. Schematic Flow Diagram: No. 1 SSP Unit.

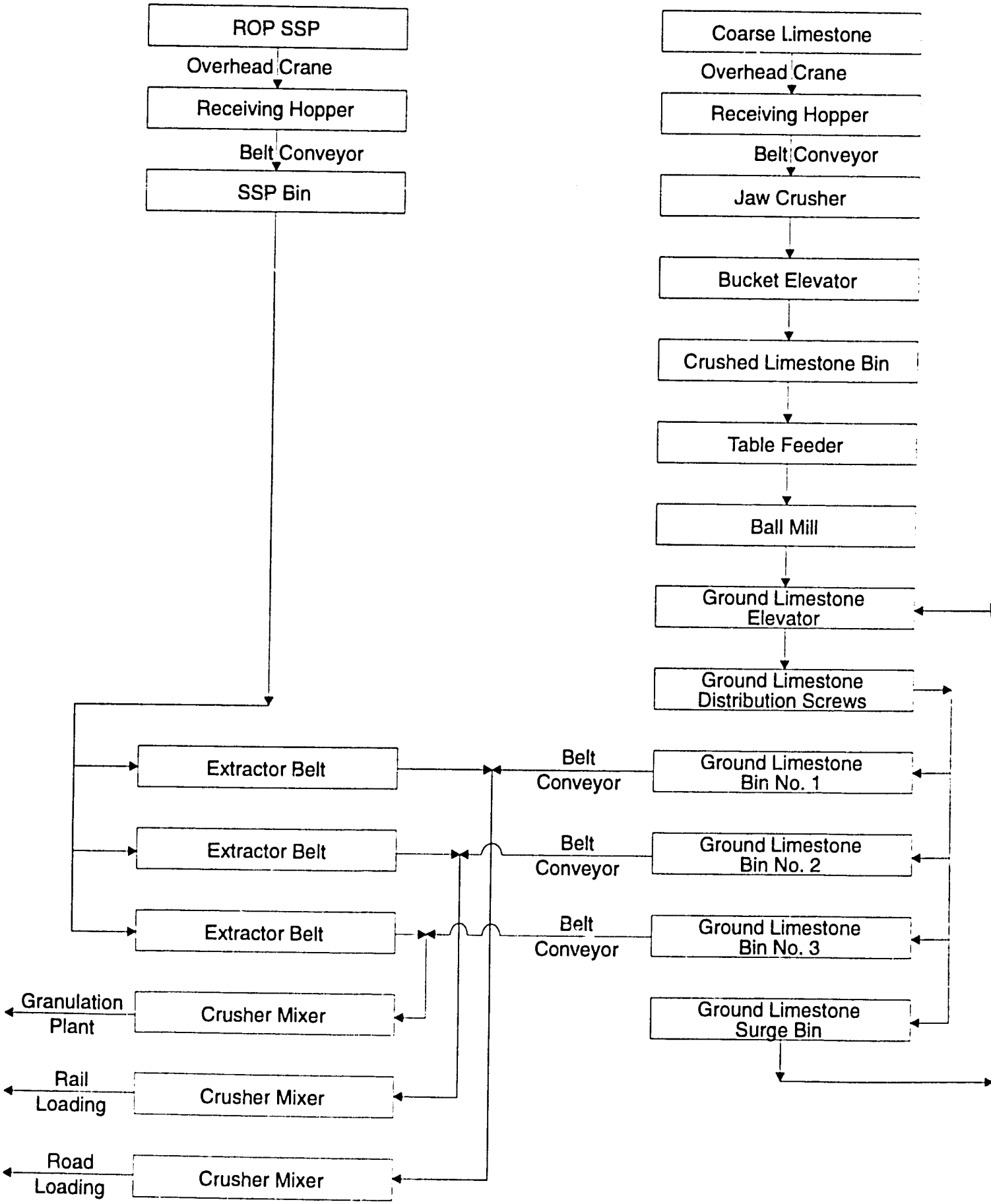

Figure 7. Schematic Flow Diagram of Limestone Unit for Neutralization of Excess Acid in ROP-SSP Product.

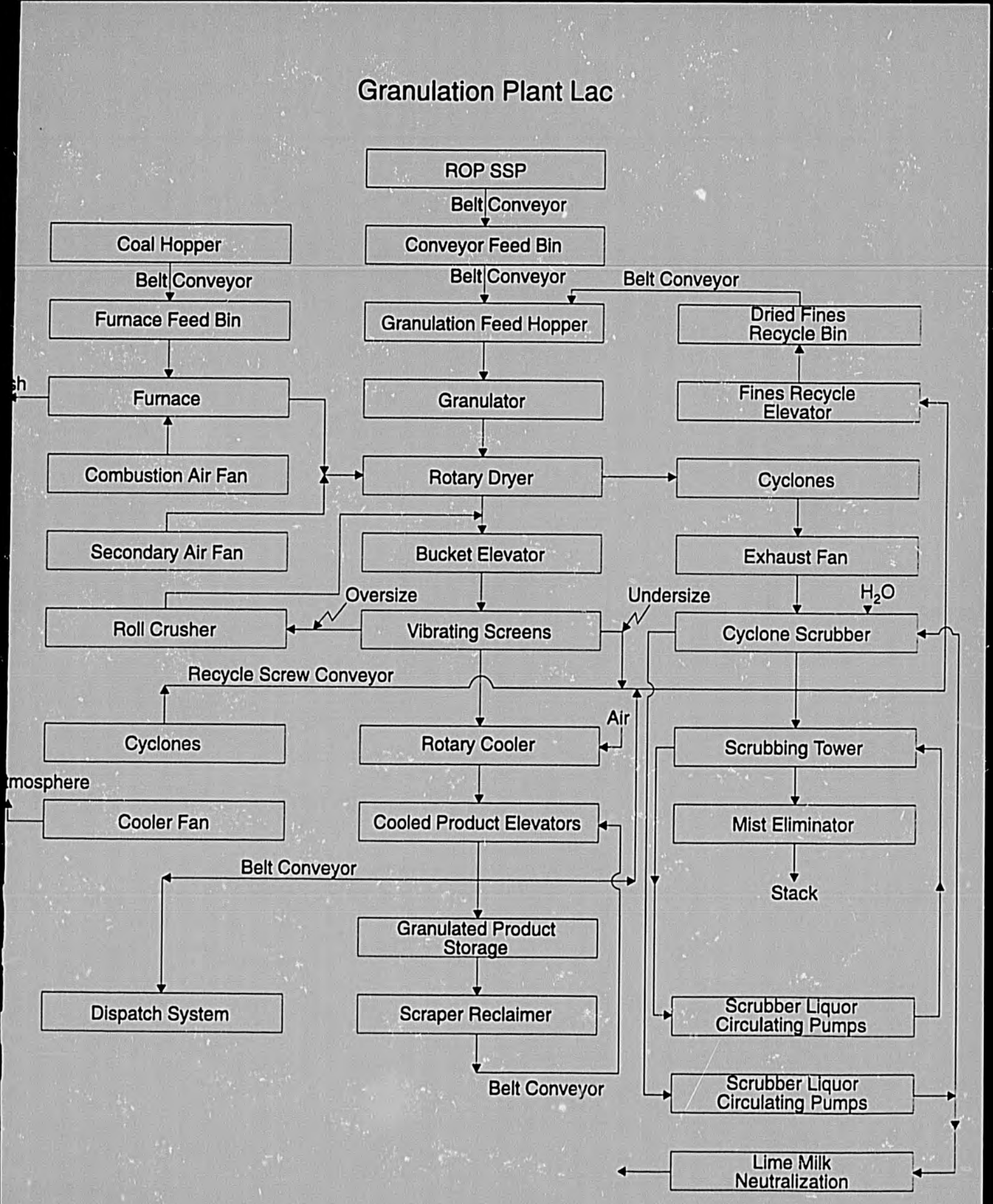

Figure 8. Schematic Flow Diagram of SSP Granualtion Unit at Lac SSP Factory.

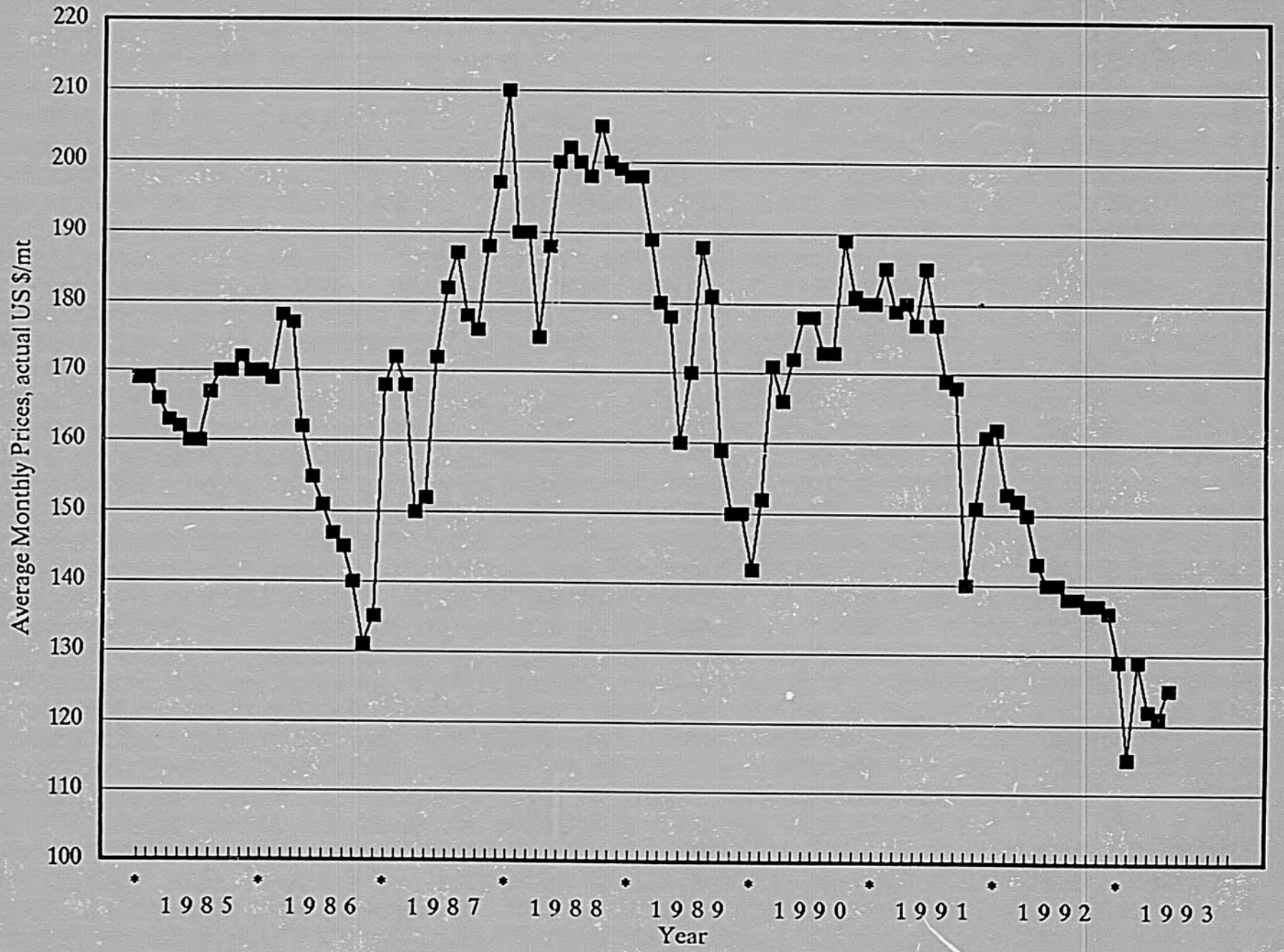

Figure 9. DAP Prices (f.o.b. U.S. Gulf, bulk US $/mt)

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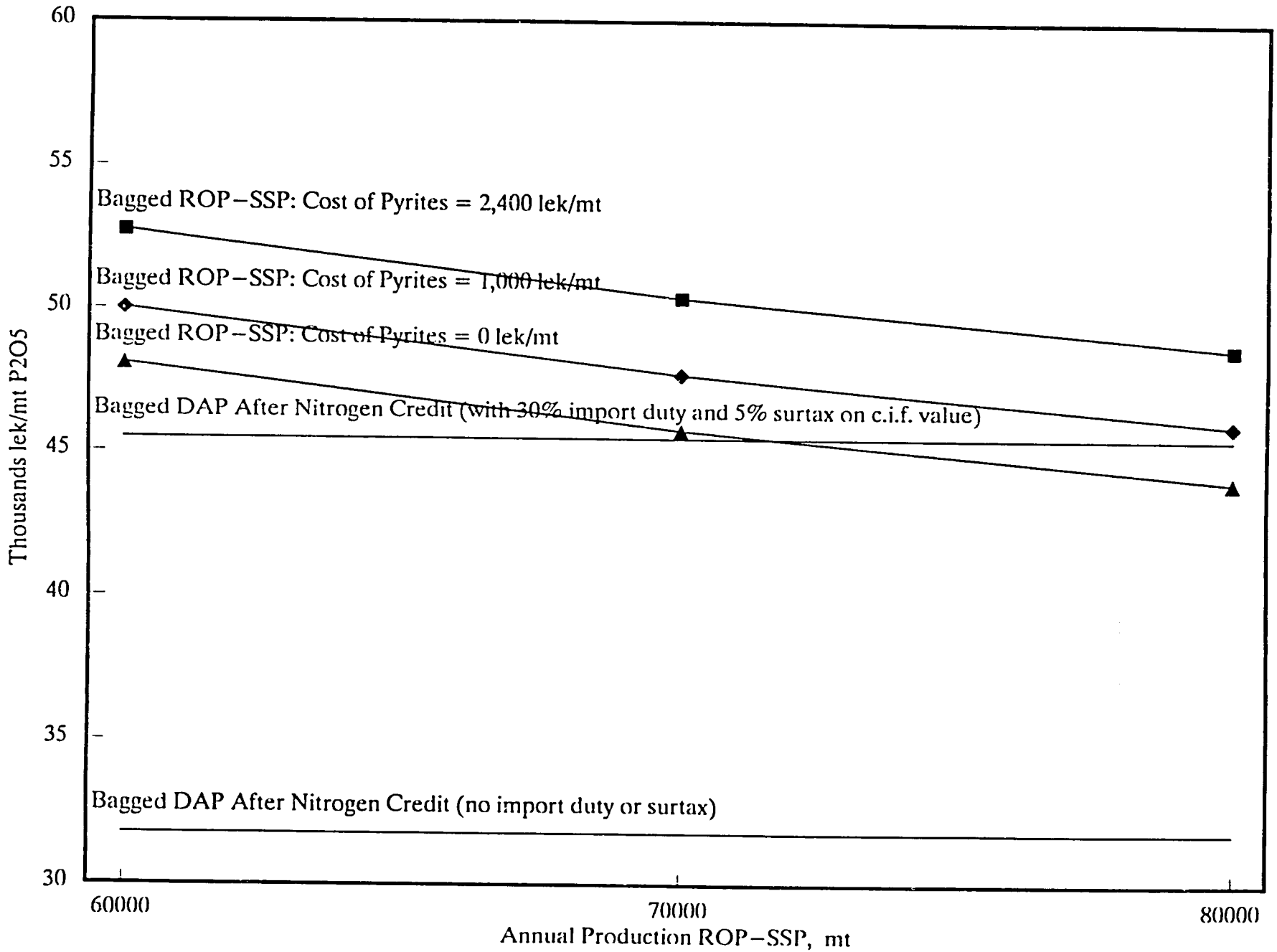

Figure 10. Cost Per Metric Ton of P_2O_5 for ROP-SSP and DAP After Transporting 100 kms in Albania by Truck

Appendix A

Terms of Reference

Draft for Comment
December 2, 1993

Appendix A

Terms of Reference (TOR)

Introduction

As a result of the changes in the political and social structure in Albania, production, distribution, and use of fertilizers have been seriously disrupted. This has caused interruption of production at the fertilizer complex at Lac, which is the sole phosphate fertilizer production site in Albania.

