PROVISIONAL INTELLIGENCE REPORT

THE FIXED NITROGEN INDUSTRY IN CZECHOSLOVAKIA

CIA/RR PR-49
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CIA/RR PR-49

(ORR Project 22.1.4)

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CONTENTS

Appendixes

Tables

Page

Chart

CIA/RR PR-49
(ORR Project 22.1.4)

~~S-E-C-R-E-T~~

THE FIXED NITROGEN INDUSTRY IN CZECHOSLOVAKIA*

Summary

The purpose of this report is to present an analysis of the fixed nitrogen industry in Czechoslovakia and to arrive at firm estimates of supplies, consumption, input requirements, capabilities, vulnerabilities, and intentions.

As considered in this report, the fixed nitrogen industry is that which produces synthetic ammonia, nitric acid, and nitrogen fertilizers. The nature of the industry in Czechoslovakia places certain limitations on the scope of the report. Because of the virtual absence of stockpiling and the relatively minor volume of trade, the analysis of supplies is largely confined to production. Because of the industry characteristic of reprocessing some products to produce others, the input study consists of a number of individual input studies, one for each commodity.

The basic product of the fixed nitrogen industry in Czechoslovakia is ammonia. A greater part of the industrially applicable forms of fixed nitrogen, nitric acid and nitrogen fertilizers, is derived from that product. The remainder is supplied in the form of nitrogen fertilizer derived from calcium cyanamide.

Only three plants in Czechoslovakia are known to be producing synthetic ammonia in significant quantities. They are the Dusikarny Plant at Marianske Hory (near Moravska Ostrava), the Synthesia Plant at Semtin (near Pardubice), and the Spolek Plant at Usti nad Labem. A fourth plant, the Stalin Works at Zaluzi (near Most), may have begun production during 1953 but will have little effect upon total industry production until some time in 1954. A fifth plant, which does not produce synthetic ammonia, is known to be producing nitrogen products.

The total estimated production of fixed nitrogen in all forms in Czechoslovakia in 1953 was 51,200 metric tons.** Of this total,

* The estimates and conclusions contained in this report represent the best judgment of the responsible analyst as of 15 December 1953.
** Tonnages are given in metric tons throughout this report.

32,200 tons were derived from synthetic ammonia, 15,000 tons from byproduct ammonia, and 4,000 tons were contained in calcium cyanamide.

In Czechoslovakia there is no stockpiling of synthetic ammonia, and, except for seasonal requirements, there is no stockpiling of nitric acid. Neither is there any significant trade in synthetic ammonia. Some nitric acid is imported, largely from East Germany, and nitrogen fertilizers in relatively small quantities are imported, almost entirely from Soviet Bloc countries.

Because of the absence of stockpiling, the available supply of fixed nitrogen in Czechoslovakia is the sum of production plus imports, and, because there are no exports, consumption equals available supply.

The major inputs to the fixed nitrogen industry are electrical energy and coal. Input quantities are of significance only in terms of individual products of the industry. Estimates of input requirements for those products are given in the body of the report.

The production of fixed nitrogen as synthetic ammonia is currently approaching capacity. By mid-1954, however, additional facilities should be available. Although nitric acid and nitrogen fertilizers are imported, there appears to be no serious shortage of nitrogen compounds.

In peacetime the major supply of synthetic ammonia is required in the production of nitric acid, nitrogen fertilizers, and industrial explosives. During a war, nitrogen products based on ammonia are indispensable. The same ammonium nitrate used as a fertilizer in peacetime becomes a major component of military explosives in wartime. Furthermore, ammonia or concentrated nitric acid is required in the manufacture of virtually all nonatomic military explosives, and concentrated nitric acid is one of the most desirable oxidizers for special rocket and guided missile fuels.

The industry is self-sufficient as far as raw materials are concerned and consequently is not vulnerable to economic warfare, but because of the small number of plants producing nitrogen products and the dependence of those plants on electrical energy and pure synthesis gas the industry is vulnerable to air attack and sabotage.

Current information indicates that agricultural requirements for fixed nitrogen in Czechoslovakia are still being emphasized. A positive indication of a drastically increased armaments program would be an increasing emphasis on the production of nitric acid and, in particular, concentrated nitric acid. This shift in emphasis would be accompanied by a decline in the production and availability of nitrogen fertilizers, particularly nitrate compounds. To date there has been no clear indication that either situation is developing.

I. History and Organization of the Industry.

Following World War I there was rapid worldwide expansion in the production of synthetic ammonia, and several commercially adaptable modifications of the original Haber-Bosch process were developed. The three plants known to be producing synthetic ammonia in Czechoslovakia at the present time were established during the period from 1928 to 1932. Since World War II, detailed plans have been made to establish 2 new plants and to enlarge the original 3. The probable present status of these plants is considered in Appendix A.

Nationalized industry in Czechoslovakia has passed through several organizational stages since 1945. In 1949 "the chemical plants were classified in production branches, regionally divided and combined into national enterprises, which in turn were subordinated to the respective industrial section of the Ministry of Industries." 1/* Each of these original enterprises contained several groups, each composed of 2 to 10 plants. The original Synthesia Enterprise controlled 39 plants, but by July 1949 it had been decided to organize certain plants as independent enterprises. 2/ The trend has continued, and it appears that today all the major plants operate independently.

In 1951 the Ministry of the Chemical Industry was composed of eight main administrations grouped, in a general way, according to the type of chemicals produced. There were Main Administrations of Fuel, Inorganic Chemistry, Synthetic Fibers, and the like. At that time

* Footnote references in arabic numerals are to sources listed in Appendix E.

each of the three known producers of synthetic ammonia was a member of a different main administration. 3/

Recent reports indicate that, since 1951, changes have been made in the organization. The new main administrations are known by numbers, there is a slightly different grouping of the national enterprises under these main administrations, and a separate main administration (VIII) now controls all warehouses under the Ministry of the Chemical Industry. 4/

The three synthetic ammonia plants known to be in production in 1953 are in different main administrations under the Ministry of the Chemical Industry. The administrative organization of these plants in Czechoslovakia in 1952 is given in Table 1.

Table 1

Administrative Organization of Synthetic Ammonia Plants in Czechoslovakia 1952 5/

Plant	Location	Administration of the Ministry of the Chemical Industry
Dusikarny	Marianske Hory	Main Administration VI
Synthesia	Semtin	Main Administration I
Spolek	Usti nad Labem	Main Administration IV

II. Supplies.

A. Production.

1. Synthetic Ammonia.

The production of synthetic ammonia in Czechoslovakia has been limited, to date, by the capacity of the established plants. It is estimated that the most significant recent increase in the production of synthetic ammonia took place between 1949 and 1952, when the largest plant was partially rebuilt and expanded. A new plant may

have started production during 1953, but significant new production was not anticipated until 1954. The production plans for 1947, and probably 1948, were overfulfilled. Information available concerning the production of nitrogen fertilizer indicates that more enthusiastic plans for later years have not been met. In particular, the greatly increased 1953 plan for nitrogen fertilizer appears to have been too ambitious, considering the synthetic ammonia known to be available. Estimated production of synthetic ammonia in Czechoslovakia for selected years from 1930 through 1954 is given in Table 2.

Table 2

Estimated Production of Synthetic Ammonia in Czechoslovakia
Selected Years, 1930-54 a/ 6/

Metric Tons

Year	Production		Probable Range of Production (Synthetic Ammonia)
	Synthetic Ammonia	Nitrogen Content	
1930	13,900	11,500	11,000 to 14,500
1931	12,200	10,000	11,000 to 14,500
1932	14,100	12,000	13,000 to 16,000
1937	19,400	16,000	17,000 to 20,000
1938	20,600	17,000	18,000 to 21,000
1942	29,400	24,200	26,000 to 32,000
1947 7/	26,000	21,400	21,500 to 29,000
1948	27,700	22,800	26,000 to 29,000
1949	29,800	24,600	28,000 to 33,000
1950 7/	32,900	27,100	30,000 to 34,000
1951	36,200	29,800	32,000 to 38,000
1952	38,500	31,700	34,000 to 40,000
1953	39,100	32,200	35,000 to 40,000
1954	61,400	50,400	49,000 to 75,000

a. For the methodology used in developing this table, see Appendix C.

No new synthetic ammonia plants are known to have begun production since 1932, but two of the original plants have been

enlarged. The estimated capacity (not actual production) of the 3 plants in production during 1953 is about 42,000 tons of ammonia per year. If the capacity of the new Stalin Works is added, the total estimated capacity will be from 57,000 to 77,000 tons in 1954.

Current production estimates for synthetic ammonia plants in Czechoslovakia are given in Table 3.

Table 3

Estimated Production of Synthetic Ammonia Plants in Czechoslovakia 1953 and 1954

Metric Tons

Plant	Location	1953	1954
Dusikarny	Marianske Hory	26,700	26,700
Synthesia	Semtin	9,700	10,000
Spolek	Usti nad Labem	2,700	2,700
Stalin Works	Zaluzi		22,000

2. Nitric Acid.

Nitric acid is produced in both dilute and concentrated forms. The dilute acid averages 60 percent pure nitric acid, and the concentrated acid averages from 96 to 99 percent pure. In arriving at estimates of production and capacity, all nitric acid, both dilute and concentrated, is converted to a basis of 100 percent nitric acid.

The three plants known to be currently producing synthetic ammonia, Dusikarny, Synthesia, and Spolek, are also producing nitric acid. The fourth synthetic ammonia plant, the Stalin Works, is expected to reach large-scale production of synthetic ammonia in 1954, but probably will not produce nitric acid.