Technical assistance will be provided to the phosphate fertilizer company at Lac for determining the most effective and efficient use of the available resources and facilities at the Lac complex to improve the future viability of the company. This also depends heavily on the availability of raw materials such as iron pyrite from Albania mines, off-gases from an adjacent copper smelting plant, and imported phosphate ore. The value-added concept of producing a single superphosphate (SSP)-based NPK granular fertilizer will also be examined.

Scope of Work

The study covered by this TOR will contain recommendations for rationalizing the Lac phosphate-based fertilizer production units through improved and more efficient use of the necessary resources in more sustainable and environmentally sound ways.

The study will analyze the conditions and capacities under which the different phosphate fertilizer production units (sulfuric acid production, SSP production, and NPK production) should operate to reach the most favorable financial/economic and environmental conditions, considering: (1) the investments that need to be made (for example, spare parts, new equipment, equipment modifications, pollution control equipment, and others); (2) structural changes in the organization for the management, operations, and maintenance functions; (3) the expected availability and supply of raw and beneficiated iron pyrites, sulfur, off-gases from copper smelting, phosphate ores

(indigenous and imported), and sulfuric acid; (4) possible production of new fertilizer grades such as SSP-based compound NPKs, including recommendations for future plant-scale tests for producing new grades recommended; and (5) the market potential for the current products and possible newly proposed products including pricing, the marketing/distribution system, and competition from imported products such as diammonium phosphate (DAP).

The activities and output of the study team will include:

Spare Parts Situation

A recommended spare parts inventory listing will be generated. Preparation of the list will be based on (1) equipment manufacturer's recommendations, (2) historical data provided by plant personnel and from operational and maintenance records, and (3) the expertise of the study team members.

The listing will also include nonequipment spares, i.e., piping/valves, sheet and bar steel, and other essential materials and supplies. Determination of whether to include a part in the list will be made using as criteria: (1) the criticality of the part and of the equipment it fits into, (2) its expected life, (3) its availability in the local and foreign market, (4) procurement lead time, (5) its duplication in other equipment, and (6) the cost of the part.

It is possible that all of the required information may not be available for identifying and determining spare parts necessary for the Chinese and Polish manufactured equipment. In such case, recommendations will be given regarding additional studies or actions to be taken to obtain the necessary spare parts information.

Estimates will be made of the costs of procuring the required spare parts based on the recommended inventory levels and spares currently in stock.

Other Investments

Analyses will be made to determine the physical and process modifications, including any new equipment, needed to improve the efficiency and operability of the units, and to decrease environmental pollutants. The aim of the recommended modifications will be to enhance the ability of the plant products to compete in the domestic and regional phosphate fertilizer market. It is expected that modifications recommended for environmental pollution control will allow compliance with accepted

standards. However, the engineering design of the recommendations will not be a part of this project.

Raw Materials Supply Situation

Assessments will be made of the long-term availability, likely quality, and the effect of their use on the environment of raw materials needed for the complex including unprocessed pyrite ore, beneficiated pyrite, off-gases from copper smelting, and phosphate ore. The issue of nitrogen and potassium (potash) supply in the case of NPK production will also be addressed.

Alternate sources of sulfur and sulfuric acid will be evaluated.

Possible New Fertilizer Grades

The possibility of producing fertilizers other than single superphosphate (SSP) will be investigated. In the event that such production appears feasible and the economics are favorable, recommendations will be made for future plant-scale test runs to determine modifications necessary to allow production on a continuous basis. The cost of the plant-scale tests and engineering design of the modifications are not a part of this study; however, recommendations will be made.

Modification of the Company Structure

The present structure of the company will be analyzed and recommendations will be made for its reorganization to achieve a structure that will be more responsive to the present day needs of the company.

The recommended structure will consider the new forces and pressures acting upon the company from (1) the marketplace, (2) environmental requirements, and (3) the need to be financially and economically competitive in a free-market system.

Cost Analysis

The expected conversion and production costs for the phosphate products produced at Lac will be calculated using input from the above activities. Sensitivity analyses will be made to determine the effect that the major cost items will have on these costs. Alternative raw materials will be considered if appropriate.

These cost data will be used to make a profitability analysis for the Lac complex including the expected cash flow for the next 10 years and the net present value (NPV) using several discounting rates. Sensitivity analyses will be performed relating

profitability to variations in product prices, sales, volume, and production costs. This information will be useful for a more detailed, but separate, analysis of the potential to privatize the Lac complex.

Marketing/Distribution/Pricing

Production and cost data from the above activities will be used to assess availability of markets in Albania as well as regional markets for the current products from the Lac complex including any possible new products such as SSP-based NPKs.

Recommendations will be made as to the distribution/marketing system which should be used. The pricing structure for the products will be determined from the cost analyses performed in the above activities. With this as a basis, determinations will be made of the marketability of the Lac plant products in Albania and the region considering competition with imported products such as diammonium phosphate (DAP) and NPKs.

Environmental Considerations

Acceptable operation of process plants of the type contained in the Lac phosphate fertilizer complex must be characterized by provisions for protection of the environment. In fact, the No. 2 sulfuric acid plant at Lac acts as an environmental pollution control device for the adjacent copper smelting operation. An important part of this study will be: identification of sources of atmospheric, aqueous, and solid pollutants; assessments of existing measures used for decreasing emissions of environmental pollutants as determined from historical data at the plant; and recommendations for modifications needed, including cost estimates, to permit the Lac complex to comply with internationally acceptable standards.

Study Methodology

In performing the study, IFDC will use its own professional staff and outside consultants with special skills. Successful performance of the study will require significant input from the Lac plant management and personnel. Free access to company records will be necessary.

Guidelines for the type of information needed from the plant are given in the following: (1) Appendix A which lists the required English documents and (2) Appendix B which is a listing of questions and other needed information.

IFDC will appoint a team to coordinate and be responsible for all of the study work including environmental analyses and recommendations. The composition of the IFDC team will be as follows:

Donald R. Waggoner – Chemical Engineer, Fertilizer Production Specialist, Team Leader
Steven J. Van Kauwenbergh – Specialist, Geology
Claude Freeman – Marketing/Training Specialist (currently assigned to Albania)
Donald Charles Young – Phosphate Fertilizer Specialist
Specialists at IFDC Headquarters – Financial/Cost Analyst, Production, and Environmental Affairs

It is important that Albanian counterparts to the IFDC team be appointed who are knowledgeable of plant financial/cost aspects, plant operations, maintenance, and raw materials supply. The counterparts should as far as possible be English-speaking.

The proposed schedule for implementing the study follows:

	Calendar Time (weeks)	Actual Work Time – Team Total (workdays)
Team preparation	2.0	20
In-country study	3.0	55
Travel to and from Albania	0.5	12
Post-study calculation period and report preparation at IFDC Headquarters	5.5	72
IFDC secretarial		14
Graphics		10
TOTAL	11	183

Reporting

The output from all the analyses performed by the study team will be presented in a final report issued at the culmination of all activities. The report will include the

results from all calculations as well as the recommendations for improving the financial/economic and environmental situations of the Lac complex.

Recommendations will be given regarding the feasibility of producing new fertilizer grades at Lac including recommendations for plant scale test runs, if required. The report will be issued in English and will use metric units.

Prior to finalizing the report, comments will be solicited from USAID, IFDC-Albania, and Lac personnel and incorporated in the report as appropriate.

Appendix A

Documents Required

Copies of the following documents, translated into English, will be required to fully analyze the sulfuric acid, single superphosphate, and granulation production units:

- Operating manuals for the different operating units.
- Lists of recommended spare parts provided by the manufacturers of the different equipment.
- Current spare parts inventory listing indicating amount in storage and equipment to which it goes. The inventory listing should include those items for which the current amount in stock is zero (0).
- Organization chart showing staffing for the different units.
- Description of the administrative organization.
- Description of the production organization.
- Description of the maintenance organization.
- Description of the marketing organization.
- Operational and maintenance records for the different operating units.

Appendix B

Information Required

The following information will be reviewed to fully analyze the sulfuric acid, single superphosphate, and granulation production units and determine their respective production costs:

- Historical and projected sales volumes for each product made, by area and by crop, and seasonal character of these.
- Design and attained production capacities in each operating unit.
- Frequency and amount of production losses (downtime) incurred, indicating reasons for the losses.
- Average on-stream factor for each operating unit, apart from feedstock shortages.
- Piece of equipment or machinery which is the major cause of shutdowns for each operating unit.
- Frequency for catalyst changes recommended by technical and operating staff for the sulfuric acid units.
- Storage capacity available for raw and intermediate materials, and for products.
- Unit consumptions of raw and intermediate materials, and of energy and other utilities.
- Current raw material procurement systems and their cost including f.o.b. price, freight, unloading, insurance, and other related taxes, fees and charges.
- Cost of alternative raw materials.
- Unit cost for electricity, steam, water, fuels, other utilities and bags.
- Amounts generated and emitted of fogs, aerosols, dusts, and entrained particles in gaseous streams (determined through actual sampling, measurement, and analysis).
- Quality and amounts of liquid effluent streams (determined through actual sampling, measurement, and analysis).
- Place where liquid effluent streams are sent.
- Place where solid wastes are sent.
- Quality of products made considering chemical and physical parameters, including particle size distribution, nutrient content, physical properties, and contaminants present (determined through actual sampling and analysis).
- Labor costs.
- Selling, distribution, administration and overhead expenses.

- Historical and projected product prices.
- Existence of any long- or short-term loans, or of any other financial burden or encumbrances on units, including amounts and payment schedules.
- Any other information which would be necessary or useful to perform the activities included in the scope of work.
- Chemical analysis of raw materials and other inputs, indicating types and amounts of impurities.
- Are spare parts for any of the pumps, turbines, and compressors/blowers available from vendors in Albania?
- Are there local vendors for the supply of piping and pipe fittings and gaskets, gasket material to make gaskets from vendors' vessel drawings?
- Are vendor parts catalog and service manuals in the plant for all pumps, turbines, blowers, and compressors for the three plants?
- For the Chinese and Polish pumps, blowers, and compressors, are spare parts available from China or Poland? From any other country? Can you tell if the machinery is cloned; and if so, can you tell from what manufacturer it is cloned so some clue might be available to know where to go to look for parts.
- Other than the installed spare machinery, are there spare parts in stores inventory for the equipment?
- At the time the plants were constructed, were the various pieces of mechanical equipment such as the pumps and compressors given a plant number to utilize in a plant spare parts catalog or parts listing?
- Does the plant have a separate plant stores system and who is it under-maintenance or operations? Are parts checked out or issued? Can anyone go into stores and get parts?
- Is the maintenance department equipped to do machining and/or fabricate parts on a routine or emergency basis?
- Are spare parts still available for the sulfuric acid-1, sulfuric acid-2, SSP-1, and the granulation unit?
- For any parts that are inventoried in the stores inventory, how are records maintained?
- What is the current status of the copper mine and processing facility that produced pyritic feedstocks for the SSP plant?
- What is the status of other copper mines in Albania that could potentially produce pyrites?
- Aside from the use of pyrites, are there any other significant sources of sulfur in Albania?

- Have any technical and/or economic studies been performed to determine the viability of producing the copper deposits under world market conditions in an environmentally acceptable fashion? What are the results of those studies?
- What mining and processing methods were used to produce copper ores and sulfur-bearing byproducts? What condition is the mining and processing equipment in? Are these mining and processing methods and equipment suitable for further commercial production in an environmentally acceptable way that considers the safety of mine and production plant workers?
- What is the current status of the small Albanian phosphate producing mine?
- Have any technical and/or economic studies been performed to determine the technical and/or economic feasibility of producing these deposits to supply phosphate feedstocks to the Lac SSP plant? What are the results of such studies?
- What is the technical feasibility of mining, beneficiating, and using feedstocks from the Albanian phosphate deposits in the Lac SSP plant?

Appendix B

Key People Met in Albania by the IFDC Team While Conducting the Study

Appendix B

Key People Met in Albania by the IFDC Team While Conducting the Study

Lac Factory Staff
Lac Single Superphosphate Factory
Lac, Albania

Mr. Simon Rica	Director
Mr. Bashkim Shahu	Chief Engineer
Mr. Isa Hoxha	Head of Mechanical Department
Ms. Pashke Marku	Chief Accountant
Mr. Baskim Curri	Chief of Procurement
Mr. Edmond Qarroj	Chemist
Mr. Eduart Hibo	Engineer
Mr. Mark Lleshi	Technical Staff
Mr. Prek Marashi	Chief of Syndicate
Ms. Sanie Hodo	Technical Staff
Mr. Elez Bordhi	Technical Staff
Mr. Bordmok Premga	Technical Staff
Mr. Muhamet Mance	Finance

Lac Copper Factory Staff

Mr. Zef Lleshi	Director
Mr. Petrit Cuka	Chief Engineer
Mr. Mahmud Demiri	Chief of Operations
Ms. Rosa Bushi	Metallurgist

Ministry of Industry, Mineral Resources and Energy
Sheshi Skenderbej 2
Tirana, Albania

Mr. Franko Krroqi	Vice Minister
Mr. Gene Luarasi	General Director of Chemical Directory
Mr. Namik Luca	Chief of Lac Region of the Department of Industry

Technical Interpreter
Mr. Buyar Dida

ALBBACER
Tirana, Albania

Mr. Halit Shgarthi	Beneficiation Technology Engineer

Spac Mine

Mr. Tonin Dodaj	Director
Mr. Gjou Ndreco	Chief Engineer
Mr. Nik Prenga	Beneficiation Engineer

Fushe-Aires Beneficiation Plant

Mr. Fran Pjetri	Chief Engineer

Geologic Enterprise of Gjirokastra

Mr. Theotoag Nika	Director

Mineral Processing Research Institute

Mr. Gene Myftiu	Director
Dr. Sokol Mati	Chief of Ore Dressing Department
Mr. Safet Boci	Engineer
Mr. Mark Kacaj	Engineer

Geologic Institute
Dr. Marie Koci

Deputy Prime Minister
(ask Ray Diamond)

Appendix C

Historical Production at Lac SSP Factory
1966-92

Appendix C

Lac Single Superphosphate Factory
Historical Annual Production of Sulfuric Acid (98% H_2SO_4)

Year	No. 1 Sulfuric Acid Unit	No. 2 Sulfuric Acid Unit
	(mtpy–98% H_2SO_4)	(mtpy–98% H_2SO_4)
Design capacity	40,000	45,000
1966	23,000	
1967	29,560	
1968	39,858	
1969	43,981	
1970	46,157	
1971	47,096	
1972	45,602	
1973	49,363	
1974	51,533	
1975	52,676	
1976	52,395	
1977	52,608	
1978	53,072	
1979	57,667	Startup
1980	52,648	NA
1981	51,744	NA
1982	48,215	NA
1983	49,633	NA
1984	51,429	NA
1985	50,446	22,623
1986	45,147	33,949
1987	52,138	28,195
1988	50,267	31,014
1989	50,599	31,618
1990	45,814	22,163
1991	17,262	3,658
1992	10,996	-

Lac Single Superphosphate Factory
Historical Annual Production of Single Superphosphate (SSP)

Year	No. 1 SSP Unit Production		
	As Run-of-Pile SSP	As Granular SSP	Total SSP
	(mtpy of product)		
Design capacity	110,000	50,000	110,000
1966	51,000	10,000	61,000
1967	61,937	11,362	73,299
1968	48,912	47,836	96,748
1969	48,354	50,449	98,803
1970	57,633	52,910	110,543
1971	58,999	51,592	110,591
1972	56,205	53,946	110,151
1973	57,770	52,288	110,058
1974	67,484	54,692	122,176
1975	70,814	54,341	125,155
1976	76,390	50,110	126,500
1977	74,832	51,013	125,845
1978	96,712	51,924	148,636
1979	99,306	51,245	150,551
1980	100,196	50,093	150,289
1981	96,649	65,351	162,000
1982	96,849	66,151	163,000
1983	78,499	63,902	142,401
1984	90,062	62,693	152,755
1985	87,515	69,459	156,974
1986	98,560	68,918	167,478
1987	114,241	60,531	174,772
1988	104,113	60,887	165,000
1989	110,152	55,035	165,187
1990	99,342	42,183	141,525
1991	41,994	1,073	43,067
1992	22,409	-	22,409

Note: No. 1 SSP is designed to produce 110,000 mtpy of run-of-pile SSP of which up to 50,000 mtpy can be converted to granular SSP.