Table 4 gives the estimated production of nitric acid in Czechoslovakia as determined from the estimated annual production of individual plants.

Table 4

Estimated Production of Nitric Acid in Czechoslovakia
Selected Years, 1930-54 a/

Metric Tons

Year	Production	Probable Range of Production
1930	15,000	11,000 to 16,000
1937	33,300	25,000 to 35,000
1938	36,300	30,000 to 37,000
1942	63,400	60,000 to 72,000
1947	32,000	28,000 to 35,000
1948	37,500	35,000 to 40,000
1949	40,700	36,000 to 44,000
1950 b/	42,300	37,000 to 45,000
1951 b/	43,500	37,500 to 46,000
1952 b/	45,200	41,000 to 48,000
1953 b/	46,500	42,000 to 49,000
1954 b/	46,500	42,000 to 49,000

a. Production figures are on the basis of 100 percent nitric acid. For the methodology used in developing this table, see Appendix C.
b. For this year, 4,000 to 5,000 tons of concentrated nitric acid are included. The remainder is produced with an average 60 percent pure acid content.

In terms of potential rather than actual production, the 3 plants currently producing nitric acid have an estimated total capacity of 78,000 tons of 100 percent nitric acid. Of this total the greater part is dilute acid capacity. The only significant concentrated nitric acid capacity, 8,500 tons, is that of the Synthesia Plant at Semtin. The Spolek Plant at Usti nad Labem undoubtedly produces small quantities of concentrated nitric acid for its dye and intermediate chemical products, but neither capacity

nor production figures for concentrated nitric acid are known. It is believed that the Dusikarny Plant at Marianske Hory, the largest nitric acid producer, has no capacity for concentrated acid production. Neither the Stalin Works at Zaluzi nor the new Nitrogen Products Plant at Lovosice has any capacity for the production of nitric acid, either dilute or concentrated. The latter plant, however, can be expected to install nitric acid production facilities within the next few years.

Actual production is substantially lower than production capacity. Current production estimates for nitric acid plants in Czechoslovakia are given in Table 5.

Table 5

Estimated Production of Nitric Acid Plants
in Czechoslovakia
1953 and 1954 a/

Metric Tons

Plant	Location	1953	1954
Dusikarny	Marianske Hory	28,000	28,000
Synthesia	Semtin	16,500 b/	16,500 b/
Spolek	Usti nad Labem	2,000	2,000

a. Production figures are on the basis of 100 percent nitric acid.
b. Production figure includes about 5,000 tons of concentrated nitric acid.

3. Nitrogen Fertilizers.

Several types of nitrogen fertilizer are produced in Czechoslovakia. To obtain both a common basis for the comparison of production and a meaningful total production figure, all fertilizer production estimates in this report will be expressed in terms of nitrogen content.

The average nitrogen content of all nitrogen fertilizers produced in Czechoslovakia up to 1939 was 18.5 percent. Currently, the average nitrogen content is believed to be slightly higher -- about 19 percent.

Production estimates can be made for three different categories of nitrogen fertilizers as follows:

a. Nitrogen Fertilizers from Synthetic Ammonia.

These products are the various mixed fertilizers produced from synthetic ammonia. The nitrogen is actually supplied by nitric acid and/or ammonia, depending on the product. The two major products in this group are ammonium nitrate and ammonium sulfate.

b. Byproduct Ammonium Sulfate.

This fertilizer is produced from the ammonia liquor recovered at coke plants. Thus it is not a product of the synthetic ammonia industry. The total nitrogen content of this fertilizer produced during 1953 amounts to about 40 percent of the total fertilizer nitrogen produced during that year.

c. Calcium Cyanamide.

One plant at Sokolov (German name -- Falkenau) produces all the cyanamide fertilizer in Czechoslovakia. The total nitrogen content of this fertilizer produced during 1953 amounts to about 10 percent of the total fertilizer nitrogen produced during that year.

The average nitrogen content of the major nitrogen fertilizers consumed in Czechoslovakia is given in summary form in Table 6.* These percentages can be used to calculate the production of nitrogen fertilizers in Czechoslovakia from the total nitrogen estimates of Table 7.**

Table 8*** gives the estimated quantities of ammonium nitrate and ammonium sulfate fertilizers produced from synthetic ammonia in Czechoslovakia during 1953.

* Table 6 follows on p. 10.
** Table 7 follows on p. 10.
*** Table 8 follows on p. 11.

Table 6

Nitrogen Content of the Major Nitrogen Fertilizers Produced in Czechoslovakia 8/

Fertilizer	Nitrogen Content (Percent)
Ammonium Nitrate	38.00
Ammonium Sulfate	20.6
Ammonium Sulfate-Nitrate Mixture	26.0
Calcium Cyanamide	21.0
Lime-Ammonium Nitrate a/	15.5
Nitrophos b/	15.5

a. Also known as Ostrava saltpeter, Ostrava nitrate, or Kalkammon saltpeter. Imported lime-ammonium nitrate normally contains about 20.5 percent nitrogen.
b. A mixture of ammonium nitrate and ground phosphate rock which contains 16 to 18 percent phosphoric anhydride.

Table 7

Estimated Production of Fertilizer Nitrogen in Czechoslovakia Selected Years, 1930-54 a/* 9/

Metric Tons

Year	Synthetic Ammonia	Byproduct Ammonium Sulfate	Calcium Cyanamide	Total
1930	7,000	5,000	6,300	18,300
1935 10/	10,500	4,900	4,300	19,700
1936 10/	8,600	6,400	5,000	20,000
1937 10/	10,100	8,230	5,300	23,630
1938 10/	9,900	8,300	5,500	23,700
1942	N.A.	N.A.	N.A.	15,000
1947	12,500	7,500	4,500	24,500 11/
1948	15,000	8,000	5,000	28,000
1949	16,000	10,000	5,000	31,000 12/

* Footnote for Table 7 follows on p. 11.

Table 7

Estimated Production of Fertilizer Nitrogen in Czechoslovakia
Selected Years, 1930-54 a/ 9/
(Continued)

Metric Tons

Year	Synthetic Ammonia	Byproduct Ammonium Sulfate	Calcium Cyanamide	Total
1950	16,500	12,000	4,500	33,000 12/
1951	17,000	13,000	4,000	34,000
1952	17,000	14,000	4,000	35,000
1953	19,000	15,000	4,000	38,000
1954	37,000	15,000	4,000	56,000

a. Production figures refer to the total nitrogen content only. Except for 1930, production figures through 1938 are reported figures and are considered accurate. Later figures are subject to comparatively large error. The estimated range of production for 1953 is 33,000 to 39,000 tons. For the methodology used in developing this table, see Appendix C.

Table 8

Estimated Production of Ammonium Nitrate and Ammonium Sulfate Fertilizers from Synthetic Ammonia in Czechoslovakia
1953 a/

Metric Tons

Fertilizer	Nitrogen Content	Production	Probable Range of Estimate (Nitrogen Content)
Ammonium Nitrate b/	11,000	29,000	9,000 to 12,000
Ammonium Sulfate	5,500	27,000	4,000 to 7,000
Other Nitrates	2,500	N.A.	1,500 to 3,500

a. For the methodology used in developing this table, see Appendix C.
b. These figures do not include excess ammonium nitrate produced by the Synthesia Plant at Semtin, which is consumed in explosives. Probably 5,000 tons of ammonium nitrate are available at the Synthesia Plant for production of explosives.

The estimated production of synthetic nitrogen fertilizers from synthetic ammonia is summarized on a plant basis in Table 9.

Table 9

Estimated Production of Synthetic Nitrogen Fertilizer Plants in Czechoslovakia 1953 and 1954 a/

Metric Tons

Plant	Location	1953	1954
Dusikarny	Marianske Hory	17,000	17,000
Synthesia	Semtin	2,000	2,000
Nitrogen Products	Lovosice b/	Negligible	18,000

a. The plant producing calcium cyanamide and coke plants recovering byproduct ammonium sulfate are not included. Production figures refer to total nitrogen content only.
b. See Appendix A.

4. All Forms of Fixed Nitrogen.

In Czechoslovakia, fixed nitrogen is produced in three different forms: synthetic ammonia, byproduct ammonium sulfate from coke plants, and calcium cyanamide.

The total production of all forms of fixed nitrogen in Czechoslovakia for several years is summarized in Table 10.*

B. Stockpiling.

Although there is no specific information concerning the stockpiling policy in Czechoslovakia, it is almost certain that neither synthetic ammonia nor nitric acid is stockpiled at present. There are probably the normal industrial stocks of 1 to 3 months' supply of nitric acid. An economy mobilized for war requires such

* Table 10 follows on p. 13.

Table 10

Total Estimated Production of All Forms of Fixed Nitrogen
in Czechoslovakia
Selected Years, 1930-54 a/

Metric Tons

Year	Synthetic Ammonia	Byproduct Ammonium Sulfate	Calcium Cyanamide	Total
1930	11,500	5,000	6,300	22,800
1937	16,000	8,230	5,300	29,530
1938	17,000	8,300	5,500	30,800
1947	21,400	7,500	4,500	33,400
1948	22,800	8,000	5,000	35,800
1949	24,600	10,000	5,000	39,600
1950	27,100	12,000	4,500	43,600
1951	29,800	13,000	4,000	46,800
1952	31,700	14,000	4,000	49,700
1953	32,200	15,000	4,000	51,200
1954	50,400	15,000	4,000	69,400

a. Production figures refer to the total nitrogen content only and are taken from Table 2, p. 5 and Table 7, p. 10.

large quantities of nitric acid and ammonia that prohibitive numbers of special pressure vessels and noncorrosive containers would be needed to store significant quantities of these commodities.