Appendix D

Historical Data Related to the Quality of Products

Appendix D

Lac Phosphate Complex
Actual Analysis Pyrites

Year	%	R_2O_3, %	Fe_2O_3, %	Al_2O_3, %	Fe, %	Total S, %	S, %	%	SiO_2, %
1967	7.15	64.35	60.17	3.11	42.25	47.47	45.99	.27	
1968	9.85	60.48	57.37	3.09	40.14	45.44	44.35	.20	
1969	14.18	58.08	56.39	1.67	39.46	43.33	42.30	.20	
1970	12.30	59.93	58.24	1.98	40.51	44.26	43.09	.24	
1971	14.05	58.70	56.28	2.32	39.38	43.14	42.11	.21	
1972	13.83	58.30	56.39	1.84	39.35	43.62	42.75	.21	
1973	14.75	59.34	57.21	2.49	40.00	43.88	43.22	.24	
1974	11.37	60.73	56.82	3.95	39.12	44.30	43.68	.42	
1975	10.84	59.93	56.89	3.02	39.20	44.73	44.28	.28	
1976	9.53	61.11	53.37	3.16	40.78	45.73	44.80	.30	
1977	13.59	60.20	55.15	5.04	38.66	43.31	42.72	.28	
1978	11.56	61.25	57.18	4.01	39.98	43.80	43.13	.27	
1979	11.06	59.35	57.57	1.56	40.49	44.28	43.72	.31	
1980	11.67	59.80	57.64	2.09	40.30	43.26	42.91	.29	
1981	17.14	56.86	55.73	1.07	38.99	40.36	38.84	.33	
1982	14.81	56.83	55.97	.90	38.43	40.84	40.28	.44	12.02
1983	16.22	55.23	53.83	2.09	37.68	38.87	38.33	.53	13.44
1984	17.86	55.98	54.20	1.74	38.11	39.05	38.70	.51	14.02
1985	17.37	54.80	50.78	3.50	36.01	38.71	37.99	.43	14.39
1986	17.03	56.50	54.30	2.27	37.48	37.39	36.80	.56	12.62
1987	19.47	56.35	53.78	3.09	37.26	37.21	36.79	.33	15.03
1988	16.07	56.90	54.61	2.15	37.86	39.49	38.97	.42	12.20
1989	14.06	59.35	57.37	1.56	40.00	40.50	40.00	.50	11.10
1990	15.00	56.83	54.91	1.92	38.40	40.70	40.10	.40	13.50
1991	17.00	56.29	54.19	2.10	37.90	39.90	39.50	.31	15.50

Actual Phosphate Rock Analysis

Year	H_2O, %	P_2O_5, %	LOI, %	%	SiO_2, %	CaO, %	F, %	CO_2, %	R_2O_3, %	SO_4, %	MgO, %
1967	11.00	34.39	6.70	2.60	2.40	52.50	4.27	3.23	.87	1.47	.52
1968	9.50	33.94	5.39	1.88	1.97	52.11	4.04	3.60	.82	1.85	.71
1969	10.40	33.79	4.10	1.66	1.76	52.64	3.96	3.30	.56	1.81	.75
1970	11.20	33.52	6.16	3.36	1.70	52.00	4.00	3.70	.78	1.80	.71
1971	13.00	33.60	4.35	2.10	1.60	50.40	4.00	2.50	1.00	2.01	.90
1972	9.50	33.60	4.05	2.50	1.55	50.15	4.00	6.50	.87	2.10	.80
1973	1.00	33.60	4.00	2.30	1.30	50.36	4.00	2.90	.90	1.92	.90
1974	1.00	33.50	3.90	2.50	2.01	51.24	4.10	2.32	1.02	2.10	.80
1975	1.20	33.50	5.70	2.45	2.10	50.80	4.10	4.00	1.00	2.20	.60
1976	1.00	33.80	5.50	2.50	1.81	51.50	4.00	4.90	1.30	2.20	.60
1977	5.00	27.70	8.40	9.60	8.70	47.50	3.00	6.30	2.50	4.90	.83
1978	5.00	27.60	10.30	9.67	6.64	50.05	3.03	6.43	2.45	3.00	1.46
1979	1.50	25.83	11.17	7.33	1.50	47.20	3.50	8.75	2.02	3.50	1.21
1980	1.50	25.74	10.70	8.80	6.00	44.50	3.60	6.90	2.00	3.50	1.20
1981	1.50	23.87	10.01	12.60	2.75	45.70	3.23	6.53	2.48	3.09	1.28
1982	2.00	27.59	6.07	8.06	3.76	45.24	2.92	6.21	2.90	3.48	1.09
1983	2.31	28.18	7.44	7.67	1.93	46.00	3.41	4.98	3.51	3.72	1.68
1984	1.20	28.92	7.89	5.41	3.26	49.89	2.98	4.22	2.67	2.54	2.08
1985	1.27	28.26	10.36	6.08	4.44	48.90	3.09	7.86	2.35	2.23	.56
1986	2.33	29.18	4.50	11.07	10.16	43.90	3.02	6.15	2.10	1.81	.65
1987	2.30	28.26	10.50	7.10	4.70	50.00	3.03	7.50	2.20	4.85	.70
1988	4.00	28.40	4.23	7.29	3.79	50.65	3.02	7.72	2.80	1.53	
1989	1.15	28.60	5.36	7.84	5.99	52.20	3.10	3.50	2.97	.54	
1990	2.50	28.48	4.90	8.00	6.82	52.10	3.17	5.44	5.51	.90	
1991	2.31	28.00	7.44	8.10	2.00	48.00	3.55	4.87	5.40	.93	
1992	2.50	27.10	8.40	9.60	6.70	49.50	3.10	4.82	5.30	1.20	

Lac Phosphate Complex
Actual Single Superphosphate Analysis

Year	Total P_2O_5, %	Available P_2O_5, %	Free Acid, % P_2O_5	H_2O, %	Conver., %
1967	19.9	19.1	3.2	7.5	95.98
1968	19.7	18.7	3.7	8.4	94.92
1969	19.4	18.5	4	10.2	95.36
1970	19.6	18.8	3.4	9.4	95.92
1971	19.5	18.5	3.7	10.2	94.87
1972	19.7	18.5	3.8	10.3	93.91
1973	19.9	18.5	3.3	8.8	92.96
1974	19.4	18.5	3.6	10.5	95.36
1975	19.5	18.7	3.9	9.5	95.90
1976	19.7	18.3	4.2	9.5	92.89
1977	17.9	16.3	4.2	11.5	91.06
1978	15.9	14.8	4.2	12.9	93.08
1979	15.6	13.9	4.1	12.9	89.10
1980	15.2	14.3	4.6	13.3	94.08
1981	14.5	13.5		13.2	93.10
1982	15.8	14.9	5.5	12.9	94.30
1983	17.5	16.3	4.9	11.8	93.14
1984	16.5	15.1	4.1	11.5	91.52
1985	16.5	15.3	3.7	11.7	92.73
1986	16.5	15.3	4.3	12.5	92.73
1987	16.6	15.5	5.4	12.5	93.37
1988	16.7	15.5	3.9	12.1	92.81
1989	16.6	15.4	4.5	12.6	92.77
1990	16.6	15.3	3.5	12.3	92.17
1991	16.4	15.1	4	12.1	92.07
1992	16.6	15	4.2	12.9	90.36

Granular Superphosphate: Annual Averages
Quality Index

No.	Year	P_2O_5 G	P_2O_5 A	P_2O_5 F	H_2O	Decomposition	Granulometry
		(%)	(%)	(%)	(%)	(%)	(-4 mm +1 mm)
1	1967	20.80	19.77	1.83	2.8	95.05	88.2
2	1968	20.71	19.67	2.04	2.98	94.98	81.1
3	1969	20.50	19.51	2.30	2.5	95.17	85.41
4	1970	20.75	19.60	2.33	3.7	94.46	84.0
5	1971	20.40	19.37	2.60	4.7	94.95	82.5
6	1972	20.50	19.60	3.22	4.6	95.61	78.9
7	1973	20.50	19.35	2.6	5.11	94.39	80.0
8	1974	20.10	19.00	2.5	6.6	94.53	79.4
9	1975	20.10	19.10	2.7	6.3	95.02	78.3
10	1976	20.14	18.72	2.8	6.07	92.97	83.0
11	1977	18.34	17.10	2.26	5.72	93.24	78.09
12	1978	16.63	16.65	1.85	5.06	94.10	76.0
13	1979	16.51	14.66	2.04	5.34	88.82	76.1
14	1980	16.27	15.03	2.34	4.41	92.34	76.75
15	1981	15.25	14.07	2.57	5.54	92.26	71.1
16	1982	16.60	15.74	2.67	5.52	94.82	59.2
17	1983	17.98	16.65	2.96	5.66	92.60	57.4
18	1984	17.41	15.73	2.48	5.35	90.35	44.6
19	1985	17.28	15.88	2.31	6.55	91.95	58.6
20	1986	17.44	16.60	2.51	5.51	95.18	60.7
21	1987	17.45	16.55	2.15	5.27	94.84	62.4
22	1988	17.45	16.55	2.15	5.15	94.84	62.4
23	1989	17.46	16.41	2.01	5.35	93.99	63.2
24	1990	17.45	16.31	2.13	5.29	93.47	61.3
25	1991	-	-	-	-	-	-
26	1992	-	-	-	-	-	-
27	1993	-	-	-	-	-	-

Note: G = Total P_2O_5
A = Available P_2O_5
F = P_2O_5 as free acid

Appendix E

Typical Equipment Inspection Sheet Used by Study Team

Appendix E

Typical Equipment Inspection Sheet Used by Study Team

Definitions Plant Equipment Condition

G	Good–Operable, no obvious maintenance requirements.
F	Fair–Operable, with routine maintenance requirements.
P	Poor–May be operable, but requiring immediate maintenance.
NO	Not operable–Requires repairs before it can be operated.
US	Unserviceable–Not repairable, requires replacement.
NR	Not required–In original design but not installed or removed from use.

Albania Project
No. 1 Superphosphate Plant

Section–Mixing, Denning, and SiF_4 Recovery

Code	Equipment Number	Photo Number	Description	Condition
	201	NR	Rock storage bin	G
	202		Screw conveyor	F–Bearings excessive wear main problem
	203		Bucket elevator	F–Chain wear
	204		Screw conveyor	F–Excessive wear of bearings main problem
	205		Screw conveyor	F–As for 204
	206		Rock dust feed bin	F
	207		Screw conveyor	F–As for 204
	208		Screw conveyor, pipe casing	F
	209		Rock bin	F
	201/1		Sulfuric acid tank	F
	201/2		Sulfuric acid tank	F
	211/1		Sulfuric acid pump	F
	211/2		Sulfuric acid pump	F
	212		Sulfuric acid head tank	Tank F–Measuring equipment US
	213		Water head tank	F
	214		Acid dilution unit	F
	215		Gas separator	F
	216		Acid distributor	F–Remote linkage P
	217		Acid dosager	F
	218		Acid sump tank	F
	219		Mixer	P–Agitators need new paddles
	220		Rotating den	F–Oil seal at top P. Shortage V belts
	221		Conveyor belt	P–Replacement idlers required.
	222		SSP crusher	P–Orphan motor

Notes: Control room instruments US. Most switch gear contacts worn and spares not available. Mixer control panel ampmeters difficult to read–etched glass.
NR = Photo number not recorded.

Appendix F

Historical Environmental Data From Lac SSP Factory and Lac Township

Appendix F

Sulfuric Acid Plant No. 1
Sulfur Dioxide Level Measurement in Plant

Work Unit	902	902	904	904	906	905	906	905	905	907	907	906	904	906	908
Location	Ground Floor	First Floor	Pump Room	W.A. Coolers	Abs. Tower	Converter Area I	Abs. T. Pumps	Heat Exchangers	Converter Area II	Acid Stage Area I	Acid Stage Area II	Acid Sump	Mist Pump	S. Acid Coolers	Acid Dilution
	(mg/m^3)														
Year 1975	14.0	11.0	17.0	55.0	13.0	11.0	35.6	37.0	32.0	26.0	35.0	25.0	25.0	52.0	12.0
1976	10.0	14.0	20.0	90.0	15.0	22.0	20.0	25.0	30.0	15.0	25.0	37.0	27.0	58.0	19.0
1977	10.0	10.3	25.0	131.0	70.0	15.0	25.0	55.0	52.0	48.0	32.0	69.0	32.0	220.0	32.0
1978	15.2	15.6	17.5	95.0	13.5	7.8	17.5	15.0	25.0	5.2	25.0	81.0	44.0	140.0	20.4
1979	13.4	16.6	29.4	105.0	45.0	13.4	19.5	27.3	33.4	54.0	39.6	80.0	51.0	150.8	39.0
1981	6.1	28.4	14.5	102.0	16.5	16.8	14.5	36.3	24.8	28.3	16.9	-	-	-	-
1982	6.7	25.1	9.4	210.0	17.1	13.5	7.6	25.2	23.5	10.9	16.4	-	-	-	-
1983	8.2	24.5	30.6	196.0	30.7	9.5	30.6	67.6	44.6	24.5	12.7	-	-	-	10.4
1984	6.7	14.0	37.2	60.5	46.5	15.6	37.2	65.0	54.7	39.8	7.8	-	-	-	-
1988	6.2	37.5	24.5	158.0	26.0	14.5	39.0	22.0	100.0	16.0	26.2	-	-	-	-
1990	-	46.8	26.7	32.0	-	38.4	-	-	-	29.2	-	-	-	116.0	-

Work Unit Definition

902	Pyrites System
904	Gas Cleaning
905	Converter
906	Absorbing System
907	Acid Storage
908	Acid Dilution

Sulfur Dioxide Level Measurements in Lac Township

Year	January	February	March	April	May	June	July	August	September	October	November	December	Average
1982	-	209	262	171	208	238	216	190	177	132	120	53	182
1983	76	207	-	25	335	222	184	260	198	92	-	226	193
1984	194	334	115	159	221	285	-	178	120	198	171	119	200
1985	156	77	-	-	238	295	194	268	220	147	103	-	188
1986	165	129	233	178	158	-	197	-	164	260	106	96	169
1987	126	154	132	143	194	182	172	-	-	155	172	214	164
1988	-	166	157	96	147	160	91	186	150	70	127	164	140
1989	-	105	142	117	135	182	150	205	145	147	140	96	142

Note: The current standard allowance is 150 mg/m^3.