On the other hand, the nitrogen fertilizer industry is normally seasonal, and storage facilities are provided at producing plants for the storage of several months' production. A practical method of stockpiling nitrogen would be that of stockpiling finished or semifinished products such as filled munitions, explosives, and ammonium nitrate. Special care is needed to store pure ammonium nitrate, which is deliquescent.

C. Trade.

In synthetic ammonia there is no significant trade involving Czechoslovakia. There is trade, however, in other nitrogen products,

including nitric acid, fertilizers, and intermediates for dyes and special chemicals.

During recent years, Czechoslovakia has imported nitric acid. Nearly all of it has come from East Germany, but there have been occasional shipments from Hungary. There is no information concerning trade with the USSR. The Czechs had intended to increase the production of nitric acid sufficiently by 1954 to dispense with imports. If this plan was based on expected production from a new plant, it may not be realized by 1954. Estimated imports of nitric acid by Czechoslovakia from 1951 through 1954 are given in Table 11.

Table 11

Estimated Imports of Nitric Acid by Czechoslovakia 1951-54 a/ 13/

Year	Metric Tons
1951	3,000
1952	1,500
1953	2,000
1954	1,000 b/

a. Practically all imports are from East Germany. Import figures are on the basis of 100 percent nitric acid.
b. It was planned to discontinue imports of nitric acid in 1954. It is doubtful now that a new plant will start production by that time, as was originally planned.

Czechoslovakia has been a net importer of nitrogen fertilizers every year. If expansion plans materialize on schedule, large imports should not be required after 1953. Before World War II, imports averaged about 2,000 tons of nitrogen. About 75 percent of this nitrogen was in the form of Chilean nitrate, and the remaining 25 percent was in the form of calcium cyanamide.

Since World War II the imports have included ammonium nitrate and ammonium sulfate from the USSR, lime-ammonium nitrate from Austria, and ammonium sulfate and lime-ammonium nitrate from East Germany. France supplied some unspecified nitrogen fertilizers during 1950 and 1951. Estimated imports of nitrogen fertilizers by Czechoslovakia from 1950 through 1953 are given in Table 12.

There have been rare and insignificant exports of nitrogen fertilizers, apparently on an individual contract basis.

Table 12

Estimated Imports of Nitrogen Fertilizers by Czechoslovakia 1950-53 14/

Metric Tons

Exporter	1950	1951	1952	1953
Soviet Bloc	3,000 a/	4,000	8,500	8,000
West	7,900	6,300		
Austria	7,500	6,100		
France	400	200		

a. Import figures refer to total nitrogen content only.

D. Availability.

As there is no trade in synthetic ammonia and there is not believed to be any stockpiling, consumption and availability are equivalent to the national production.

Some nitric acid is imported at present, but it is planned to increase production in order to dispense with such imports. Some nitrogen fertilizers are also imported, but new plant facilities should help in overcoming the shortage during 1954.

The estimated availability of synthetic ammonia, nitric acid, and nitrogen fertilizers in Czechoslovakia during 1953 is given in Table 13.

Table 13

Estimated Production, Consumption, and Net Trade in Synthetic Ammonia, Nitric Acid, and Nitrogen Fertilizers by Czechoslovakia 1953

Metric Tons

Commodity	Production	Consumption	Net Trade
Synthetic Ammonia	39,100	39,100	0
Nitric Acid a/	46,500	48,500	+ 2,000 b/
Nitrogen Fertilizers c/	38,000	46,000	+ 8,000

a. Figures are on the basis of 100 percent nitric acid.
b. Plus (+) indicates net imports.
c. Figures refer to the total nitrogen content only.

Tables 14 and 15* are presented for comparison. The estimated availability of nitrogen fertilizers in Czechoslovakia over several years is summarized in Table 14.

Table 14

Estimated Production, Consumption, and Net Trade in Nitrogen Fertilizers by Czechoslovakia Selected Years, 1935-54 a/**

Metric Tons

Year	Production b/	Consumption	Net Trade
1935	19,700	21,880	+ 2,180 15/ c/
1936	20,000	22,110	+ 2,110 15/
1937	23,630	24,830	+ 1,200 15/

* Table 15 follows on p. 17.
** Footnotes for Table 14 follow on p. 17.

Table 14

Estimated Production, Consumption, and Net Trade in Nitrogen Fertilizers by Czechoslovakia Selected Years, 1935-54 a/ (Continued)

Metric Tons

Year	Production b/	Consumption	Net Trade
1938	23,700	24,700	+ 1,000 15/
1942	15,000	15,000	0
1947	24,500	28,500	+ 4,000
1948	28,000	33,000	+ 5,000 d/
1949	31,000	36,000	+ 5,000 d/
1950	33,000	43,900	+10,900 e/
1951	34,000	44,300	+10,300 e/
1952	35,000	43,500	+ 8,500 e/
1953	38,000	46,000	+ 8,000 e/
1954	56,000	56,000	0

a. Figures refer to the total nitrogen content only.
b. Production figures are taken from Table 17, p. 10.
c. Plus (+) indicates net imports.
d. Plan figure is taken from Table 15, p. 17.
e. Import figure is taken from Table 12, p. 15.

Table 15

Planned Production, Consumption, and Net Trade in Nitrogen Fertilizers by Czechoslovakia 1948-53 a/* 16/

Metric Tons

Year	Production	Consumption	Net Trade
1948	28,270	33,270	+ 5,000 b/
1949	29,681	34,681	+ 5,000

* Footnotes for Table 15 follow on p. 18.

Table 15

Planned Production, Consumption, and Net Trade in Nitrogen Fertilizers by Czechoslovakia 1948-53 a/ 16/ (Continued)

Metric Tons

Year	Production	Consumption	Net Trade
1950	37,516	40,016	+ 2,500
1951	39,595	42,095	+ 2,500
1952	41,191	43,691	+ 2,500
1953 c/	42,930	45,430	+ 2,500

a. Figures refer to the total nitrogen content only.
b. Plus (+) indicates net imports.
c. In 1951 the planned production of nitrogen fertilizers for 1953 was increased by 50 percent to about 64,500 tons. 17/

Table 15 presents the estimated availability of nitrogen fertilizer in Czechoslovakia for 6 years as anticipated by the Czechs in their Five Year Plan (1949-53). Comparison with Table 14 indicates that this original Plan was entirely feasible.

III. Consumption.

A. Synthetic Ammonia.

Synthetic ammonia is primarily consumed directly in the production of nitric acid and fertilizers. Of the total nitric acid produced from synthetic ammonia, 60 to 70 percent is consumed, in turn, in the production of fertilizers.

Most of the remaining ammonia is used in the chemical, metallurgical, and refrigeration industries. One of the chemical requirements for ammonia is in the production of urea.

Urea is used to produce glue for the furniture industry and other synthetic resins for lacquers and plastics. It had been a dollar import; so provision was made to use 350 tons of ammonia to

produce 500 tons of urea at the Dusikarny Plant during 1951. Plans were also formulated for the production of 5,000 tons of urea per year, beginning in 1952. This production would provide about 1,700 tons for export and would require about 3,500 tons of synthetic ammonia. 18/ The 1951 production was undoubtedly achieved, but by mid-1953 there was no confirmation of the larger production.

As detailed information concerning all requirements for synthetic ammonia is lacking, two very general categories, in addition to agriculture, will be considered. Table 16 gives the estimated consumption of synthetic ammonia in Czechoslovakia for 1953 by broad categories of use.

Table 16

Estimated Consumption of Synthetic Ammonia in Czechoslovakia 1953 a/

Use	Consumption (Metric Tons)	Percent of Total
Nitrogen Fertilizers	23,100	59.0
Explosives (Industrial and Military) b/	5,000	12.8
Other	11,000	28.2

a. For the methodology used in developing this table, see Appendix C.
b. This requirement includes ammonia consumed in the production of the required nitric acid.

B. Nitric Acid.

There is not sufficient detailed information to provide a comprehensive nitric acid consumption pattern. Thus the same broad categories as were used in Table 16 will be used in Table 17* to express the estimated consumption of nitric acid.

* Table 17 follows on p. 20.

Miscellaneous uses include the manufacture of many chemicals, dyes, and lacquers. A considerable quantity is also consumed in the metallurgical industry.

Table 17

Estimated Consumption of Nitric Acid in Czechoslovakia 1953 a/

Use	Consumption (Metric Tons)	Percent of Total
Nitrogen Fertilizers	32,000	66.0
Explosives (Industrial and Military)	11,000	22.7
Other	5,500	11.3

a. For the methodology used in developing this table, see Appendix C.
b. Consumption figures are on the basis of 100 percent nitric acid.

C. Nitrogen Fertilizers.

Although ammonium nitrate can readily be diverted to the production of explosives, it can be assumed for present purposes that all of the available fertilizer nitrogen will be consumed as fertilizer. It is estimated that 46,000 tons of nitrogen were consumed as a constituent of fertilizers during 1953.