Source: Lac SSP Factory

Appendix F-2

No. 1 Superphosphate and Granulation Plant
Fluorine Level Measurements in Plant

Work Unit	201	202	202	202	325	204	204	206	Allowable
Location	First Floor	Second Floor	Third Floor	Control Room	First Floor	Scrubber	Granulator	Reactor	Limit
	(mg/m^3)								
Year 1975	11.7	5.7	2.0	1.0	1.0	1.1	2.9	2.1	1.0
1976	2.4	1.9	2.2	1.3	1.2	1.4	1.2	2.3	
1977	1.7	1.3	1.3	1.1	1.4	1.2	1.7	1.9	
1978	1.5	1.1	1.4	0.5	0.5	1.2	0.9	0.9	
1979	1.8	1.9	1.2	0.9	0.5	1.3	0.8	1.8	
1981	1.9	1.4	1.3	1.0	1.1	1.8	1.4	0.8	
1982	1.8	1.6	1.5	1.2	1.1	2.0	1.6	1.1	
1983	1.5	1.8	1.8	1.3	1.3	2.0	2.0	1.3	
1984	2.0	1.8	1.9	1.2	1.0	2.1	1.6	1.1	
1985	2.1	1.8	2.3	1.5	1.3	2.2	2.5	1.5	

Work Unit Definition

201	Phosphate Rock Crushing
202	Mixing and Denning
204	Granulation Plant
325	Effluent Treatment
206	Sodium Fluosilicate

No. 1 Sulfuric Acid Plant
Dust Level Measurements in Plant

Work Unit	901	901	901	902A	903	903	910	903/1	Allowable
Location	Rolls Crusher	Jaw Crusher	Screen	Feed Bin	Boiler	Cinders Conv.	Cinders Bin	E. D. Precipitator	Limit
	(mg/m³)								
Year 1975	-	17.0	14.0	18.0	-	43.0	-	27.0	15.0
1976	-	7.5	5.6	28.0	22.0	-	34.6	22.0	
1977	30.9	34.0	33.0	45.0	7.2	49.0	45.0	62.3	
1978	-	27.2	18.3	19.5	42.4	47.8	52.7	76.1	
1979	-	12.4	-	11.8	-	18.3	29.4	32.6	
1981	18.4	16.0	17.0	22.6	18.3	45.0	17.0	60.1	
1982	27.0	32.0	36.0	29.7	45.0	53.0	94.0	62.0	
1983	28.0	31.5	31.5	29.5	53.0	69.7	91.0	64.2	
1984	21.0	19.0	22.0	38.0	69.7	71.0	104.0	109.5	
1985	30.0	65.7	61.0	15.0	71.0	20.0	150.0	130.0	
1987	25.3	27.0	23.0	42.0	20.0	30.6	59.8	149.4	
1988	19.7	26.0	25.7	46.7	36.4	36.4	48.7	140.8	

Work Unit Definition
- 901 Pyrites Crushing, Drying, and Screening
- 902A Pyrites Feed System
- 903 Pyrites Roasting

Note: E.D. Precipitator = Dry electrostatic precipitator.

No. 1 Superphosphate and Granulation Plant
Dust Level Measurements in Plant

Work Unit	201	204	201-201/A	201/A	201/A	201/A	201/A	202	202	203	203	203
			Ground Floor	I Floor	II Floor	III Floor	IV Floor	I Floor	II Floor	I Floor	II Floor	III Floor
	(mg/m³)											
Year 1975	76	87	99	17	33.5	34	68	30	28	19	8.5	12
1976	84	113	95	16.5	58	40	71.5	27	29.5	15.6	9.7	14.7
1977	64	98	76	18	49	43	57	28.5	25	17.3	10.1	13.7
1978	70.4	120	81	19.7	47.8	39	58.7	31	29	18.1	17.6	14.3
1979	83	131	92	20.3	49.5	41.2	60.3	32.7	31.3	19.5	19.6	15.3
1980	4.7	129	94	21.7	48.7	43.7	63.3	30.7	95	20.0	20.7	16.3
1981	4.5	170	83	17	42	58	88	51	49	27	19.5	18
1982	47	180	110	19	53.5	54	64	43	25	14.5	18	34
1983	19	91.7	90	20.7	18.5	61	29.5	47	43	19.5	22	36.5
1984	49.5	132	124	18.2	37	49	44	53	28	35.5	32	50.1
1985	33	150	170	19.7	47	64.5	63	50.5	22.5	29.7	26	27.3
Dust	•	•	•	•	•	•	•	••	••	••••	••••	••

(Continued)

No. 1 Superphosphate and Granulation Plant
Dust Level Measurements in Plant (Continued)

Work Unit	204	204	204	204	206	206	Allowed Quantities (Dust)				
	I Floor	II Floor	III Floor	IV Floor	I Floor	II Floor	Phosphate Rock	S.S.O.	Coal	Limestone	No. 2 SiF6
	(mg/m^3)										
Year 1975	15.6	17	23	24	4	9.5	15	15	10	2	1
1976	18.1	19.5	21.7	20.8	4.71	5.1					
1977	20.1	20.3	24	21	5.2	5.3					
1978	19.2	15.1	20.7	13.8	6	6.3					
1979	2.4	17.3	19.2	14.7	6.7	7.2					
1980	22.4	18.4	20.1	15.7	5.8	6					
1981	25.7	29.7	27	14.8	8.7	9.3					
1982	17	18	16	18.5	4.8	8.4					
1983	34	35	37.5	20	5.3	10.3					
1984	28	20	26	31.7	[illegible].2	8.3					
1985	19	27	40	37.3	5.2	6.7					
Dust	***				*****	*****					

Work Unit Definition

201	Phosphate Rock Crushing
201/A	Phosphate Rock Grinding and Handling
202	Mixing and Denning
203	Limestone Grinding
204	Granulation Plant
206	Sodium Fluosilicate

Dust Type Definition

*	Phosphate Rock
**	SSP
***	Coal
****	Limestone
*****	Sodium Fluosilicate

Average Analysis of Liquid Effluent Discharge

Contaminant	pH	AS	F	SO_4	Sus. Solids	Cl
Nominal Limit	6.5-8.5	0.1 mg/l	15 mg/l	500 mg/l	10 mg/l	500 mg/l
Year						
1974	4.6	0.01	146.5	640	400	661
1975	5.7	0.12	152.0	597	286	734
1976	6.0	0.19	115.0	409	353	528
1977	6.1	0.20	86.5	352	306	418
1978	6.2	0.20	43.8	223	415	337
1979	6.0	0.21	33.8	409	563	541
1980	5.9	0.16	32.1	472	476	456
1982	6.0	0.25	46.5	584	510	479
1984	5.4	0.39	57.9	613	507	521
1985	4.9	0.53	71.4	721	501	469
1986	5.4	0.40	56.3	522	311	263
1987	5.6	0.59	64.0	535	200	439
1988	4.5	0.62	97.0	700	309	-
1989	5.0	0.95	108.0	695	250	175
1991	5.3	0.20	80.0	478	306	428
1992	5.2	0.18	63.0	451	209	259

Appendix G

Agricultural Input Dealer List, Albania: 1992/93

Appendix G
Agricultural Input Dealer List, Albania: 1992/93

Nr.	Name	Address	IFDC Auctions UREA I x50	IFDC Auctions UREA II x50	IFDC Auctions DAP I x25	IFDC Auctions DAP II x10	Factory Sales Dec '92–'93 Urea (Fier)	Factory Sales Dec '92–'93 AN	Factory Sales Dec '92–'93 SSP (Lac)	Total Fertilize (ton)	AFADA member	Pestic.	Seeds	Credit for UREA 1st auction [lek]	No of loans	Credit for UREA2nd auction [lek]	No of loans	Credit for DAP 1st auction [lek]	No of loans	Credit for DAP 2nd auction [lek]	No of loans	Total Credit [lek]	Total No of loans
	BALLSH DISTRICT																						
1	SHAHIN BEJDJAJ	L."5 SHKU[illegible]"	1	1	1	11	86	12		333	YES	NO	NO	48500	1	45000	1	275000	1	1200000	1	1568500	4
2	FITIM BARE	DRENOVE	1	1	1	10	70	15		310	YES	NO	NO	90000	1	80000	1	300000	1	1200000	1	1670000	4
3	FATMIR ZOTAJ	FRATAR						30	15	45	YES	NO	NO										
4	PETRIT HODAJ	HEKAL						10		10	NO												
5	ENVER CAUSHI	HEKAL					135	32	17	184	YES	YES	YES										
6	FEHIM HYSKAJ	METOH						14	13	27	NO												
										====													
										909													
	BERAT DISTRICT																						
ACE	AGROTREGTARE	UZNOVE		1	6	15	88			438	YES	NO	NO					1200000	2			1200000	2
7	SULO VERCA	BARDHAJ					14		21	35	YES	NO	NO										
8	NUREDIN MYZYRI	FUSHE PESHTAN		1	1	12	87		28	310	YES	NO	NO					300000	1	1204000	1	1504000	2
9	BESNIK SALILLARI	FUSHE–PESHTAN					80		8	88	NO												
10	PELLUMB TARE	GALIN					7		16	23	YES												
11	LUAN BILCARI	LAPARDHA			3	42	121		7	623	YES	YES	YES					900000	3	3600000	2	4500000	5
12	RESHAT BEQIRI	LUMAS					26	7	14	47	NO												
13	BASHKIM VOKRRI	L."Donika Kastrioti"	1	1	2	20	158	14		472	YES	YES	YES	98000	1			300000	1	1800000	1	2198000	3
14	NAFIE GJOKA	MBRAKULL						10		10	NO												
15	XHEVAIR HARIZI	PELLUMBAS				8	38			118	YES	YES	YES							960000	1	960000	1
16	ISUF CAMI	ROSHNIK							22	22	NO												
17	RUFAN LILA	SYZEZ				34	79		9	428	YES	NO	NO							1127300	2	1127300	2
18	NOVRUZ DELIBASHI	VELCAN				10	53			153	YES	NO	YES							900000	2	900000	2
19	RUSTEM TARE	ZHITOM						10		10	NO												
20	ARBEN ARAPI	STAROVE					13			13	NO												
21	ISUF AGALLIU	L."Jani Vruo"				1				10	NO												
22	NUREDIN AGO	SHEQEZ					33			33	NO												
23	BASTRI SHEHU					1				10	NO												
24	SULEJMAN GAZHINA						35		12	47	NO												
										====													
										2890													
	DEVOLL DISTRICT																						
25	SABRI TURABI	BABAN(HOCISHT)		1						50	YES	NO	NO			30000	1					30000	1
26	HAKI TOSKA	BILISHT					32	37		69	NO												
27	NURI MANELLI	BILISHT						12		12	NO												
28	MENTOR HAJDARLLIU	BILISHT(SUL)				1	13			23	NO												
29	YLLI MANCKA	HOCISHT		1						50	YES	NO	NO			34000	1					34000	1

Notes:

1. Fertilizer purchases to the end of July 1993.
2. Does not include factory trade credit (FNFF).
3. Does not include recent AFADA applicants (August 1993).

Nr.	Name	Address	IFDC Auctions UREA I x50	IFDC Auctions UREA II x50	IFDC Auctions DAP I x25	IFDC Auctions DAP II x10	Factory Sales Dec '92-'93 Urea (Fier)	Factory Sales Dec '92-'93 AN	Factory Sales Dec '92-'93 SSP (Lac)	Total Fertilizer [ton]	AFADA member	Pestic.	Seeds	Credit for UREA 1st auction [lek]	No of loans	Credit for UREA2nd auction [lek]	No of loans	Credit for DAP 1st auction [lek]	No of loans	Credit for DAP 2nd auction [lek]	No of loans	Total Credit [lek]	Total No of loans
30	ARBEN MANESHI	MENKULAS		1	2					100	YES	NO	YES					270000	1			270000	1
31	VASFI SHERIFI	POJAN	1							50	YES	YES	YES	9000	1							9000	1
32	ENGJELL JAZXHI	PONCARE			2			20		70	YES	YES	YES					300000	1			300000	1
33	HASIP RREPA	PROGER			1					25	YES	YES	YES					305000	1			305000	1
34	IRFAN HYSKA						44	5		49	NO												
35	ZARIF ZARANI	MIRAS					8			8	YES	YES	YES										
										====													
	DIBER DISTRICT									506													
ACE	AGROTREGTARE	PESHKOPI		2			96		24	220	NO					100000	1					100000	1
36	YLLI HYKA							25		25	NO												
37	HAXHI ISLAMI	MAQELLARE					18			18	NO												
38	FERIT HASA	KALA E DODES					27			27	NO												
										====													
	DURRES DISTRICT									290													
ACE	AGROTREGTARE	DURRES	7		1		308			683	NO			156600	1							156600	1
SF	NB HAMALLAJ	HAMALLAJ			3					75	NO												
AGI	AGROIMPORT	SPITALLE	1							50	NO												
SF	NB SUKTH	SUKTH			1	2	40			85	NO							300000	1	320000	1	620000	2
PF	NB "AGRO-ADRIATIK"					5				50	NO												
SF	NB RRUSHKULL	RRUSHKULL	2				29			129	NO			81112	1							81112	1
39	FIRMA SHAHINI	HARDHISHTE,SHIJAK	1	2			47	9		206	NO			100000	1	200000	2					300000	3
40	BASHKIM ISAKU	Rr."Bashkimi",Nr.60	1							50	NO			100000	1							100000	1
41	SOTIR TOPALLI	RRUSHKULL	1							50	NO			35300	1							35300	1
42	JONUZ KAPLLANI	SHIJAK						18		18	NO												
43	MUHAMET NRAXHI	SHIJAK,XHAFZOTAJ					100			100	YES	YES	NO										
44	ABDYL LILO	L17RrPjeter HanxhariN764	1	2	1	20				375	YES	YES	YES	25000	1	82502	1	300000	1	1500000	1	1907502	4
45	NAFIZ SEFERKOLLI	SUKTH	1	1						100	YES	YES	NO	59400	1	100000	1					159400	2
46	SAMI MALOKU	SUKTH	1							50	NO			100000	1							100000	1
47	NEZIR COPA	SEFERAJ	1	1						100	NO			100000	1	100000	1					200000	2
48	BAJRAM CALLIKU	XHAFZOTAJ,SHIJAK	1							50	YES	YES	YES										
										====													
	ELBASAN DISTRICT									2171													
ACE	AGROTREGTARE	ELBASAN	10	6	1		74		105	1004	YES	YES	YES	200000	1							200000	1
ACE	AGROTREGTARE	BELSH		2						100	NO			200000	1	216800	2					416800	3