According to a discussion (1948) of the Five Year Plan (1948-53), the Ministry of Agriculture wanted 60,000 tons of nitrogen. It is also reported that 3.02 kilograms of nitrogen were applied to each hectare of agricultural land in Czechoslovakia in both 1937 and 1938. The Plan anticipated the application of 4.40 kilograms per hectare in 1948, 6.06 kilograms in 1953, and 7.00 kilograms in 1954. Eventually 20 kilograms per hectare would be required. 19/

D. All Forms of Fixed Nitrogen.

Consumption estimates for synthetic ammonia and nitric acid cover many of those for all forms of fixed nitrogen. It is important to note, however, that of the total fixed nitrogen available in 1953, about 75 percent, or 46,000 tons, was to be consumed as fertilizer. Immediately after World War II the percentage of the total available fixed nitrogen (including imports) consumed by agriculture amounted to about 73 percent. For comparison it can be noted that in the US agricultural consumption of fixed nitrogen during 1947 and 1948 amounted to about 70 percent of the total supply.

In Czechoslovakia the remaining fixed nitrogen is consumed by industry in the form of ammonia, nitric acid, and their derivatives. Some calcium cyanamide may be used by the chemical industry.

IV. Input Requirements.

A. Synthetic Ammonia.

Power requirements for synthetic ammonia production vary greatly with the process used. Of a total production of 39,100 tons of synthetic ammonia during 1953, it is estimated that about 68 percent, or 26,700 tons, was to be produced from coke-oven-gas hydrogen; about 25 percent, or 9,700 tons, from coke-water-gas hydrogen; and the remaining 7 percent, or 2,700 tons, from electrolytic hydrogen.

The electrical energy required to produce 1 ton of synthetic ammonia by the three different processes is as follows 20/:

	Kilowatt-Hours
Coke-Oven-Gas Hydrogen	2,200
Coke-Water-Gas Hydrogen	1,400
Electrolytic Hydrogen	13,300

The raw material requirements (with the exception of electrical energy) for the production of 1 ton of synthetic ammonia are similar to all 3 processes. The following requirements are based on the experience of one US producer:

Nitrogen	Cubic Meters	720 to 800
Hydrogen	Cubic Meters	2,000 to 2,400
Iron Catalyst	Grams	135 to 150
Water	Cubic Meters	100 to 400
Steam (Process)	Metric Tons	1.0 to 2.0

Calculated from these coefficients, the quantitative input requirements for the manufacture of 39,100 tons of synthetic ammonia in Czechoslovakia during 1953 are given in Table 18.

Table 18

Input Requirements for the Manufacture of Synthetic Ammonia in Czechoslovakia 1953

Input	Unit	Requirement
Nitrogen	Million Cubic Meters	28.2 to 31.3
Hydrogen	Million Cubic Meters	78.2 to 83.8
Iron Catalyst	Kilograms	5,300 to 5,900
Water	Million Cubic Meters	3.9 to 15.0
Steam (Process)	Metric Tons	39,000 to 78,000
Electrical Energy	Million Kilowatt-Hours	100 to 115

B. Nitric Acid.

Raw material and power requirements for the production of nitric acid are similar in all installations although large variations occur in the quantities of cooling water and steam required. The raw materials and the electrical energy required for the manufacture of nitric acid in the USSR will be used as a basis for determining the requirements in Czechoslovakia. 21/

The average consumption coefficients for the manufacture of 1 ton of nitric acid are as follows:

Synthetic Ammonia	Kilograms	290 to 300
Platinum Catalyst	Grams	0.10 to 0.13
Water (for Cooling)	Cubic Meters	80 to 145
Steam	Kilograms	145 to 360
Electrical Energy	Kilowatt-Hours	210 to 300

Calculated from these coefficients, the quantitative input requirements for the manufacture of 46,500 tons of nitric acid in Czechoslovakia during 1953 are given in Table 19.

Table 19

Input Requirements for the Manufacture of Nitric Acid in Czechoslovakia 1953

Input	Unit	Requirement
Synthetic Ammonia	Metric Tons	13,500 to 14,000
Platinum Catalyst	Kilograms	4.7 to 6.1
Water (for Cooling)	Million Cubic Meters	3.7 to 6.8
Steam	Metric Tons	6,800 to 16,700
Electrical Energy	Million Kilowatt-Hours	9.8 to 14.0

C. Nitrogen Fertilizers.

Input requirements will be calculated for three major fertilizers produced in Czechoslovakia. These fertilizers accounted for about 94 percent of the synthetic fertilizer nitrogen produced during 1953.

1. Ammonium Nitrate.

The average consumption factors for the production of 1 ton of ammonium nitrate are as follows 22/:

Synthetic Ammonia	Kilograms	217 to 220
Nitric Acid (100 Percent)	Kilograms	785 to 795
Steam	Kilograms	400 to 1,000
Water	Cubic Meters	20 to 40
Electrical Energy	Kilowatt-Hours	15 to 30

Calculated from these coefficients, the total quantitative input requirements for the production of 34,000 tons of ammonium nitrate in Czechoslovakia during 1953 are given in Table 20.

Table 20

Input Requirements for the Manufacture of Ammonium Nitrate in Czechoslovakia 1953

Input	Unit	Requirement
Synthetic Ammonia	Metric Tons	7,400 to 7,500
Nitric Acid (100 Percent)	Metric Tons	26,500 to 27,000
Steam	Metric Tons	13,500 to 34,000
Water	Thousand Cubic Meters	680 to 1,360
Electrical Energy	Thousand Kilowatt-Hours	510 to 1,020

2. Ammonium Sulfate.

a. Ammonium Sulfate from Synthetic Ammonia.

The average consumption factors for the production of 1 ton of ammonium sulfate from synthetic ammonia are as follows 23/:

Synthetic Ammonia	Kilograms	260 to 280
Sulfuric Acid (68 to 71 Percent Pure)	Kilograms	745 to 765
Water	Cubic Meter	1
Electrical Energy	Kilowatt-Hours	18 to 20

Calculated from these coefficients, the total quantitative input requirements for the production of 27,000 tons of ammonium sulfate from synthetic ammonia in Czechoslovakia during 1953 are given in Table 21.

Table 21

Input Requirements for the Manufacture of Ammonium Sulfate from Synthetic Ammonia in Czechoslovakia 1953

Input	Unit	Requirement
Synthetic Ammonia	Metric Tons	7,000 to 7,600
Sulfuric Acid (68 to 71 Percent Pure)	Metric Tons	20,000 to 21,000
Water	Cubic Meters	27,000
Electrical Energy	Thousand Kilowatt-Hours	485 to 540

b. Ammonium Sulfate from Byproduct Coke Ovens.

The average consumption factors for the production of 1 ton of ammonium sulfate from byproduct coke ovens are as follows 24/:

Byproduct Ammonia (100 Percent)	Kilograms*	250 to 260
Sulfuric Acid (75 to 78 Percent Pure)	Kilograms	960 to 980
Steam	Metric Tons	3 to 6
Water	Cubic Meters	6 to 8
Electrical Energy	Kilowatt-Hours	25 to 30

Calculated from these coefficients, the total quantitative input requirements for the production of 78,000 tons of byproduct ammonium sulfate in Czechoslovakia during 1953 are given in Table 22.**

* Estimated.

** Table 22 follows on p. 26.

Table 22

Input Requirements for the Manufacture of Ammonium Sulfate from Byproduct Coke Ovens in Czechoslovakia 1953

Input	Unit	Requirement
Byproduct Ammonia (100 Percent)	Metric Tons	19,500 to 20,200
Sulfuric Acid (75 to 78 Percent Pure)	Metric Tons	75,000 to 77,000
Steam	Thousand Metric Tons	235 to 470
Water	Thousand Cubic Meters	468 to 625
Electrical Energy	Million Kilowatt-Hours	1.9 to 2.3

3. Calcium Cyanamide.

The requirements for the manufacture of 1 ton of calcium cyanamide are as follows 25/:

Calcium Carbide	Kilograms	650 to 750
Nitrogen	Cubic Meters*	160 to 300
Electrical Energy	Kilowatt-Hours	80 to 90

Calculated from these coefficients, the total quantitative input requirements for the manufacture of 19,000 tons of calcium cyanamide in Czechoslovakia during 1953 are given in Table 23.**

V. Capabilities, Vulnerabilities, and Intentions.

A. Capabilities.

The capabilities of Czechoslovakia in the production of fixed nitrogen are important not because of the size of the industry but because the industry supplies raw materials to several other strategic industries. It is estimated that during 1953 Czechoslovakia produced

* Estimated.
** Table 23 follows on p. 27.

Table 23

Input Requirements for the Manufacture of Calcium Cyanamide in Czechoslovakia 1953

Input	Unit	Requirement
Calcium Carbide	Metric Tons	12,500 to 14,500
Nitrogen	Million Cubic Meters	3.2 to 5.7
Electrical Energy	Million Kilowatt-Hours	1.5 to 1.7

an estimated 39,100 tons of synthetic ammonia, or a little more than 5 percent of the corresponding estimated production of the USSR. 26/

The nitrogen content of this ammonia is available to the modern and well-organized explosives and munitions industry. Other chemical industries also have strategic uses for this nitrogen.

The production of fixed nitrogen as synthetic ammonia is currently approaching capacity. The synthetic ammonia available during 1953 could have provided as much concentrated nitric acid for strategic uses as was available during World War II. The explosives industry of Czechoslovakia could readily use the concentrated nitric acid to produce additional quantities of TNT (trinitrotoluene), picric acid, hexogen, and other military explosives.

Whatever amount of ammonium nitrate is produced with the remaining nitric acid and ammonia can be allocated to the explosives industry and agriculture as desired.

By the end of 1953, additional capacity should be available for the production of synthetic ammonia and nitrogen fertilizers. A logical development to expect in the near future would be the construction of additional nitric acid capacity.

B. Vulnerabilities.

The fixed nitrogen industry of Czechoslovakia is self-sufficient in regard to raw materials and consequently is not vulnerable to economic warfare. Construction of new facilities in Czechoslovakia has been delayed, however, by the restrictions placed by the West on the export of specially designed equipment. 27/

As a limited number of plants make up the industry, it is vulnerable to air attack. The vulnerability of synthetic nitrogen plants was demonstrated during World War II. Three plants produce nearly all of the nitrogen products of strategic value at present, and 2 more may be in production by 1954.

Within the industry the production and availability of synthetic ammonia is the determining factor in the production of nitric acid and the many end products of military significance. The ammonia-producing units, in turn, depend upon adequate supplies of pure synthesis gas and electrical energy. Both of these input items are produced within or near the individual plant. Interrupting the supply of either would stop plant production. In addition, an interruption in the electricity or hydrogen supply at these plants would seriously affect production of synthetic methanol at the Stalin Works and at the Dusikarny Plant as well as production of synthetic fuel at the Stalin Works.

C. Intentions.

Information through 1953 indicates the agricultural requirements for fixed nitrogen in Czechoslovakia are still being emphasized. Originally, the one important new nitrogen installation planned since World War II was to reserve 50 percent of the nitrogen for the Ministry of National Defense. Since that time, however, the plans have been involved in various degrees of political intrigue, and it now appears that new nitrogen production will be considerably less than originally planned. It is expected that during 1954 the new facilities will produce only ammonia and ammonium sulfate. These products are primarily for agricultural use and are of no direct value to the military establishment.

A positive indication of a drastically increased armaments program would be an increasing emphasis on the production of nitric acid and, in particular, concentrated nitric acid. This shift in emphasis would be accompanied by a decline in the production and

availability of nitrogen fertilizers, particularly nitrate compounds.

To date there has been no clear indication that either situation is developing.

APPENDIX A

FIXED NITROGEN PLANTS IN CZECHOSLOVAKIA

1. Dusikarny Plant. 28/

a. Full Name. Dusikarna Ostravske Chemicke Zavody (Nitrogen Plant of the Ostrava Chemical Works).

b. Location. Marianske Hory (near Moravska Ostrava).

c. Coordinates. 49°50' N - 18°15' E.

d. Estimated Annual Capacity (Metric Tons).

Synthetic Ammonia		Nitric Acid (100 Percent)	
1930	13,500	1930	21,000
1932	18,000	World War II	48,000
1942	28,000 29/	1949	50,000 30/
		1953	55,000

Nitrogen Fertilizers (Nitrogen Content)

1949 25,000

e. Estimated Annual Production (Metric Tons).

Synthetic Ammonia		Nitric Acid (100 Percent)	
1950	23,000 (22,000 to 25,500)	1950	26,000 (23,000 to 28,000)
1951	25,500 (22,000 to 26,700)	1951	27,000 (23,000 to 28,000)
1952	26,700 (24,300 to 28,000)	1952	28,000 (25,000 to 30,000)
1953	26,700 (24,300 to 28,000)	1953	28,000 (25,000 to 30,000)
1954	26,700 (24,300 to 28,000)	1954	28,000 (25,000 to 30,000)

Nitrogen Fertilizers (Nitrogen Content)

1950	15,000 (13,000 to 18,000)
1951	15,500 (13,000 to 18,000)
1952	15,500 (13,000 to 18,000)
1953	17,000 (14,000 to 19,000)
1954	17,000 (14,000 to 19,000)

f. Process.

The ammonia is synthesized by the Claude process, which operates at an elevated pressure of about 1,000 atmospheres and at about 400°C. Five Skoda 7-stage compressors were in use in 1948, 2 for ammonia synthesis, 1 for methanol synthesis, and 2 in reserve. The iron oxide catalyst was formerly obtained from France, but in 1948 a lower-quality catalyst was being produced at the plant. 31/

Standard processes are used for the production of nitric acid by the oxidation of ammonia and subsequent absorption of the oxides in water. According to one report, the entire installation is of Fauser design, and the product is about 60 percent nitric acid. Another report states that a Fauser unit produces acid of 48 to 50 percent strength.

Various fertilizer mixtures are produced by standard neutralization processes.

g. Comments.

The capacity figures as given for ammonia are well documented. It is interesting to note that one source reports that the first unit was installed during the period from 1928 to 1930 and had a capacity of 7,200 tons of nitrogen and that a second unit was added immediately. Prior to World War II, plans were made to add a third unit as well as to improve efficiency to a capacity of about 23,000 tons of nitrogen. This suggests that any future expansion may be accomplished by adding units of about 7,500 tons of nitrogen annually.

The capacity figure for nitric acid in 1949 is firm. There were plans at that time to increase the capacity by adding more absorbers. Considering the over-all activity at the plant, it is estimated that the capacity for nitric acid during 1953 was about

55,000 tons expressed as 100 percent acid.

The reported capacity for fertilizer production in terms of nitrogen content is considered firm. Yearly production estimates for 1934 to 1938 were prepared from firm national production reports after making allowances for other forms of fertilizer nitrogen. Since World War II the production estimates have been based on the availability of nitrogen at the plant as well as on the few reports concerning national production of nitrogen fertilizers.

Most of the fertilizer is produced as compound, or mixed, fertilizer. Ostrava saltpeter (lime-ammonium nitrate), one of the main products, is a mixture of potassium, sodium, calcium, and ammonium nitrates, containing about 15.5 percent nitrogen. Ammonium sulfate-nitrate mix, or compound fertilizer B, contains 26 percent nitrogen. A third fertilizer, known as Nitrophos, is a mixture of ammonium nitrate and ground phosphate rock containing 15.5 percent nitrogen and 16 to 18 percent phosphoric anhydride. Some ammonium chloride is also mixed with lime for use as a fertilizer. 32/

2. Synthesia Plant. 33/

a. Full Name. Synthesia Narodni Podnik (Synthesia National Corporation).

b. Location. Semtin (near Pardubice).

c. Coordinates. 50°02' N - 15°47' E.

d. Estimated Annual Capacity (Metric Tons).

Synthetic Ammonia		Weak Nitric Acid*	
1932	4,200	1949	12,000
1937	7,000		
1948	10,500 34/		

Concentrated Nitric Acid*		Ammonium Nitrate	
1944	6,000	1948	9,000
1948	8,500 35/		

* Figures are on the basis of 100 percent nitric acid.

e. Estimated Annual Production (Metric Tons).

Synthetic Ammonia		Weak Nitric Acid*	
1950	7,300 (6,000 to 7,900)	1950	11,000 (9,000 to 12,000)
1951	8,100 (6,700 to 8,500)	1951	11,000 (9,000 to 12,000)
1952	9,100 (7,300 to 9,700)	1952	11,500 (10,000 to 12,000)
1953	9,700 (7,900 to 10,100)	1953	11,500 (10,000 to 12,000)
1954	10,000 (7,900 to 10,100)	1954	11,500 (10,000 to 12,000)

Concentrated Nitric Acid*		Ammonium Nitrate**	
1950	4,000	1950	9,000 (8,000 to 11,000)
1951	4,000	1951	9,500 (8,000 to 11,000)
1952	4,000	1952	10,000 (9,000 to 11,000)
1953	5,000	1953	10,000 (9,000 to 11,000)
1954	5,000	1954	10,500 (9,000 to 11,000)

f. Process.

Ammonia is synthesized by the ICI (Imperial Chemical Industries) process. This process is similar to the Haber-Bosch process, using a "promoted" catalyst of iron oxides and operating at 200 to 250 atmospheres pressure. The hydrogen is provided by coke-water gas, and the nitrogen by a liquid-air installation.

Concentrated nitric acid is produced directly by oxidation of ammonia, according to the German Hoko process. 36/

g. Comments.

The Synthesia Plant and the plant formerly known as Explosia are neighboring units of a combine built chiefly for the production of explosives. The construction of the Explosia Plant was begun in 1928, and the synthetic ammonia unit of the Synthesia Plant was completed during the following 2 years. The nitrogen products are utilized in peacetime as fertilizer and in the production of specialty chemicals as well as in the production of military and industrial explosives.

* Figures are on the basis of 100 percent nitric acid.
** This quantity of ammonium nitrate is apportioned among fertilizer and explosives production as required.

The capacity figures given for weak nitric acid and concentrated nitric acid are not final. They have not been confirmed, and there is no firm basis for a current capacity estimate for ammonium nitrate. Such capacity is relatively easy to add to, however, and in view of the general expansion activities recently taking place and the availability of raw materials, it is believed that the ammonium nitrate capacity is currently about 12,000 tons annually.

In 1948 there were plans to double the production facilities for ammonia and nitric acid. 37/ Such an increase in capacity is entirely possible, but at this time there is no positive intelligence available to indicate such expansion.

Production estimates for ammonium nitrate and weak nitric acid are based on the availability of nitrogen in the form of ammonia and are limited by plant capacity estimates. In this manner a consumption pattern for synthetic nitrogen typical of such plants is developed. Until 1951 the 2 products required 70 to 75 percent of the available nitrogen, the remaining 25 to 30 percent being used for the production of concentrated nitric acid and various other nitrogen compounds. This concentrated nitric acid is in great demand at nearby plants for special nitration processes in the explosives, pharmaceutical, and intermediate chemicals industries.

The Synthesia Plant does not produce enough weak nitric acid to cover its own requirements and those of the nearby explosives, pharmaceutical, and plastics plants. During 1949, about 10,000 tons of weak nitric acid were received from the Dusikarny Plant, and according to the source this rate was only slightly above the normal peacetime shipments.