Appendix G-2

Nr.	Name	Address	IFDC Auctions UREA I x50	IFDC Auctions UREA II x50	IFDC Auctions DAP I x25	IFDC Auctions DAP II x10	Factory Sales Dec '92–'93 Urea (Fter)	Factory Sales Dec '92–'93 AN	Factory Sales Dec '92–'93 SSP (Lac)	Total Fertilize [ton]	AFADA member	Pestic.	Seeds	Credit for UREA 1st auction [lek]	No of loans	Credit for UREA 2nd auction [lek]	No of loans	Credit for DAP 1st auction [lek]	No of loans	Credit for DAP 2nd auction [lek]	No of loans	Total Credit [lek]	Total No of loans
SF	NB DUSHK	DUSHK	1							50	NO			955000	1							955000	1
SF	NB XHERIE	XHERIE		1	1					75	NO					100000	1	300000	1			400000	2
SF	NB XIBRAKE	XIBRAKE		1	2					100	NO					100000	1	600000	2			700000	3
SF	NB CERRIK	CERRIK		1	2					100	NO					100000	1	300000	1			400000	2
SF	NB BELSH	BELSH		1						50	NO					100000	1					100000	1
SF	NB "SYRJA DYLGJERI"	ELBASAN		2						100	NO												
49	AVRAM BINJAKU	GJINAR					15			15	YES	YES	NO										
50	DRITA ALIAJ						15			15	NO												
51	XHEVDET RUKA						13			13	NO												
52	XHEVAT FERHATI	BANJE	1	2		12	71	40		381	NO			35000	1	100000	1			15000000	1	15135000	3
53	ADEM MUCA	BELSH		2		10	121			321	YES	YES	YES							1200000	1	1200000	1
54	PELLUMB OSMANI	BELSH(FIERZE)						10		10	NO												
55	XHEMIL ZDRAVA	DESHIRAN		1			68			118	NO					100000	1					100000	1
56	QANI SHERJA	FUNARE	1	5	1	1	82			417	YES	NO	NO	31000	1	100000	1	140000	1			271000	3
57	SABRI BALLKOCI	F.MENGEL	3	2						250	NO	YES	YES	87997	1	100000	1					187997	2
58	FAIK LAMCJA	GJERGJAN	1	1						100	NO			72500	1	100000	1					172500	2
59	DHIMITER SHEMPLAKU	GJINAR					15	6		21	NO												
60	XHEVDET MIRAKA	GOSTIME				10	204	5		309	YES	YES	NO							1200000	1	1200000	1
61	YLLI ZANI	GOSTIME		2	1	15				275	YES	NO	NO			150000	1	300000	1	1800000	2	2250000	4
62	KUJTIM STAFA	GRACEN					23	7		30	NO												
63	QERIM BEQARI	GRACEN	1	1	1	10	77	29	8	339	YES	YES	NO	86558	1	100000	1	300000	1	1200000	1	1686558	4
64	DYLBER RAMA	GREKAN			1		13			38	YES	NO	NO					300000	1			300000	1
65	XHEVDET RUSTJA	GREKAN		2			11		14	125	NO					100000	1					100000	1
66	GEZIM ZENELI	KATUNDI I RI		1		5	105		20	225	YES	YES	YES			100000	1			600000	1	700000	2
67	AGUSTIN CALA	LUMAS		1		10	19	27		196	YES	YES	YES			100000	1			600000	1	700000	2
68	"ELGAKOTI"	L.8.NENTORI		1				5		55	NO					100000	1					100000	1
69	TAFIL RUCI	MENGEL(TEQE)		1			5			55	NO					90000	1					90000	1
70	BESHIR SULA	MOLLAS			1	10	30			155	NO							300000	1	1200000	2	1500000	3
71	FADIL VRAPI	PAJUN		1				5		55	YES	YES	YES			100000	1					100000	1
72	SKENDER CELA	PAJUN		1	1		30			155	YES	YES	YES	44555	1	100000	1	300000	1			444555	3
73	RAMAZAN ALLA	POLIS–VALE		1			25			75	YES	YES	YES			100000	1					100000	1
74	XHEMAL TANUSHI	POLIS–VALE		1						50	YES	NO	NO			147500	1					147500	1
75	AGIM BOJA	SHIRGJAN		1	1		50			125	NO					100000	1	300000	1			400000	2
76	QEMAL DALIPI	SHUSHICE	1	2	1		17			192	YES	NO	NO	100000	1	100000	1	300000	1			500000	3
77	REXHEP KOCI	SHUSHICE	1	2		13	167			447	YES	NO	NO	100000	1	200000	1			1600000	1	1900000	3
78	HEKURAN SHESHI						41	7		48	NO												
79	MUSTAFA QOSE	GRACEN				1	13			23	NO												
80	AGIM ELEZI					1				10	NO									120000	1	120000	1
81	GEZIM SALLA					3				30	NO									380000	1	380000	1
82	KADRI DURAKU					10				100	NO									1200000	1	1200000	1
83	SAMI KAZIU					5				50	NO									600000	1	600000	1
84	BESNIK MUKAJ					2				20	NO												
										==== 6422													

Appendi

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Nr.	Name	Address	IFDC Auctions UREA I x50	IFDC Auctions UREA II x50	IFDC Auctions DAP I x25	IFDC Auctions DAP II x10	Factory Sales Dec '92-'93 Urea (Fier)	Factory Sales Dec '92-'93 AN	Factory Sales Dec '92-'93 SSP (Lac)	Total fertilize [ton]	AFADA member	Pestic.	Seeds	Credit for UREA 1st auction [lek]	No of loans	Credit for UREA 2nd auction [lek]	No of loans	Credit for DAP 1st auction [lek]	No of loans	Credit for DAP 2nd auction [lek]	No of loans	Total Credit [lek]	Total No of loans
	ERSEKA DISTRICT																						
85	NEXHIP LUMANI						16	9		25	NO												
86	BARDHI DIKA	SELENICE			1		100			125	YES	YES	YES					281250	1			281250	1
										==== 150													
	FIER DISTRICT																						
ACE	AGROTREGTARE	FIER	10						520	1020	NO			600000	3							600000	3
SF	NB GERCALLI	GERCALLI	4						5	205	NO			600000	3							600000	3
SF	NB PATOS	PATOS			1					25	NO												
SF	NB HADAJ	HADAJ			2		20			70	NO												
SF	NB METAJ	METAJ			2		12			62	NO												
SF	NB ROSKOVEC	ROSKOVEC			4					100	NO												
87	NESHAT GJELI	ADE					13	7	90	110	YES	YES	YES										
88	PAJTIM HYSAJ			4						200	NO												
89	PELLUMB MALOKU						100	10		110	NO												
90	XHEVDET SHEHU						100			100	NO												
91	PELLUMB DERVISHI	CAKRAN						12		12	NO												
92	MUSTAFA RUCI	DRIZAR					52	55	4	111	NO												
93	FIRMA "BYLIS"	FIER					200			200	NO												
94	RAUF ZENO	FIER					84	12		96	NO												
95	ESAT BUZI	KALLM					37	20		57	YES	YES	YES										
96	AGRON XHINDI	KURIAN						20	6	26	YES	YES	NO										
97	MAKSIM BALLUKU	LIBOFSHE					10			10	NO												
98	NAIM BREDHI	LIBOFSHE						14		14	NO												
99	VLASH BARDHI	LIBOFSHE					29			29	YES	NO	NO										
100	VLADIMIR KOLA	L."Kastriot";P.245	3							150	NO												
101	FREDI TAKO	PORO					14			14	NO												
102	MITI XHIXHI	ROSKOVEC					21	9	5	35	NO												
103	IZETE RUKA	STRUME					23	30		53	NO												
104	MYNYR HAZISI	STRUME					29	29		58	NO												
105	QEMAL PETRITI	VAJKAN			1		21			46	YES	YES	YES					300000	1			300000	1
106	YLVI TORO	KURJAN					18	7	10	35	NO												
107	SHYQYRI SULCAJ						68			68	NO												
108	FITUS SINANI	CAKRAN					19			19	YES	NO	NO										
109	BAJRAM XHAXHAJ	BELISHOVE					41	8		49	NO												
										==== 3034													

Appendix G-1

Nr.	Name	Address	IFDC Auctions UREA I x50	IFDC Auctions UREA II x50	IFDC Auctions DAP I x25	IFDC Auctions DAP II x10	Factory Sales Dec '92-'93 Urea (Fter)	Factory Sales Dec '92-'93 AN	Factory Sales Dec '92-'93 SSP (Lac)	Total Fertilize [ton]	AFADA member	Pestic.	Seeds	Credit for UREA 1st auction [lek]	No of loans	Credit for UREA2nd auction [lek]	No of loans	Credit for DAP 1st auction [lek]	No of loans	Credit for DAP 2nd auction [lek]	No of loans	Total Credit [lek]	Total No of loans
	GJIROKASTRA DISTRICT																						
ACE	AGROTREGTARE	GJIROKASTER		1			30			80	NO					100000	1					100000	1
SF	NB DRINO	DRINO					26			26	NO												
SF	NB BULO'	BULO'			1		10			35	NO							300000	1			300000	1
110	CELO CUNI	CAPUNA						10		10	NO												
111	VANGJEL VASO	SOFRATIKE					70			70	NO												
112	VLADIMIR LLAKA	VRISERA						10		10	NO												
										====													
										231													
	GRAMSH DISTRICT																						
ACE	AGROTREGTARE	GRAMSH	1	1					9	109	NO			100000	1	100000	1					200000	2
113	HASAN OAFA	DRIZE						10	10	20	NO												
114	KADRI MEHALLA	PRRENJAS					22		23	45	NO												
115	RIZA MIRAKA	SULJET					15			15	NO												
116	RESHIT SHAHINI						43		12	55	NO												
										====													
										244													
	HAS DISTRICT																						
SF	NB KRUME	KRUME							73	73	NO												
SF	NB FAJZE	FAJZE							51	51	NO												
										====													
										124													
	KAVAJA DISTRICT																						
ACE	AGROTREGTARE	KAVAJE	6		1		134			459	YES	YES	YES	162000	1			300000	1			462000	2
SF	NB FRUTORE	KAVAJE			1					25	NO							300000	1			300000	1
PF	NB ALB-ITAL BASHTOVA	BASHTOVE			1					25	NO												
SB	DEGA E FARNAVE	KAVAJE			1					25	NO							300000	1			300000	1
	AGRIGOSE	KAVAJE				1				10	NO									160000	1	160000	1
117	MALIQ KULLALI	GOS (SYNEJ)					26	10		36	NO												
118	HYSEN KOCI	HAJDARAJ	1	1	1	17	66		5	366	NO			84301	1	100000	1	300000	1	2000000	1	2484301	4
119	DASHNOR CULLHAJ	KRYEVIDH		1						50	NO					100000	1					100000	1
120	ILIR KAJA	KRYEVIDH	1							50	NO			89000	1							89000	1
121	SELIM UKU	LEKAJ	1				20	15		85	NO			60000	1							60000	1
#	TELHA UKU	SUKAJ	1	2						150	NO			60000	1	83345	1					143345	2

Appendix

Nr	Name	Address	IFDC Auctions UREA I x50	IFDC Auctions UREA II x50	IFDC Auctions DAP I x25	IFDC Auctions DAP II x10	Factory Sales Dec '92-'93 Urea (Fter)	Factory Sales Dec '92-'93 AN	Factory Sales Dec '92-'93 SSP (Lac)	Total Fertilize [ton]	AFADA member	Pestic.	Seeds	Credit for UREA 1st auction [lek]	No of loans	Credit for UREA2nd auction [lek]	No of loans	Credit for DAP 1st auction [lek]	No of loans	Credit for DAP 2nd auction [lek]	No of loans	Total Credit [lek]	Total No of loans
122	KUJTIM HAJDINI	LUZI VOGEL		1						50	NO					95000	1					95000	1
123	LUAN BUSHI	LUZI VOGEL					10	10		20	NO												
124	RAMIZ LUSHKA	LUZI VOGEL					37	12		49	NO												
125	ADRIATIK&VESIP XHANI	LUZI I MADH	2	3	1					275	NO			176950	2			300000	1			476950	3
126	AGRON IBRA	LUZI I MADH			1					25	NO							300000	1			300000	1
127	KASTRIOT XHANI	LUZI I MADH	1		1					75	YES	NO	NO					300000	1			300000	1
128	SAFET LECINI	LUZI I MADH			1		5	5		35	NO							300000	1			300000	1
129	YMER GUGASHI	L.1 KAVAJE			1					25	NO							300000	1			300000	1
130	KALEM BUSHI	L.6 KAVAJE	1	2						150	YES			48500	1							48500	1
131	AZEM SHEHU	L.5 KAVAJE	10	5	6	20	5			1105	YES	NO	YES	86500	1			300000	1	2000000	1	2386500	3
132	SHAQIR LLIXHA	L 6 KAVAJE		1						50	NO					80000	1					80000	1
133	TAHIR KANAPARI	L.SALLBEK	1	1	1					125	NO			35800	1	26320	1	274000	1			336120	3
134	FEJZULLAH ISTREFI	QERRET	1	1						100	YES	YES	YES	75000	1							75000	1
135	KADRI KALAJA	SHTODHER		1	1					75	NO					100000	1	300000	1			400000	2
136	SEFEDIN SULA	SINABALLE-RROGOZHINE					17			17	NO												
137	KAPLLAN PEZA	STERBEK	1							50	YES			96500	1							96500	1
138	BURHAN CACA	SYNEJ		2	2	1	156	18		334	NO					100000	1	600000	2			700000	3
139	IDAJET DAIU	SYNEJ	1	1	2					150	NO			100000	1	90650	1	300000	1			490650	3
140	RESHIT BYKU	SYNEJ		1	1		23	11		109	NO					95000	1	300000	1			395000	2
141	GALIP MUCA	VOROZEN					16			16	NO												
										==== 4116													
	KORCE DISTRICT																						
ACE	AGROTREGTARE	KORCE			1		12			37	NO												
142	JANAQ RAJDHO							24		24	NO												
143	KUJTIM ZHUPA							33		33	NO												
144	PERPARIM BRAHIMLLARI						5	16		21	NO												
145	RAMADAN MAZE							17		17	NO												
146	ROLAND BAMLLARI	POJAN		1						50	YES	YES	YES			50000	1					50000	1
147	VIKTOR BLIDO							24		24	NO												
148	NEFAIL SHUKULLI	LOZHAN			2		100			150	YES	NO	NO					300000	1			300000	1
149	ALI MANOKU	LUMALAS	1	1	3		15			190	YES	YES	YES	60000	1	65000	1	605000	2			730000	4
150	GRAMOZ DODA	MIRAS						20		20	NO												
151	MUHAREM HALLKAJ	MOGLICE						14		14	NO												
152	DYLBER MALO	PIRG		1				15		65	YES	NO	NO			85085	1					85085	1
153	BASHKIM KALARI	ZEREC	1	1					6	106	YES	NO	YES	50008	1							50008	1
154	AUREL AGOLLI						30			30	NO												
										==== 781													

Appendix G-6

Nr.	Name	Address	IFDC Auctions UREA I x50	IFDC Auctions UREA II x50	IFDC Auctions DAP I x25	IFDC Auctions DAP II x10	Factory Sales Dec '92-'93 Urea (Ker)	Factory Sales Dec '92-'93 AN (Ker)	Factory Sales Dec '92-'93 SSP (Lac)	Total Fertilize [ton]	AFADA member	Pestic.	Seeds	Credit for UREA 1st auction [lek]	No of loans	Credit for UREA 2nd auction [lek]	No of loans	Credit for DAP 1st auction [lek]	No of loans	Credit for DAP 2nd auction [lek]	No of loans	Total Credit [lek]	Total No of loans
	KRUJA DISTRICT																						
ACE	AGROTREGTARE	KRUJE	3				126			276	NO												
ACE	AGROTREGTARE	FUSHE KRUJE	4	3						350	YES												
SF	NB SUKTH-VENDAS								24	24	NO												
155	SHEFQET VELJA						11	10		21	NO												
156	PASHK TROKSI	BILAJ	1	1			54			154	YES	YES		100000	1	80500	1					180500	2
157	HAJRULLA PATURI	BORIZANE					13	10		23	YES	NO	NO										
158	MURAT XHAFA	BORIZANE	3				23			173	YES	YES	YES	50000	1							50000	1
159	MEHDI ELEZI	BRUZ		1			17	19		86	YES					100000	1					100000	1
160	SKENDER AJAZI	BUBQ	1							50	NO			100000	1							100000	1
161	KADRI MALJA	BUDULL	1	1	1		60	5	13	203	YES	YES	NIO	100000	1	48600	1	275000	1			423600	3
162	KURT STAFUKA	FUSHE-KRUJE					7	7		14	NO												
163	FADIL ALLUSHI	NIKEL		1		1	11	10		81	YES	NO	NO			80000	1					80000	1
164	IBRAHIM CANGU	NIKEL	2	2	1	1	101	24		360	YES	NO	NO	200000	2	100000	1	263000	1			563000	4
165	QAZIM MEMOCI					1				10	NO												
166	ISUF KARAZI	PREZE (BUDULL)		1						50	NO					90600	1					90600	1
										====													
										1875													
	KUCOVA DISTRICT																						
167	NESHAT MARA	AVALEAS (KOZARE)	1	1	2	11	75			335	YES	YES	NO	100000	1							100000	1
168	ZYRA CEPA	AVALEAS (KOZARE)			1	7	7			102	YES	YES	YES							250000	1	250000	1
169	VANGJEL DHIMITRI	PERONDI				5				50	YES									750000	1	750000	1
										====													
										487													
	KUKES DISTRICT																						
ACE	AGROTREGTARE						4			4	NO												
170	R.MYFTARI ("PASTREC")	TOPOJAN		1			58			108	YES	NO	YES			49000	1					49000	1
171	SEVAIR DOKLE	SHISHTAVEC					24			24	NO												
172	RAMADAN KALOSHI						25			25	NO												
173	XHEMAL NELA						23			23	NO												
174	FIDAI DIDA						20			20	NO												
										====													
										204													
	LAC DISTRICT																						
ACE	AGROTREGTARE	LAC					24		11	35	NO												
175	LIK KASMI	FUSHE-MILOT		1						50	YES	YES	YES			100000	1					100000	1

Appendix C

Nr.	Name	Address	IFDC Auctions UREA I x50	IFDC Auctions UREA II x50	IFDC Auctions DAP I x25	IFDC Auctions DAP II x10	Factory Sales Dec '92-'93 Urea (Fter)	Factory Sales Dec '92-'93 AN	Factory Sales Dec '92-'93 SSP (Lac)	Total Fertilize [ton]	AFADA member	Pestic.	Seeds	Credit for UREA 1st auction [lek]	No of loans	Credit for UREA2nd auction [lek]	No of loans	Credit for DAP 1st auction [lek]	No of loans	Credit for DAP 2nd auction [lek]	No of loans	Total Credit [lek]	Total No of loans
176	PASHK GJOKA	GALLATE	1	1						100	NO			100000	1	100000	1					200000	2
177	ZEF VATA	FUSHE-MILOT		1						50	NO					100000	1					100000	1
178	EDMOND BLIDO	LAC					18	11		29	NO												
										====													
										264													
	LEZHA DISTRICT																						
ACE	AGROTREGTARE	LEZHE	5	4	1					475	YES	YES	YES	200000	1			300000	1			500000	2
179	NUSH THERCAJ	TALE					31	22		53	YES												
180	EDUARD PREKA						70			70	NO												
181	GJERGJ DEDA						25			25	NO												
182	ISMAIL SOKOLI				1					25	NO							280500	1			280500	1
										====													
										648													
	LIBRAZHD DISTRICT																						
ACE	AGROTREGTARE	LIBRAZHD	4	2	2		100			450	YES			90000	1			200000	1			290000	2
183	RIZA SULA	CERMENIKE					13			13	NO												
184	AHMET COCA	KOTODESH					100			100	NO	YES	YES										
185	HAMIT LLESHI	KUTURMAN			1					25	YES	YES	YES					300000	1			300000	1
186	SAMI TANUSHI	POLIS-GUR SHPAT		1						50	YES	YES	YES			100000	1					100000	1
187	IDAJET BALLA	PRRENJAS					4	24		28	NO												
188	EDI ALICKOLLI	P.86. LIBRAZHD	2	2	3		50	10		335	YES	YES	YES	125000	1	100000	1	300000	2			525000	4
189	JONUS KACO	SPATHAR	1	1					3	103	YES	NO	NO	100000	1	100000	1					200000	2
										====													
										1104													
	LUSHNJA DISTRICT																						
ACE	AGROTREGTARE	LUSHNJE	10	7	10	50	510	50		2160	YES							300000	1	7500000	2	7800000	3
SF	NB SAVER	SAVER							14	14	NO												
190	FATMIR MUSAKU				1					25	NO							300000	1			300000	1
191	ARISTIDH QORRI	ALLKAJ			1					25	YES	YES	NO					300000	1			300000	1
192	PELLUMB XHELA	BALLAGAT					42			42	NO												
193	NDRICIM MECO	BICOK					11			11	NO												
194	ISUF MUCA	CERME E SIPERME					26			26	YES	YES	NO										
195	AGIM GJINI	DIVJAKE						21		21	NO												
196	AGIM SPIRO	DIVJAKE						10		10	NO												
197	FEJZI METOHU	FIER SHEGAN			1	6	21			106	YES	YES	NO					300000	1	750000	1	1050000	2
198	NEBI KRASNIQI	FIER SHEGAN		2	1	13	5	5		265	YES	YES	YES			98400	1	300000	1	1800000	1	2198400	3

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	Name	Address	IFDC Auctions UREA I x50	IFDC Auctions UREA II x50	IFDC Auctions DAP I x25	IFDC Auctions DAP II x10	Factory Sales Dec '92-'93 Urea (Fier)	Factory Sales Dec '92-'93 AN (Fier)	Factory Sales Dec '92-'93 SSP (Lac)	Total Fertilizer [ton]	AFADA member	Pestic.	Seeds	Credit for UREA 1st auction [lek]	No of loans	Credit for UREA 2nd auction [lek]	No of loans	Credit for DAP 1st auction [lek]	No of loans	Credit for DAP 2nd auction [lek]	No of loans	Total Credit [lek]	Total No of loans
199	YLLI DULI	FIER SHEGAN			1	20	224	34	10	493	YES	YES	YES					300000	1	2100000	2	2400000	3
200	RRAPI DUKA	GRADISHT					13	59		72	NO												
201	MIKAIL NDONI	KEMISHTAJ			1			5		30	NO							300000	1			300000	1
202	VLADIMIR NUSHI	KRUTJE				13	51	27		208	YES	YES	YES							1015000	2	1015000	2
203	AGIM BAME	LUMTH(GORRE)	1	2	4	17	66	41		527	YES	YES	YES	96550	1	100000	1	900000	3	1200000	1	2296550	6
204	LUFTAR BUZI	LUSHNJE			3		100			175	NO							812000	3			812000	3
205	SOKRAT QORRI	KEMISHTAJ				5			25	75	YES	YES	YES							750000	1	750000	1
206	MINA GOREA	MIZE						15		15	NO												
207	XHELAL CELA	NGUREZ			1	7				95	YES	YES	YES					300000	1	1050000	1	1350000	2
208	DEMIR ARAPI	ZGJAN-KARBUNARE		2	1	5	5	20		200	YES	YES	YES			100000	1	300000	1	750000	1	1150000	3
209	IRAKLI KOLA	KRUTJE-GJAZE				8				80	YES									1200000	1	1200000	1
210	PELLUMB BECKA					10				100	NO									1500000	1	1500000	1
211	IRAKLI GORREJA	DIVJAKE				5				50	YES												
										====													
	MALESI E MADHE DISTRICT									4825													
212	BRAHIM ALIMETAJ	KOPLIK					10			10	NO												
213	SAIMIR CANAJ	GRUEMIRE					15	25		40	YES	YES	NO										
214	QEMAL DELISHAJ	KOPLIK					37	5	4	46	NO												
215	VAT FTONI						38			38	NO												
										====													
	MAT DISTRICT									134													
ACE	AGROTREGTARE	BURREL		3	1				5	180	NO					184450	1	300000	1			484450	2
216	AVNI BUSHI	URAKE					72	8		80	NO												
217	GEZIM MALKURTI							23		23	NO												
218	QEMAL DIKA						30	8	5	43	NO												
219	MEHMET COLLAKU	FULLQET					11			11	YES	NO	YES										
220	SAMI TOPALLI	FULLQET					11	18		29	YES	NO	NO										
221	LEFTER PALLUCI	RUKAJ					19	8	9	36	YES	YES	NO										
222	AFRIM LALA	KLOS					65	12	9	86	NO												
223	MARTIN LLESHI							30		30	NO												
										====													
	MIRDITA DISTRICT									518													
ACE	AGROTREGTARE	RRESHEN		1	1		105		80	260	YES					75650	1	300000	1			375650	2
224	MIRASH RRANXA		1							50	NO												
225	BAJRAM HAXHIA	RRESHEN						11		11	NO												
										====													
										321													

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Nr.	Name	Address	IFDC Auctions UREA I x50	IFDC Auctions UREA II x50	IFDC Auctions DAP I x25	IFDC Auctions DAP II x10	Factory Sales Dec '92-'93 Urea * (Fier)	Factory Sales Dec '92-'93 AN	Factory Sales Dec '92-'93 SSP (Lac)	Total Fertilize [ton]	AFADA member	Pestic.	Seeds	Credit for UREA 1st auction [lek]	No of loans	Credit for UREA2nd auction [lek]	No of loans	Credit for DAP 1st auction [lek]	No of loans	Credit for DAP 2nd auction [lek]	No of loans	Total Credit [lek]	Total No of loans
	PEQIN DISTRICT																						
ACE	AGROTREGTARE	PEQIN		1			100			150	NO												
SP	NB PEQIN	PEQIN	1							50	NO					100000	1					100000	1
226	RIFAT TABAKU	KARTHNEK-SHEZE				2	36	11	5	72	YES	YES	NO							270000	1	270000	1
227	MAKSIM TABAKU	PAJOVE			1	10	29	21		175	YES	YES	YES					300000	1	1200000	1	1500000	2
228	SHEFIT TABAKU	SHEZE					20	13		33	NO												
										==== 480													
	PERMET DISTRICT																						
ACE	AGROTREGTARE	PERMET		2	1		9			134	NO					100000	1	300000	1			400000	2
229	EDUARD MULLARAJ	L."PARTIZANI"					86	12		98	YES	NO	NO										
230	GEZIM HYSI							16		16	NO												
231	KUJTIM ZHUPA							14		14	NO												
232	KOSTA KORATI	BUBES						24		24	NO												
233	AGIM RUSTEMI	SUK					10	13		23	YES	YES	YES										
										==== 309													
	POGRADEC DISTRICT																						
ACE	AGROTREGTARE	POGRADEC							5	5	NO												
234	PELLUMB SHYTI							14		14	NO												
235	ENGJELL JONUZI	CERAVE			1		26	10		61	YES	NO	NO					300000	1			300000	1
236	GEZIM PLLAHA	LIN	1	1	1		82	10		217	YES	NO	NO	88000	1	85750	1	300000	1			473750	3
237	CELNIK TOPALLI	PROPTISHT		1			122	18	13	203	YES	NO	NO			73500	1					73500	1
238	AZBI MUCO	TREBINJE	1	1	1		58	13		196	YES	NO	NO	84166	1	40500	1	300000	1			424666	3
239	NAZAR YZELLARI	ZERVACKE		1	1					75	YES	NO	NO			82000	1	290000	1			372000	2
										==== 771													
	PUKA DISTRICT																						
240	DED MALUTA	BASHKIA PUKE		1						50	NO					100000	1					100000	1
241	LAZER MEHILLI	FUSHE-ARREZ		1						50	NO					100000	1					100000	1
242	NIKOLIN VATA	FUSHE-ARREZ		1						50	NO					100000	1					100000	1
										==== 150													
	SHKODRA DISTRICT																						
ACE	AGROTREGTARE	SHKODER	9		1					475	YES												

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Nr.	Name	Address	IFDC Auctions UREA I x50	IFDC Auctions UREA II x50	IFDC Auctions DAP I x25	IFDC Auctions DAP II x10	Factory Sales Dec '92–'93 Urea (Fier)	Factory Sales Dec '92–'93 AN	Factory Sales Dec '92–'93 SSP (Lac)	Total Fertilize [ton]	AFADA member	Pestic.	Seeds	Credit for UREA 1st auction [lek]	No of loans	Credit for UREA 2nd auction [lek]	No of loans	Credit for DAP 1st auction [lek]	No of loans	Credit for DAP 2nd auction [lek]	No of loans	Total Credit [lek]	Total No of loans
SF	NB BERDICE	BERDICE			1					25	NO												
SF	NB BUSHAT	BUSHAT			1					25	NO							300000	1			300000	1
243	AGRON VOGLI	BARBULLUSH					169			169	YES	YES	NO										
244	MYSLI SUKAJ	BERDICE	2	4						300	YES	YES	YES	100000	1							100000	1
245	HYSEN PREVIZI	BUSHAT	2				93	8	4	205	YES	YES	YES	100000	1							100000	1
246	REXHEP SHIMA	BUSHAT					8	8		16	NO												
247	ZIJA HOXHA	DAJC I RI	1							50	NO			100000	1							100000	1
248	PJETER GOCAJ	DARRAGJAT	3	3	1	10				425	YES	YES	YES	100000	1			300000	1			400000	2
249	HALIM HASAJ	DRAGOC – MES	1	1			61			161	YES	YES	YES	80000	1							80000	1
250	QAMIL KULLA	DRISHT		1						50	YES	NO	NO			100000	1					100000	1
251	NDOC PREKA	Rr.Berdicaj Nr.138	3	3	1					325	YES	YES	YES			100000	1	300000	1			400000	2
252	FIQIRI HASANI	MJEDE					114	11		125	NO												
253	KOL KALAVECI	Rr.Sh.Bushati No.1197		1						50	NO												
254	RROK VELLI	MES					32			32	NO												
255	SKENDER ZHEJANI						35	5		40	NO												
256	SHPEND SUKAJ						28			28	NO												
										====													
	SARANDA DISTRICT									2501													
ACE	AGROTREGTARE	SARANDE	7							350	NO			400000	2							400000	2
SF	NB VRINE	VRINE					48		25	73	NO												
										====													
	SKRAPAR DISTRICT									423													
ACE	AGROTREGTARE	COROVODE	3	2			11		48	309	NO												
257	GEZIM GJINECI						25		8	33	NO												
258	ILJAZ ISMAILI	TREBEL–KONAK					27		16	43	YES												
259	ALTIN BAKOLLARI	SPATHAR						21		21	NO												
260	ALBERT ZAIMI	THERPEL					28	22	22	72	YES												
261	NAFI GOJKO	MBRAKULL					37		10	47	NO												
262	SHEFQET MUSABELLIU						12	4		16	NO												
263	RAZI QERSHIJA						7		7	14	NO												
										====													
	TEPELENA DISTRICT									525													
ACE	AGROTREGTARE	TEPELENE		2						100	YES												
264	TEFIK ZIKAJ						10	30		40	NO												

Appendix

Nr.	Name	Address	IFDC Auctions UREA I x50	IFDC Auctions UREA II x50	IFDC Auctions DAP I x25	IFDC Auctions DAP II x10	Factory Sales Dec '92-'93 Urea (Fier)	Factory Sales Dec '92-'93 AN	Factory Sales Dec '92-'93 SSP (Lac)	Total Fertilize [ton]	AFADA member	Pestic.	Seeds	Credit for UREA 1st auction [lek]	No of loans	Credit for UREA2nd auction [lek]	No of loans	Credit for DAP 1st auction [lek]	No of loans	Credit for DAP 2nd auction [lek]	No of loans	Total Credit [lek]	Total No of loans
265	AGIM JAUPI	IZVAR					19	11		30	NO												
										====													
	TIRANA DISTRICT									170													
ACE	AGROTREGTARE	TIRANE	6	5		5				600	NO			200000	1							200000	1
SF	NB KAMEZ	KAMEZ					33	5	252	290	NO												
SF	NB DRITAS	DRITAS							15	15	NO												
+	CARITAS	TIRANE			8	1				210	NO												
266	QEMAL XHANI	BALDUSHK		1						50	YES	YES	YES			70000	1					70000	1
267	SAMI GJANA	BALDUSHK	1							50	YES	YES	YES	56000	1							56000	1
268	XHEVDET SELBA	IBE			1					25	NO												
269	VESEL MEMA	KLLOJKE		4			10			210	NO					100000	1					100000	1
270	ARTUR BRAHJA	NDROQ		1						50	NO					90000	1					90000	1
271	SHPETIM MANCAKU	NDROQ	2	3	2	53	900			1730	YES	YES	YES	76250	1	94575	1	600000	2	5000000	1	5770825	5
272	RAMAZAN COKU	PEZE	1	2						150	NO			75000	1	100000	1					175000	2
273	RAMAZAN SINANI	PEZE (MAKNOR)	1	1	1	8	49			254	YES	NO	NO	80000	1	61001	1	114000	1	920000	2	1175001	5
274	QAZIM CARUNGU	PREZE		1			5			55	YES					85000	1					85000	1
275	KADRI RAHMANI	SHEMRI						14		14	NO												
276	ENVER HYSA	SHENGJERGJ					8	29	5	42	NO												
277	NAIM RROCEKU	SHENGJERGJ					10	10		20	NO												
278	SKENDER ZELA	VISHAJ-BALDUSHK		1						50	YES					100000	1					100000	1
279	FATMIR KOSTA	VRAP		2		1				110	YES	YES	YES			101000	2					101000	2
280	KUJTIM RAMUSHI	VRAP		1			5			55	YES	YES	YES			67300	1					67300	1
281	MEHMET SULA	ZALL-BASTAR						16	5	21	NO												
282	RAMAZAN SITA	ZALL-BASTAR					23	5		28	NO												
										====													
	TROPOJA DISTRICT									4029													
ACE	AGROTREGTARE	BAJRAM CURRI		1			38			88	NO					100000	1					100000	1
										====													
										88													