3. Spolek Plant. 38/

   a. Full Name. Spolek pro Chemickou a Hutni Vyrobu (Association for Chemical and Metallurgical Production).

   b. Location. Usti nad Labem (German name -- Aussig).

   c. Coordinates. 50°42' N - 14°08' E.

d. Estimated Annual Capacity (Metric Tons).

Synthetic Ammonia		Weak Nitric Acid*	
1928	3,400	1928	1,500
		1951	2,200

e. Estimated Annual Production (Metric Tons).

Synthetic Ammonia		Weak Nitric Acid*	
1950	2,600 (2,200 to 2,700)	1950	1,400 (1,200 to 1,500)
1951	2,600 (2,200 to 2,700)	1951	1,600 (1,500 to 2,000)
1952	2,700 (2,300 to 2,800)	1952	1,800 (1,500 to 2,000)
1953	2,700 (2,300 to 2,800)	1953	2,000 (1,800 to 2,100)
1954	2,700 (2,300 to 2,800)	1954	2,000 (1,800 to 2,100)

f. Process.

The NEC (Nitrogen Engineering Corporation) process normally employs a promoted catalyst of iron oxide granules operating at 300 to 400 atmospheres pressure and about 475°C. Pure hydrogen is produced as a byproduct of the electrolysis of brine solutions, and nitrogen is provided by Linde-Frankl air machines.

g. Comments.

This plant is the smallest producer of synthetic ammonia in the country and as such consumes a relatively large percentage of its own ammonia and nitric acid in the production of specialty products. The plant was the original producer of dyes and fine chemicals in Czechoslovakia.

Although the reported production of synthetic ammonia has varied greatly, a sound technical check of production and capacity figures can be made by considering the amount of pure hydrogen available. Hydrogen is produced here at the same time as chlorine, sodium hydroxide, and potassium hydroxide by electrolyzing solutions of sodium and potassium chlorides.

* Figures are on the basis of 100 percent nitric acid.

On the basis of reliable information, which indicates a production capacity of 17,000 tons of sodium hydroxide and 5,000 tons of potassium hydroxide, 5.6 million cubic meters of pure hydrogen would be available for ammonia synthesis. 39/

Theoretically, about 2,000 cubic meters of pure hydrogen would be required per ton of ammonia produced. If allowance is made, however, for loss and inefficiency, about 2,200 cubic meters of hydrogen are actually required to produce 1 ton of ammonia.

If 5.6 million cubic meters of hydrogen are available, the maximum production of synthetic ammonia will be about 2,600 to 2,700 tons per year. Increasing electrolytic efficiency or capacity could make more hydrogen available for a slight increase in ammonia production. Since 1950 there has been no evidence of new construction in the electrolytic department.

The production of profitable dyes and specialty products has been based largely on the availability of nitric acid. Until 1950, nitric acid capacity was 1,500 tons per year (100 percent basis), including acid of 36 percent, 48 percent, and 80 percent strength. The equipment was in poor condition, and definite plans were made to install new plant facilities for the production of 3,600 tons of nitric acid. This would probably amount to about 2,200 tons on a 100 percent basis, and this is assumed to represent current capacity.

The Spolek Plant is not believed to possess capacity for any significant production of concentrated nitric acid. During World War II, Germany obtained about 6,000 tons of nitric acid (98 percent) per year from the Aussiger Verein at Prague, but this is believed to have been produced at Semtin.

4. Stalin Works. 40/

   a. Full Name. Stalinovy Zavody (Stalin Works).

   b. Location. Zaluzi (near Most).

   c. Coordinates. 50°34' N - 13°36' E.

d. Estimated Annual Capacity (Metric Tons).

Synthetic Ammonia

28,000 (15,000 to 35,000)

e. Estimated Annual Production (Metric Tons).

Synthetic Ammonia

1953 Negligible
1954 22,000 (12,000 to 28,000)

f. Process.

Specific process and operating conditions are not known. Hydrogen is available from Winkler generators, which also provide the hydrogen for synthetic fuel production. Nitrogen is available from Linde-Frankl air machines, which produce oxygen used in the production of synthetic fuel.

g. Comments.

The estimates listed above are based solely on actual plans made in 1948, as interpreted with the aid of sparse current intelligence. A hydrogenation plant of this type is an ideal location for the synthesis of ammonia. Raw materials, high-pressure equipment, and properly trained personnel are already available.

According to a reliable report, designs were prepared during 1947 for an ammonia unit with an annual capacity of 35,000 to 40,000 tons. Political influence subsequently caused plans to be made for the construction of a plant in the vicinity of Moravska Ostrava with an annual capacity of about 50,000 tons of ammonia. At that time (early 1948) it was decided to erect an ammonia synthesis unit at the Stalin Works to start producing during 1952 at the rate of 15,000 to 20,000 tons annually. This plant was well along in the design stage by mid-1948. 41/

No plans were made to utilize the ammonia at the plant. A pipeline to "Usti nad Labem or some undetermined place" was under consideration, which is significant when it is realized that Lovosice

is just south of Usti nad Labem and about 30 kilometers from Most. 42/ A 1952 report states that the new Nitrogen Products Plant at Lovosice is connected by underground pipeline with the Stalin Works. 43/ A later (1953) report indicating that the Nitrogen Products Plant at Lovosice is using the ammonia produced at the Stalin Works confirms the existence of this connecting pipeline. 44/

There have been reports of efforts by Czechoslovakia to obtain plant and equipment from outside the country. An ammonia synthesis plant was requested from the French firm, Air-Liquide, during 1950 or early 1951. 45/ In the spring of 1952 the East German Central Office for Research and Technology (ZAFT) received a request from Czechoslovakia for information concerning a cracking unit to produce a synthesis gas from cokery gas. The annual capacity of a plant based on such a cracking unit would be 24,000 to 28,000 tons of ammonia or 20,000 to 23,000 tons of nitrogen. 46/

The plant requested from France was not available, and there is no report of a definite order or of delivery of the cracking unit from East Germany. This equipment could be used at the Stalin Works or to provide additional capacity at the Dusikarny Plant at Marianske Hory.

It is not known when the plant will (or did) begin production, but no substantial production was expected during 1953. The Nitrogen Products Plant at Lovosice was not expected to be able to start producing fertilizers until late 1953.

5. Nitrogen Products Plant at Lovosice. 47/

a. Location. Lovosice.

b. Coordinates. 50°31' N - 14°04' E.

c. Estimated Annual Capacity. Not available.

d. Estimated Annual Production (Metric Tons).

Nitrogen Fertilizer (Nitrogen Content).

1953	Negligible
1954	18,000 (11,000 to 24,000)

e. Process.

The specific process and equipment to be used are not known. The various processes, however, differ only in details. Most of the fertilizer produced at present is probably ammonium sulfate, but some ammoniated superphosphates may be produced.

f. Comments.

This is the plant publicly identified as the proposed Martinov Plant at Hlucin. Construction was stopped at Hlucin in 1950, and the project was abandoned. The site at Lovosice is reported not suitable in all respects. 48/ The nitrogen fertilizer plant is one of a group of plants at Lovosice producing sulfuric acid, superphosphates, and rayon.

There are no facilities for the production of a synthesis gas, ammonia, or nitric acid. A logical development for the near future would be the installation of equipment for the production of nitric acid.

In 1948, plans were made for the production of synthetic ammonia at the Stalin Works and for the installation of an underground pipeline to transport the ammonia. 49/ A 1952 report confirms the existence of such a pipeline between the Nitrogen Products Plant at Lovosice and the Stalin Works, a distance of about 30 kilometers, 50/ and a 1953 report states that the Nitrogen Products Plant at Lovosice is using the ammonia produced at the Stalin Works. 51/

The estimated production of nitrogen fertilizers is based solely on the estimated availability of synthetic ammonia from the Stalin Works. There is no positive intelligence showing that the fertilizer plant is as large as that originally planned for the Martinov Plant.

APPENDIX B

BRIEF HISTORY AND TECHNOLOGY OF THE FIXED NITROGEN INDUSTRY

1. Introduction.

As an element in natural and synthesized chemical compounds, nitrogen is essential to both agrarian and industrial economies. In agriculture it is utilized primarily for fertilizer. In industry it is essential for the production of explosives, plastics, dyes, pharmaceuticals, and other industrial chemicals. This report considers only the major nitrogen compounds: synthetic ammonia, nitric acid, and nitrogen fertilizers.

Prior to 1900, chemical, or fixed, nitrogen (as distinct from nitrogen occurring naturally in vegetable and animal matter) was supplied by Chilean saltpeter (sodium nitrate), and ammonia was obtained as a byproduct from the coking of coal. By the turn of the century, increasing nitrogen requirements caused scientists to consider the atmosphere, with its 75 percent nitrogen by weight, as a raw material. Today, elemental nitrogen may be obtained by the fractional distillation of liquid air.

The calcium cyanamide process was the first commercial process to utilize nitrogen from the air. This process, developed in Germany about 1900, was based on the principle that metallic carbides will readily absorb nitrogen gas and form solid cyanamides. Calcium cyanamide so formed can be used as fertilizer. Further treatment of this compound will result in the formation of other nitrogen-bearing compounds.

With the advent of low-cost hydroelectric power, interest in an electric arc process was revived, and in 1904 a successful operation was begun in Norway. In this process, air is passed through an electric arc which burns a small fraction of the nitrogen to nitric oxide. The electric arc process and the cyanamide process both require considerable electric energy, as calcium carbide, used in the cyanamide process, is produced in an electric furnace.