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Nr.	Name	Address	IFDC Auctions UREA I x50	IFDC Auctions UREA II x50	IFDC Auctions DAP I x25	IFDC Auctions DAP II x10	Factory Sales Dec '92-'93 Urea (Fier)	Factory Sales Dec '92-'93 AN	Factory Sales Dec '92-'93 SSP (Lac)	Total Fertilize [ton]	AFADA member	Pestic.	Seeds	Credit for UREA 1st auction [lek]	No of loans	Credit for UREA 2nd auction [lek]	No of loans	Credit for DAP 1st auction [lek]	No of loans	Credit for DAP 2nd auction [lek]	No of loans	Total Credit [lek]	Total No of loans
	VLORA DISTRICT																						
ACE	AGROTREGTARE	VLORE	6							300	NO			350000	2							350000	2
283	SHABAN ZENAJ						20	22		42	NO												
284	MUHAREM BINAJ	AMONICE						39		39	NO												
285	ANDON DEMA	BUNAVI					28			28	NO												
286	JETNOR PASHAJ	KOCUL	1				40			90	YES	YES	YES										
287	SELAUDIN LUTAJ	L.Kushtrimi P.33	2				50			150	YES	YES	YES	152000	2							152000	2
288	DHIMITER DAIU	NARTE	3							150	YES	NO	NO	152000	1							152000	1
289	MYJET KAPAJ	Rr.Sadik Zoto P.1205/12	3					12		162	YES	YES	NO										
#	XHEMIL BIMO	VLORE	1							50	NO			100000	1							100000	1
										1011													
	T O T A L		193	186	143	619	10251	1985	1834	42770				9055047	79	8404028	91	25084750	85	72676300	52	115220125	307

Appendix G-1

Appendix H

AFADA Membership List. Albania 1993

A F A D A Membership List. ALBANIA 1993

	NAME	FULL ADDRESS	Education	Any Fertilizer sold	Fertilizer Bought to IFDC	Fertilizer Bought to FNF	Fertilizer Bought to LPF	Any Pest. sold	Any Seeds sold	Any Other sold
	BERAT									
1	BASHKIM VOKRRI	*L.Donika Kastrioti*	M O	YES	YES	YES	YES	YES	YES	YES
2	BEQAR LILAJ	*SYZEZ*	H E	YES	YES	YES	YES	YES	YES	NO
3	ENGJELL QATO	*LAPARDHA*	H A	NO	NO	NO	NO	YES	YES	NO
4	FATMIR SULA	*GORICAN*	M A	YES	NO	YES	NO	NO	NO	NO
5	FEJZI VELCAJ	*BARDHAJ*	M A	YES	NO	YES	YES	NO	NO	NO
6	HYDAI SHEHU	*A C E*	H A	YES	YES	YES	YES	YES	NO	YES
7	LUAN BILCARI	*LAPARDHA*	M A	YES	YES	YES	YES	NO	NO	NO
8	NAFI GOJKA	*MBRAKULL*	H E	YES	NO	YES	YES	NO	YES	YES
9	NOVRUZ BELIBASHI	*GALIN*	M E	YES	YES	YES	YES	YES	NO	NO
10	NOVRUZ DELIBASHI	*VELCAN*	M A	YES	YES	NO	NO	NO	NO	NO
11	NUREDIN MYZYRI	*FUSHE–PESHTAN*	M A	YES	YES	YES	YES	NO	NO	NO
12	PELLUMB TARAJ	*GALINE*	M A	YES	NO	YES	YES	NO	NO	NO
13	REFAT HARIZI	*PELLUMBAS*	M A	YES	NO	YES	NO	NO	NO	NO
14	RUFAN LILAJ	*SYZEZ*	H A	YES	YES	YES	YES	YES	YES	NO
15	SULO VERCA	*BARDHAJ*	M A	YES	NO	YES	YES	NO	NO	NO
16	XHEVAIR HARIZI	*PELLUMBAS*	M A	YES	NO	YES	NO	NO	YES	NO
	DEVOLL									
17	ARBEN MANESHI	*MENKULAS*	H A	YES	YES	YES	NO	YES	YES	NO
18	ENGJELLUSH JAZXHIU	*PONCARE*	H A	YES	YES	YES	NO	YES	YES	YES
19	GEZIM MICOLLI	*VRANISHT*	H A	YES	NO	YES	NO	YES	YES	NO
20	HASIP REPA	*PROGER*	H A	YES	YES	YES	YES	YES	NO	NO
21	SABRI TURABI	*HOCISHT*	H A	YES	YES	NO	NO	YES	NO	YES
22	VASFI ZERANI	*MIRAS*	H A	YES	NO	NO	NO	YES	YES	YES
23	YLLI MANCKA	*BABAN*	H A	YES	YES	YES	NO	YES	YES	NO
24	ZIHNI MUSA	*MANCURISHT*	H O	NO	NO	NO	NO	NO	NO	NO
	DURRES									
25	ABDYL LILO	*L 17 Rr P.Hanxhari*	H A	YES	YES	NO	NO	NO	NO	NO
26	BAJRAM CALLIKU	*XHAFZOTAJ*	M E	YES	YES	NO	NO	NO	NO	YES
27	DIANA VRIONI	*SUKTH*	H A	YES	NO	YES	NO	YES	YES	NO
28	IDAJET KORA	*L.9 Rr A.Goga*	H E	YES	YES	NO	NO	NO	NO	YES
29	LUTFI ISUFI	*L.16 Rr.K.Kazanxhi P.861*	H A	NO	NO	NO	NO	YES	NO	NO
30	MUHAMET NRAXHI	*XHAFZOTAJ SHIJAK*	M E	YES	YES	YES	NO	NO	YES	NO
31	NAFIZ SEFERKOLLI	*SUKTH*	M E	YES	YES	NO	NO	NO	NO	NO

	NAME	FULL ADDRESS	Education	Any Fertilizer sold	Fertilizer Bought to IFDC	Fertilizer Bought to FNF	Fertilizer Bought to LPF	Any Pest. sold	Any Seeds sold	Any Other sold
	ELBASAN									
32	ADEM MUCA	*BELSH*	M A	YES	YES	YES	NO	YES	YES	YES
33	AGIM BOJA	*SHIRGJAN*	H E	YES	YES	YES	NO	YES	YES	NO
34	AGUSTIN CALA	*LUMAS*	M A	YES	YES	YES	NO	YES	YES	YES
35	AHMET PELLUMBI	*L.K.Labinotit P.64/I SH.2 AP.4*	H A	YES	NO	NO	YES	YES	YES	YES
36	AVRAM BINJAKU	*GJINAR*	M E	YES	NO	YES	NO	NO	NO	NO
37	DYLBER RAMA	*GREKAN*	H E	YES	YES	YES	NO	YES	YES	YES
38	FADIL VRAPI	*PAJUN*	H A	YES	YES	YES	NO	YES	YES	NO
39	GEZIM ZENELI	*KATUNDI RI*	H A	YES	YES	YES	YES	YES	YES	YES
40	KOSTANDIN CAKALLI	*L.11 Nentori P.580 SH.2 AP.6*	H A	YES	NO	NO	NO	YES	NO	YES
41	NAMIK OMERI	*A C E*	H A	YES	YES	YES	YES	YES	NO	YES
42	QANI SHERJA	*FUNARE*	H A	YES	YES	YES	NO	YES	YES	YES
43	QEMAL DALIPI	*SHUSHICE*	H E	YES	YES	YES	NO	YES	YES	NO
44	QERIM BEQARI	*GRACEN*	H E	YES	YES	YES	YES	YES	YES	NO
45	RAMAZAN ALLA	*POLIS-VALE*	H A	YES	YES	YES	NO	YES	YES	NO
46	REXHEP KOCI	*SHUSHICE*	M E	YES	YES	YES	NO	YES	YES	NO
47	SABRI BALLKOCI	*MENGEL*	H A	YES	YES	YES	YES	YES	NO	NO
48	SAMI KAZIU	*L.I P.15/I - CERRIK*	M O	YES	NO	YES	NO	YES	YES	NO
49	SKENDER CELA	*PAJUN*	M A	YES	YES	YES	NO	YES	YES	NO
50	XHEMAL TANUSHI	*POLIS-VALE*	M E	YES	YES	YES	NO	YES	YES	NO
51	XHEMIL ZDRAVA	*DESHIRAN*	M A	YES	YES	YES	YES	YES	YES	NO
52	XHEVAT FERHATI	*SHUSHICE E VOGEL*	H A	YES	YES	YES	YES	YES	NO	NO
53	XHEVDET MIRAKA	*GOSTIME*	M A	YES	NO	YES	NO	YES	NO	NO
54	YLLI ZANI	*GOSTIME*	H A	YES	YES	YES	NO	YES	YES	NO
	FIER									
55	AGRON XHINDI	*KURIAN*	M A	YES	NO	YES	YES	NO	NO	NO
56	ALFRED MERTIRI	*BISHAN*	H A	YES	YES	NO	NO	NO	NO	NO
57	ARSHI BIDA	*BASHKIM LEVAN*	M E	YES	NO	YES	YES	YES	YES	NO
58	ASLLAN SAKO	*KRESHPAN CAKRAN*	H A	YES	NO	YES	NO	YES	YES	YES
59	BASHKIM RUCA	*CAKRAN*	H A	YES	NO	YES	YES	YES	YES	YES
60	ESAT BUZI	*KALLMI MADH*	M A	YES	NO	YES	NO	NO	NO	NO
61	FITUS SINANI	*CAKRAN*	H A	YES	YES	NO	YES	YES	YES	YES
62	NESHAT GJELI	*ADE*	M A	YES	NO	YES	YES	YES	YES	NO
63	NOVRUZ DYRMISHI	*L.Liri Gera(parafabrikatet) P.9 SH.2*	M A	YES	NO	YES	YES	NO	NO	NO
64	QANI RUSTEMI	*VLASH ROSKOVEC*	M A	YES	YES	YES	YES	YES	YES	YES
65	QEMAL BAJRAMI	*L.R.Sallata Nr.17*	M A	YES	YES	YES	NO	YES	YES	NO
66	QEMAL PETRITI	*VAJKAN*	M A	YES	YES	YES	NO	NO	YES	NO
67	RESHAT HAZIZI	*STRUME*	M A	YES	NO	YES	YES	YES	NO	NO
68	SHPETIM KASTRATI	*LEVAN*	M A	YES	NO	YES	YES	NO	YES	NO
69	TAHIR GREMI	*BELINE*	M A	YES	YES	NO	NO	YES	YES	NO
70	VLASH BARDHI	*LIBOFSHE*	M O	YES	NO	YES	NO	NO	NO	NO
	HAS									
71	AZEM MULAJ	*A C E*	H A	YES	YES	NO	NO	YES	YES	NO

Appendix H-2

	NAME	FULL ADDRESS	Education	Any Fertilizer sold	Fertilizer Bought to IFDC	Fertilizer Bought to FNF	Fertilizer Bought to LPF	Any Pest. sold	Any Seeds sold	Any Other sold
	KAVAJE									
72	AZEM SHEHU	*L.5*	M O	YES	YES	YES	YES	YES	YES	NO
73	DHIMITER GABICI	*L.2 P.166*	H E	YES	YES	YES	YES	YES	YES	YES
74	FEJZULLA ISTREFI	*QERET*	M A	YES	YES	YES	NO	YES	NO	NO
75	KALEM BUSHI	*L.6*	H E	YES	YES	YES	YES	YES	YES	YES
76	KAPLLAN PEZA	*KRYEVIDH*	H A	YES	YES	YES	YES	YES	YES	YES
77	KASTRIOT XHANI	*LUZ I MADH*		YES	YES	NO	NO	NO	NO	NO
78	KUJTIM HAJDINI	*LUZ I VOGEL*	M A	YES	YES	YES	NO	YES	NO	YES
79	MERSIN KOROBOJA	*GOLEMAS GOLEM*	M A	YES	NO	NO	NO	YES	YES	YES
80	NURI BLLAMI	*SPILLE KRYEVIDH*	H A	YES	NO	YES	YES	YES	NO	NO
81	NURI HYLVIU	*A C E*		YES	YES	YES	YES	YES	YES	NO
82	RAMIZ LUSHKA	*LUZ I VOGEL*	M O	YES	NO	YES	NO	NO	NO	YES
83	RIFAT KOLA	*L.3*	M O	YES	YES	YES	YES	YES	YES	YES
84	SAFET LECINI	*LUZ I MADH*	M A	YES	YES	YES	NO	NO	NO	YES
85	SELIM UKU	*LEKAJ*	M O	YES	YES	YES	NO	NO	NO	YES
86	TAHIR KANAPARI	*L.2 (Sallbeg) N.2*	H A	YES	YES	YES	NO	YES	NO	NO
87	VESIP XHANI	*LUZ I MADH*	H A	YES	YES	YES	NO	YES	YES	NO
	KOLONJE									
88	BARDHYL DIKO	*SELENICE*	M A	YES	YES	YES	NO	YES	YES	YES
89	FLAMUR DEMAJ	*A C E*	H E	YES	YES	YES	NO	YES	NO	YES
	KORCE									
90	ADIL JAKOLLARI	*MOGLICE DOBERSON*	H A	NO	NO	NO	NO	NO	NO	NO
91	ALI MANOKU	*LUMALAS*	H A	YES	YES	YES	NO	YES	YES	NO
92	BASHKIM KALARI	*ZEREC*	H A	YES	YES	NO	NO	YES	YES	YES
93	DHIMITER CACA	*L.1 Rr.F.Noli N.88*	H A	YES	YES	NO	YES	YES	YES	YES
94	DYLBER MALO	*PIRG*	H A	YES	YES	YES	NO	YES	YES	YES
95	FARI MERSINI	*Rr.G.Turja 44 Nr.7*	M O	YES	NO	NO	NO	YES	YES	YES
96	FESTIM PISHTARI	*Rr.XII.Dishnica Nr.5*	H A	YES	NO	NO	YES	YES	NO	NO
97	GEZIM GORA	*VLOCISHT*	H A	NO	NO	NO	NO	NO	NO	YES
98	LLAZI ROPI	*A C E*	H A	YES	YES	YES	NO	YES	NO	NO
99	NEFAIL SHUKULLI	*LOZHAN*	H A	YES	YES	YES	YES	YES	NO	NO
100	NEVZAT HAXHIU	*KUCI ZI*	H A	YES	NO	YES	NO	YES	NO	NO
101	NEXHMIE BASHLLARI (firma ROBERTO)	*MALIQ*	M E	NO	NO	NO	NO	NO	NO	YES
102	RESHAT SPAHO	*L.18 Rr.P Shamo P.22*	M O	YES	NO	NO	NO	YES	YES	YES
103	ROLAND BAMLLARI	*POJAN*	H A	YES	YES	YES	NO	YES	YES	YES
104	SEFI KUTROLLI	*L.18 Rr.P.Shamo P.6*	M O	NO	NO	NO	NO	NO	NO	NO
105	SOTIR SEKULLA	*ZAROSHKE – LIQENAS*	H A	YES	NO	NO	NO	YES	NO	YES
106	VASFI SHERIFI	*POJAN*	H A	YES	YES	YES	NO	YES	YES	NO
107	VASIL JANKULLA	*GORICE MADHE LIQENAS*	H A	YES	NO	NO	NO	YES	YES	YES
108	ZANE BIBA	*MOGLICE*	H A	YES	NO	NO	NO	YES	YES	YES