The direct synthetic ammonia (Haber-Bosch) process, developed in Germany in 1910, provides the most economical method of nitrogen

fixation by the combination of atmospheric nitrogen with hydrogen to form synthetic gaseous ammonia. This process has now almost entirely replaced the two earlier processes. The cyanamide process is still used as a means of fixing atmospheric nitrogen for fertilizer but not as a producer of ammonia and ammonia salts.

The hydrogen required for the Haber-Bosch process may be obtained from any of several sources: (a) electrolytic chlorine cells, (b) electrolytic decomposition of water, (c) semi-water gas from coke, (d) coke-oven gas, (e) natural gas, (f) gas from lignite, or (g) petroleum refinery gas. The source utilized by any particular plant will depend on the installation and on availability of raw material.

Today, synthetic ammonia produced by the Haber-Bosch process, or one of its several modifications, provides approximately 80 percent of the world's production of chemical nitrogen for industrial and agricultural use. 52/

Nitrogen is made available for commercial use in the following forms: (a) aqua ammonia, ammonia in a water solution, for use as liquid fertilizer or as an inexpensive base in a multitude of industrial reactions; (b) liquid anhydrous ammonia (under pressure) for use as a refrigerant; and (c) gaseous or liquid ammonia for use in the production of industrial organic chemicals and explosives.

In peacetime the major requirements of synthetic ammonia are for the production of nitric acid, nitrogen fertilizers, and commercial explosives. In wartime, nitrogen compounds synthesized from ammonia are indispensable, and the ammonium nitrate used as fertilizer in peacetime becomes a major component of explosives. In addition, ammonia and concentrated nitric acid are required in the manufacture of all conventional (nonatomic) military explosives. Concentrated nitric acid is used as an oxidizer for rocket and guided missile petroleum-base fuels. Hydrazine, N_2H_4, is used as a fuel or fuel igniter in rockets and in the Walther torpedo.

2. Technology.*

a. Synthetic Ammonia.

Synthetic ammonia, NH_3, is produced by combining atmospheric nitrogen with hydrogen.

* A chart illustrating the technology of the fixed nitrogen industry follows p. 46.

The processes used throughout the world are based almost exclusively on the original Haber-Bosch method of bringing pure hydrogen and nitrogen together under suitable conditions of pressure and temperature in the presence of a positive catalyst and the subsequent recovery of the ammonia produced. The production of synthetic ammonia consists basically of four well-defined steps: (1) production of the hydrogen-nitrogen gas mixture, (2) purification of the gas mixture, (3) compression of the hydrogen-nitrogen mixture and the synthesis of ammonia, and (4) recovery of pure ammonia from the unreacted gases. The production and purification of the synthesis gas (3 parts hydrogen and 1 part nitrogen) account for approximately 75 percent of the manufacturing cost of synthetic ammonia. Nitrogen from the atmosphere is supplied by 1 of 3 methods: (1) air can be liquefied under pressure, and the pure nitrogen recovered by distillation; (2) air can be introduced into the gas generator and burned to remove the oxygen; or (3) steam and air can be blown continuously through an incandescent bed, resulting in the formation of a gas containing nitrogen, hydrogen, and carbon monoxide.

There are many technical differences among the dozen or so commercial processes in use throughout the world, but the major difference, one which can be used to identify a particular process, lies in the operating pressure used in the synthesis. Typical pressures range from slightly below 100 atmospheres in the Mont Cenis process to slightly over 1,000 atmospheres in the Claude process. The operating temperatures range from 400°C to 650°C. Regardless of the specific source of nitrogen and hydrogen utilized, the equipment must be of sufficiently rugged construction to withstand the high pressures and temperatures required and must be lined with special corrosion-resistant alloys.

The conversion of the gas mixture to ammonia is realized in useful percentages only in the presence of a catalyst (material which promotes a desired chemical reaction without itself becoming part of the final product). Any one of several catalysts may be employed, depending upon the particular operating temperature and pressure. Maintenance of the catalyst constitutes a technical problem of some magnitude, for it may be easily "poisoned" (activity reduced) by the presence of foreign material (especially sulfur) in the reactive gas mixture. The variables of temperature, pressure, and catalyst combine to determine the single-pass degree of conversion of the gas mixture into synthetic ammonia.

b. Nitric Acid.

Nitric acid, HNO_3, is normally produced in two grades, weak and concentrated. The weak nitric acid is a water solution with an acid content of 40 to 65 percent. Concentrated nitric acid is acid which is 96 to 99 percent pure.

The earliest method used commercially to produce nitric acid involved the treatment of sodium nitrate with sulfuric acid in cast iron retorts. The residue in the retort after the distillation period contains sodium bisulfate and excess sulfuric acid. This residue, called niter cake, is a raw material in the manufacture of hydrochloric acid.

Another method of producing nitric oxide and, in turn, nitric acid is the electric arc process, one which is not currently in general use.

Most nitric acid is made by the oxidation of ammonia. Although different installations may vary somewhat in equipment design and operating conditions, the basic process involves the following steps: (1) ammonia is oxidized to nitric oxide by passing a mixture of ammonia gas and air, or air enriched with oxygen, through a converter, usually employing a platinum-rhodium gauze catalyst, at about 750°C; and (2) the resulting nitric oxide is cooled and further oxidized to nitrogen dioxide, which is absorbed in water to form a weak nitric acid solution.

If ammonia oxidation is carried out at atmospheric pressure, a nitric acid of about 40 to 55 percent strength is obtained. If it is carried out at pressures up to 100 pounds per square inch, the product contains from 60 to 65 percent nitric acid.

Concentrated nitric acid can then be produced in two ways: (1) the weak nitric acid is mixed with sulfuric acid in a retort and distilled to produce a concentrated nitric acid of 99 percent strength; or (2) the ammonia oxidation process, as used to produce weak nitric acid from nitrogen dioxide, is further employed to polymerize the nitrogen dioxide to nitrogen tetraoxide. This liquid nitrogen tetraoxide is then heated under high pressure (autoclaving) with weak nitric acid and gaseous oxygen to produce concentrated nitric acid up to 99-percent strength. This process is known as the Fauser process.

c. Nitrogen Fertilizers.

Principal fertilizer constituents containing nitrogen are as follows: nitrates of ammonium, sodium, calcium, and potassium; ammonium salts such as sulfate, phosphate, chloride, and nitrate; ammonia for ammoniating superphosphates; calcium cyanamide; and synthetic urea. Each compound can be used separately or as a component of a mixed fertilizer. The production processes for several of the major tonnage items will be discussed here. Small quantities of certain of these products are recovered as byproducts of other manufacturing processes. Most of such production, however, is provided by the chemical reactions of ammonia or nitric acid with various inorganic compounds. This type of production must be carried out in heavy, but comparatively simple, equipment.

Ammonium nitrate solution is produced by reacting ammonia with dilute nitric acid (about 40 percent pure). The water is evaporated, leaving the commercial product in crystalline form. Ammonium nitrate tends to absorb moisture from the atmosphere, and it has been necessary to devise methods for granulating and coating the salt to keep it dry and free flowing. Pelleting, by liquefying and spraying into a cooling chamber to make small, solid balls with a hard outer surface, is one method of obtaining the desired properties.

Large tonnages of sodium nitrate are made by reacting soda ash from the ammonia-soda, or Solvay, process with nitric acid from ammonia oxidation. End use as a fertilizer or as an explosive component is determined by grain size and purity of the product. The smaller grain sizes are used for gunpower manufacture.

Ammonium sulfate may be produced by three commercial methods: (1) ammonia solution recovered from coke oven byproducts is reacted with sulfuric acid; (2) synthetic ammonia is reacted with sulfuric acid, yielding a very pure product when recovered by crystallizing and centrifuging; and (3) ammonium carbonate is reacted with finely ground gypsum (hydrated calcium sulfate) forming insoluble calcium carbonate and dissolved ammonium sulfate, the two salts are separated by filtration, the ammonium sulfate is crystallized upon evaporation, and the crystals are then centrifuged and further dried in a rotary dryer.