Appendix H

	NAME	FULL ADDRESS	Education	Any Fertilizer sold	Fertilizer Bought to IFDC	Fertilizer Bought to FNF	Fertilizer Bought to LPF	Any Pest. sold	Any Seeds sold	Any Other sold
	KRUJE									
109	AFRIM KULLI	*A C E*	H A	YES	YES	YES	YES	YES	NO	YES
110	BAJRAM KARAJ	*ARAMERAS*	H A	YES	NO	NO	NO	YES	YES	NO
111	FADIL ALLUSHI	*NIKEL*	H A	YES	YES	YES	NO	NO	NO	NO
112	FLAMUR SHIMA	*BORIZANE*	H A	NO	NO	NO	NO	NO	NO	YES
113	HAJRULLA PATURI	*BORIZANE*	H E	YES	NO	YES	NO	NO	NO	YES
114	HAJRULLA POTURI	*BORIZANE*	M E	YES	NO	YES	NO	NO	NO	YES
115	IBRAHIM CANGU	*NIKEL*	M A	YES	YES	YES	YES	YES	YES	YES
116	KADRI MALJA	*BUDULL*	H A	YES	YES	YES	YES	YES	NO	YES
117	MEHDI ELEZI	*BRUZ*	M A	YES	YES	YES	NO	YES	NO	NO
118	MEHDI ELEZI	*BRUZ*	M A	YES	YES	YES	NO	YES	NO	NO
119	MURAT XHAFA	*BORIZANE*	H A	YES	YES	YES	YES	NO	NO	YES
120	PASHK TROKSI	*BILAJ*	M A	YES	YES	YES	YES	NO	NO	YES
	KUCOVE									
121	LATIF CEPA	*KOZARE*	M A	YES	YES	YES	NO	YES	YES	NO
122	NESHAT MARA	*HAVALEAS*	M E	YES	YES	YES	NO	NO	NO	YES
123	VANGJEL DHIMITRI	*PERONDI*	H A	YES	NO	YES	YES	YES	YES	YES
	KUKES									
124	RUSHIT MYFTARI	*TOPOJAN*	H A	YES	YES	YES	NO	NO	YES	NO
	LAC									
125	LIK KASMI	*MILOT*	H E	YES	NO	NO	YES	NO	NO	NO
	LEZHE									
126	KADRI HAKA		H E	YES	NO	YES	NO	YES	YES	YES
127	LLESH LOKUQI	*A C E*	M A	YES	YES	YES	YES	YES	NO	YES
128	NDUE PREKA	*A C E*	H A	YES	YES	YES	YES	YES	YES	NO
129	NIKOLL LUKA	*KALLMET*	M O	YES	NO	NO	YES	NO	NO	NO
130	NUSH THERCAJ	*TALE*	M O	YES	NO	YES	YES	YES	YES	YES
131	TONIN PACAJ	*ISHULL-SHENGJIN*	M E	YES	NO	YES	YES	NO	NO	NO
	LIBRAZHD									
132	AHMET COCA	*KOTODESH*	H A	YES	NO	YES	NO	NO	NO	NO
133	EDI ALICKOLLI	*LIBRAZHD*	M A	YES	YES	YES	YES	YES	YES	NO
134	HAMIT LLESHI	*KUTURMAN*	M A	YES	YES	NO	NO	NO	NO	NO
135	HYQMET SHALJA	*A C E*	H E	YES	YES	YES	YES	YES	NO	YES
136	JONUZ KACA	*SPATHAR*	M A	YES	YES	YES	NO	NO	NO	NO
137	SAMI TANUSHI	*POLIS-GUR SHPAT*	M A	YES	YES	YES	NO	NO	NO	NO

Appendix H-4

	NAME	FULL ADDRESS	Education	Any Fertilizer sold	Fertilizer Bought to IFDC	Fertilizer Bought to FNF	Fertilizer Bought to LPF	Any Pest. sold	Any Seeds sold	Any Other sold
	LUSHNJE									
138	AGIM BAME	*GORE LUMTH*	H A	YES	YES	YES	NO	YES	YES	YES
139	ARISTIDH QORRI	*ALLKAJ*	M A	YES	NO	YES	YES	YES	YES	YES
140	DEMIR ARAPI	*BICAKAJ ZGJAN*	M E	YES	YES	YES	NO	NO	NO	NO
141	DURRAMAN HYSENI	*CERME*	H A	NO	NO	NO	NO	NO	NO	YES
142	FEJZI METOHU	*FIER-SHEGAN*		YES	YES	YES	NO	NO	NO	NO
143	IRAKLI GORREJA	*DIVJAKE*	H A	YES	YES	YES	NO	NO	YES	YES
144	IRAKLI KOLA	*GJAZE-KRUTJE*	H A	YES	YES	NO	NO	NO	NO	YES
145	ISUF MUCA	*CERME E SIPERME*	M A	YES	NO	YES	NO	YES	YES	YES
146	MIKAIL NDONI	*KEMISHTAJ*	M A	YES	YES	YES	NO	NO	NO	YES
147	NDINI NDONI	*GRABIAN*	H A	YES	NO	NO	NO	YES	YES	YES
148	NEBI KRASNIQI	*FIER-SHEGAN*	H A	YES	YES	YES	NO	NO	NO	NO
149	PELLUMB XHELA	*BALLOGAT*	M O	YES	YES	YES	NO	NO	NO	YES
150	RRAPI DUKA	*GRADISHTE*	H A	YES	NO	YES	NO	NO	NO	YES
151	SKENDER HYSENI	*TERBUF*	H A	YES	NO	NO	NO	YES	YES	YES
152	SOKRAT QORRI	*KEMISHTAJ*	M A	YES	YES	YES	YES	YES	NO	NO
153	VANGJEL ZIU	*GORICAJ - KEMISHTAJ*	H A	YES	YES	YES	NO	YES	NO	YES
154	VLADIMIR NUSHI	*KRUTJE*	M A	YES	YES	YES	NO	NO	NO	NO
155	XHELAL CELA	*NGURREZ*	H A	YES	NO	NO	YES	YES	YES	YES
156	YLLI DULI	*FIER-SHEGAN*	M A	YES	YES	YES	YES	NO	NO	YES
	MALESI E MADHE									
157	BRAHIM LEKAJ		H A	YES	NO	YES	NO	YES	YES	YES
158	FERIT HASAJ	*KOPLIK*	H A	YES	NO	YES	NO	YES	NO	NO
159	LEKE NDREU		M A	YES	NO	YES	NO	YES	YES	YES
160	MARASH MICI	*KOPLIK*	H A	YES	YES	NO	NO	YES	YES	NO
161	MUSTAF VUCAJ	*VUC-ZOGAS*	H A	NO	NO	NO	NO	NO	NO	NO
162	PASHKO NOKAJ		H A	YES	YES	NO	NO	NO	NO	NO
163	PREL HASANAJ	*HOT-BAJZE*	M A	NO	NO	NO	NO	NO	NO	YES
164	QEMAL DELISHAJ	*KOPLIK QENDER*	M O	YES	YES	YES	NO	NO	YES	NO
165	SAIMIR CANAJ	*KOPLIK - GRUEMIRE*	M A	YES	NO	YES	NO	NO	NO	NO
	MALLAKASTER									
166	DILAVER MURATAJ	*KUTE*	M A	NO	NO	NO	NO	NO	NO	YES
167	ENVER CAUSHI	*HEKAL*	M A	YES	NO	YES	YES	YES	YES	NO
168	FAIK MALAJ	*PATOS*	H A	YES	NO	YES	NO	YES	YES	NO
169	FATMIR ZOTAJ	*FRATAR*	M A	YES	YES	YES	YES	YES	YES	YES
170	FITIM BARE	*DRENOVE BALLSH*	H A	YES	YES	YES	YES	YES	YES	NO
171	RRAPO XHEMALI	*VICOK - BALLSH*	M A	YES	NO	YES	NO	NO	NO	NO
172	SHAHIN BEJDAJ	*L.5 Shkurti BALLSH*	H A	YES	YES	YES	NO	YES	YES	YES

Appendix H

	NAME	FULL ADDRESS	Education	Any Fertilizer sold	Fertilizer Bought to IFDC	Fertilizer Bought to FNF	Fertilizer Bought to LPF	Any Pest. sold	Any Seeds sold	Any Other sold
	MAT									
173	LEFTER PALLUCI	*RUKAJ*	M A	YES	NO	YES	YES	NO	NO	YES
174	MEHMET COLLAKU	*FULLQET KLOS*	M A	NO	NO	NO	NO	NO	NO	NO
175	SAMI TOPALLI	*FULLQET KLOS*	M A	YES	NO	NO	YES	NO	NO	NO
	MIRDITE									
176	MIRASH RRANXA	*A C E*	M E	YES	YES	YES	YES	YES	YES	NO
177	PASHK BIBA	*FAN*	M A	YES	NO	YES	YES	YES	YES	YES
	PEQIN									
178	MAKSIM TABAKU	*PAJOVE*	H A	YES	YES	YES	NO	YES	YES	YES
179	RIFAT TABAKU	*KARTHNEKE-SHEZE*	M A	YES	YES	YES	NO	YES	NO	YES
	PERMET									
180	AGIM RUSTEMI	*SUK*	M A	YES	NO	YES	NO	NO	NO	NO
181	BILBIL BEQARI	*L.Teqe*	H A	YES	NO	YES	NO	NO	NO	NO
182	ESAT ISAI	*SUKE*	H A	YES	NO	NO	NO	YES	YES	YES
183	PELLUMB ALLIU	*BALLABAN*	H A	YES	NO	YES	NO	YES	YES	YES
184	QERIM MULLARAJ	*L. Partizani*	H A	NO	NO	NO	NO	NO	YES	YES
	POGRADEC									
185	AZBI MUCA	*TREBINJE*	H A	YES	YES	YES	NO	YES	NO	NO
186	CELNIK TOPALLI	*PROPTISHT*	M A	YES	YES	YES	NO	YES	NO	NO
187	ENGJELLUSH JONUZI	*CERAVE*	M A	YES	YES	YES	NO	YES	YES	YES
188	GEZIM PLLAHA	*LIN*	H A	YES	YES	YES	NO	YES	YES	YES
189	MUHAMER HOXHALLARI	*BUCIMAS*	H A	YES	YES	NO	NO	YES	YES	YES
190	NAZAR YZELLARI	*ZERVACKE*	M A	YES	YES	YES	NO	YES	NO	NO
	PUKE									
191	NDUE MARTINI	*P. 17*	M E	NO	NO	NO	NO	YES	YES	NO
	SHKODER									
192	FRAN LLESHI	*SHKJEZ BUSHAT*	M A	NO	NO	NO	NO	NO	NO	YES
193	ARTAN BANUSHI	*BUL.M.Barleti P.161*	H E	YES	YES	YES	YES	YES	YES	YES
194	HASAN METI	*MJEDE*	H A	YES	YES	YES	YES	YES	YES	NO
195	SIMON JAHU	*BOKSI RI VELIPOJE*	M A	YES	YES	YES	NO	YES	YES	YES
196	PAL UJKA	*BOKSI RI VELIPOJE*	M A	YES	YES	YES	YES	YES	YES	YES
197	HALIM HASI	*DRAGOC MES*	M O	YES	YES	YES	NO	NO	NO	YES
198	HYSEN PREVIZI	*BUSHAT*	M A	YES	YES	YES	YES	YES	YES	YES
199	NDOC PREKA	*Beidice N.138*	H A	YES	YES	YES	NO	YES	YES	YES
200	QAMIL KULLA	*DRISHT*	M E	YES	YES	NO	NO	NO	YES	YES

	NAME	FULL ADDRESS	Education	Any Fertilizer sold	Fertilizer Bought to IFDC	Fertilizer Bought to FNF	Fertilizer Bought to LPF	Any Pest. sold	Any Seeds sold	Any Other sold
201	MYSLI SUKAJ	BERDICE	H A	YES	YES		NO	YES	YES	NO
202	AGRON VOGLI	BARBULLUSH		YES	NO	NO	YES	YES	YES	NO
203	PJETER GOCAJ	DARAGJAT DAJC	M A	YES	YES	YES	NO	NO	YES	YES
204	RROK BECI		H A	YES	NO	YES	NO	NO	NO	NO
205	FILIP GJERGJI	DAJC	H A	NO	NO	NO	NO	YES	NO	NO
206	MAKS MEMISHAJ	Rr.V.Shanto P.999	H A	NO	NO	NO	NO	YES	NO	NO
207	VILDAN GOKAJ	Rr.R.Rusi Nr7	H A	NO	NO	NO	NO	YES	NO	NO
208	FIQIRET HASANI	MJEDE	M E	YES	YES	YES	NO	NO	NO	NO
209	ISMET DIBRA	A C E	H A	YES	YES	YES	NO	YES	NO	NO
210	FAHRI TUSHI	BUSHAT	H A	YES	NO	YES	YES	YES	NO	NO
	SKRAPAR									
211	ALBERT ZAIMI	THEREPEL	H E	YES	NO	YES	YES	YES	YES	NO
212	ILJAZ ISMAILAJ	TREBEL-KONAK	H E	YES	NO	YES	YES	NO	NO	NO
	TEPELENE									
213	GEZIM MAMLIKA	A C E	H A	YES	YES	YES	YES	YES	NO	YES
	TIRANE									
214	ZYBER KACANI	LINZE	M O	NO	NO	NO	NO	NO	NO	YES
215	BEQIR PLAKU	FARK E VOGEL	H A	NO	NO	NO	NO	NO	NO	NO
216	QEMAL XHANI	BALDUSHK	H A	YES	YES	NO	NO	NO	NO	NO
217	SHPETIM MANCAKU	NDROQ	M A	YES	YES	YES	NO	YES	YES	YES
218	RAMAZAN SINANI	PEZE MAKNOR	H E	YES	YES	YES	YES	YES	YES	NO
219	MUHAREM SHESHERI	PREZE	H A	YES	YES	YES	YES	YES	YES	NO
220	FATMIR KOSTA	VRAP	H A	YES	YES	YES	YES	YES	NO	NO
221	SAMI GJANA	BALDUSHK	H A	YES	YES	YES	YES	YES	YES	NO
222	GEZIM DOREZI	PEZE HELMES	M A	YES	NO	YES	YES	YES	NO	NO
223	LULEZIM CURRI	NDROQ	H A	NO	NO	NO	NO	NO	YES	YES
224	TOFIK UKU	LALM-VAQAR	M A	YES	NO	NO	NO	YES	YES	NO
225	FATMIR MUCA	MAMINAS	M A	YES	NO	NO	NO	YES	YES	NO
226	KUJTIM RAMUSHI	VRAP	M A	YES	YES	YES	NO	NO	NO	NO
227	FUAT HAJDARI	PEZE HELMES	H E	YES	YES	NO	NO	NO	NO	NO
228	QAZIM CARUNGU	PREZE	H E	YES	YES	YES	YES	NO	NO	NO
229	PETRIT BRETI	RR.Irfan Tomini P.40 SH.3 AP.28	H A	YES	NO	NO	NO	YES	YES	NO
230	TOMOR LUGA	RR.Musa Agolli N.38	M O	YES	NO	YES	NO	YES	YES	YES
231	SKENDER ZELA	VISHAJ	M A	YES	YES	YES	NO	YES	NO	YES
232	Dr.SHERIF LUSHAJ	S S I	H A	NO	NO	NO	NO	NO	NO	NO
233	XHEVDET PELLUMBI	S S I	H A	NO	NO	NO	NO	NO	NO	NO
234	XHEVDET SELBA	IBE	M A	YES	NO	NO	NO	YES	YES	NO

Appendix H

	NAME	FULL ADDRESS	Education	Any Fertilizer sold	Fertilizer Bought to IFDC	Fertilizer Bought to FNF	Fertilizer Bought to LPF	Any Pest. sold	Any Seeds sold	Any Other sold
	VLORE									
234	MYJET LUTO KAPAJ	*Rr.S.Zoto P.1205/12*	H E	YES	YES	NO	NO	NO	NO	NO
235	SELAUDIN LUTAJ	*L.KUSHTRIMI*	H A	YES	YES	NO	NO	YES	YES	NO
236	DHIMITER DAIU	*NARTE*	H A	YES	YES	NO	NO	YES	YES	NO
237	KASTRIOT ALIAJ	*KOTE*	H A	NO	NO	NO	NO	YES	NO	NO
238	MATO MATAJ	*KOTE*	M E	YES	NO	YES	NO	YES	NO	NO
239	JETNOR PASHAJ	*KOCUL*	M A	YES	YES	YES	NO	YES	YES	NO