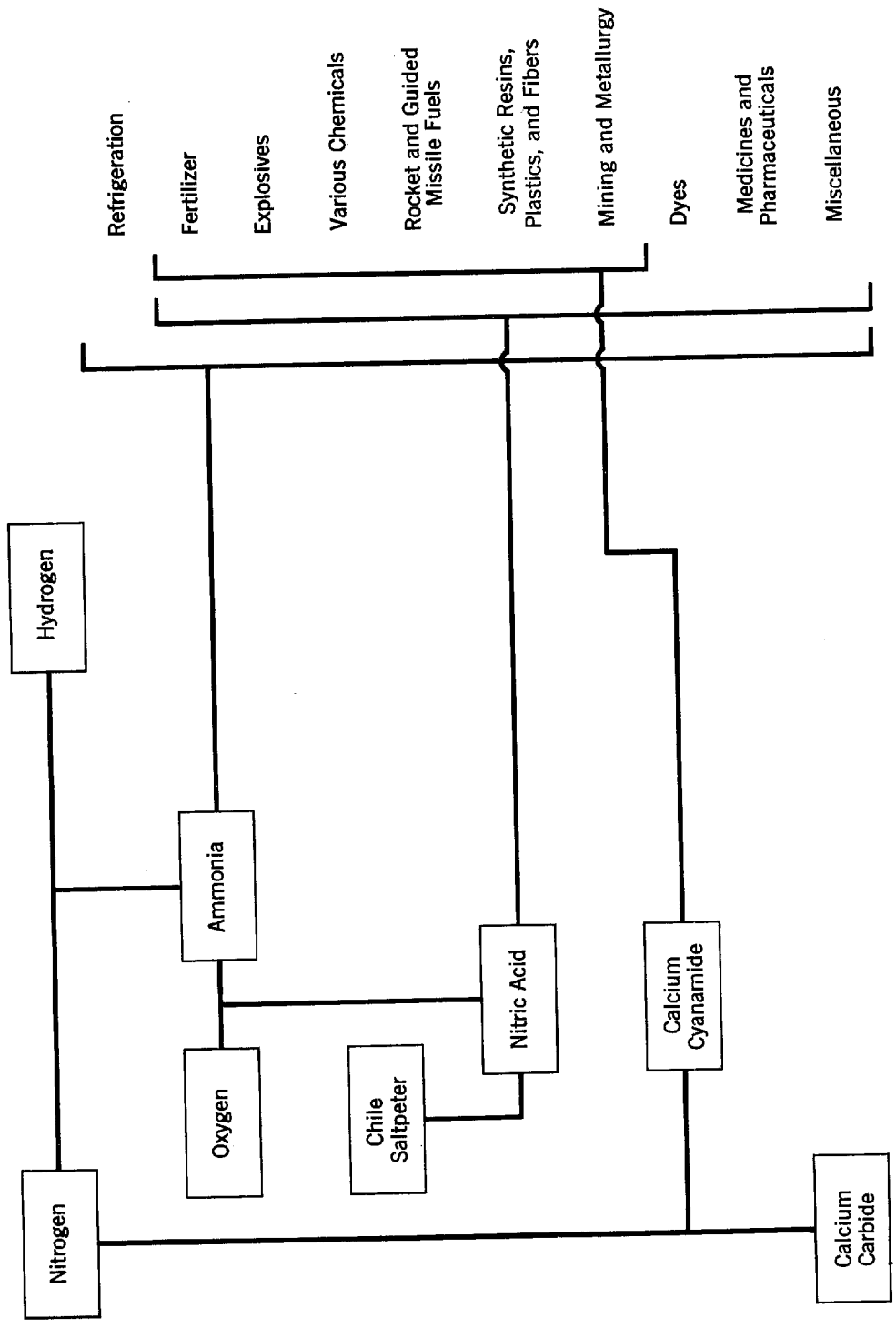
The economical production of ammonia by the Haber-Bosch process has made practical use of ammoniated superphosphates as fertilizers. A strong ammonia solution (40 to 80 percent ammonia) is sprayed onto a charge of superphosphates in a rotating mixer. The action of the mixer constantly exposes new surfaces to the ammonia. In this process any residual sulfuric acid in the superphosphate which would cause rotting of the shipping bags is neutralized.

Calcium cyanamide, $CaCN_2$, formerly the intermediate in the production of ammonia, is widely used as a fertilizer or as an ingredient in mixed fertilizers. Calcium cyanamide is formed when nitrogen gas is brought into contact with finely ground calcium carbide in a cylindrical oven at a temperature up to about 1,000°C. When the reaction is completed, after 40 to 60 hours, the mass is cooled and pulverized. Water is added to decompose any free calcium carbide and to hydrate the lime. The addition of oil diminishes dustiness. The black powder remaining contains about 60 percent calcium cyanamide and about 22 percent fixed nitrogen. It is used as an ingredient in mixed fertilizer.

Synthetic urea, NH_2CONH_2, can be produced commercially by reacting carbon dioxide with calcium cyanamide in water and then hydrolyzing the free cyanamide so formed with acid. It may also be produced by the indirect dehydration of the intermediate, ammonia carbamate, formed by the reaction of excess ammonia and carbon dioxide under high pressure. Urea fertilizers contain more fixed nitrogen (in excess of 40 percent) than any other fertilizer. In addition, urea has an important application in the manufacture of plastics and resins (urea-formaldehyde type).

FIXED NITROGEN INDUSTRY

General Process and Use Relationship



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APPENDIX C

METHODOLOGY

1. Production.

a. Synthetic Ammonia, Table 2.

There are available reliable statistics on individual plant and national production of synthetic ammonia in Czechoslovakia prior to World War II. National production of synthetic ammonia in 1947 and 1948 was reported by Czechoslovakia, and some logical estimates for 1949 and 1950 have been made. These estimates are based largely on the requirements for the production of nitrogen fertilizer in Czechoslovakia as that production has been reported.

In this report, national estimates from 1949 to 1954 have been developed from individual plant estimates. The plant estimates for the period before World War II and for 1946 through 1949 are considered firm, for they have been substantiated by reported and planned national production. Production since 1949 has been estimated for each plant on the basis of plant intelligence showing increased activity, expansion, and rebuilding. The unusually broad range given for 1954 production is dictated by the uncertainty surrounding the installation of major new facilities. For specific plant information, see Appendix A.

b. Nitric Acid, Table 4.

All national production estimates have been derived from individual plant estimates. Plant estimates, in turn, are based on the comparatively well-known availability of synthetic ammonia, specific plant information concerning equipment and production of nitric acid, and the requirements for nitric acid. A large probable range of production is given because the estimates were indirectly derived. For specific plant information, see Appendix A.

c. Fertilizer Nitrogen, Table 7.

Estimates of production prior to World War II are taken from reliable comprehensive statistics. National production of nitrogen

fertilizers was reported for 1946 through 1948, and logical estimates for later years have been published. The Five Year Plan was also considered in making later estimates.

Firm national production estimates were used to check individual plant estimates through 1948. Since that time individual plant estimates have been made on the basis of additional plant information indicating expansion, rebuilding, and production. Individual plant estimates now provide the basis for national production estimates. For specific plant information, see Appendix A.

d. Ammonium Nitrate and Ammonium Sulfate Fertilizers from Synthetic Ammonia, Table 8.

Again, reliable pre-World War II information helped by providing a guide for this type of breakdown in production estimates. Up to 1939 the highest annual production of ammonium sulfate from synthetic ammonia amounted to the equivalent of 5,500 tons of nitrogen. One plant is currently the only source of this particular fertilizer, and estimated production is believed to be between 4,000 and 7,000 tons of nitrogen.

Comparatively firm production estimates for ammonium sulfate and calcium cyanamide account for a certain percentage of the total available fertilizer nitrogen. The remaining available nitrogen has been divided between the major nitrate fertilizer, ammonium nitrate, and one category of "other nitrates." In all cases, these estimates were checked against available plant information.

2. Consumption Requirements.

a. Synthetic Ammonia, Table 16.

The estimate of the requirement for the production of nitrogen fertilizers is comparatively firm. According to Table 7, 19,000 tons of the fertilizer nitrogen produced during 1953 in Czechoslovakia will come from synthetic ammonia. This is equivalent to about 23,100 tons of ammonia, or 59 percent of the available supply.

This figure includes that ammonia converted to nitric acid which, in turn, is converted to fertilizer. In this manner the nitrogen contributed to fertilizer production by nitric acid (Table 17) is included in this estimate of 23,100 tons of synthetic ammonia.

The remaining 41 percent of the available synthetic ammonia is then divided between explosives and miscellaneous industrial uses. This distribution estimate is considered logical but not firm. The allocation for explosives will cover the production of the required nitric acid (Table 17) plus the ammonia required for the production of perhaps 5,000 tons of ammonium nitrate at the Synthesia Plant. This much ammonium nitrate, in addition to the requirements for fertilizer, is probably available there.

b. Nitric Acid, Table 17.

See the methodology used in the preparation of Table 16.

Nitric acid provides the nitrate form of nitrogen for nitrogen fertilizers. According to Table 8, production of ammonium nitrate fertilizer will require 11,000 tons of nitrogen during 1953. As 50 percent of this nitrogen is nitrate nitrogen, about 5,500 tons of nitrogen will be required from nitric acid. About 2,500 tons of nitrate nitrogen will also be required for the production of the "other nitrates." The total amount of 8,000 tons of nitrate nitrogen will be supplied by about 32,000 tons of nitric acid (100 percent basis). Depending on the efficiency of the various processes involved, the probable range of this requirement for nitric acid is 31,000 to 34,000 tons.

The remaining 16,500 tons of the available nitric acid will provide the well-developed explosives industry with about 11,000 tons, and 5,500 tons will be available for miscellaneous uses. These last two estimates of requirements are considered logical in view of the sizes of the consuming industries, but they are not firm.

APPENDIX D

GAPS IN INTELLIGENCE

The productive capacity for fixed nitrogen at the older plants in Czechoslovakia is relatively well known. It would be of great value, however, to know the current rate of production of both synthetic ammonia and nitric acid. For this purpose, information concerning actual production at the individual plants will be most helpful.

The most glaring gap in intelligence on these strategic commodities is the status of new plants. Confirmation of the relationship between the Stalin Works and the Nitrogen Products Plant at Lovosice is needed. If original plans are being followed, the new synthetic ammonia plant at the Stalin Works will eventually double the previous national production of synthetic ammonia. Thus it is essential that information concerning the capacity and production of this plant be obtained. It will also be important to obtain more information concerning production at the Nitrogen Products Plant at Lovosice. What specific nitrogen fertilizers are produced? How much? It can be assumed that within a very few years a new installation for the production of nitric acid will be erected, probably at Lovosice. It will be extremely important to know the capacity of such a plant, particularly for the possible production of concentrated nitric acid, and to know the date the plant begins operation.

APPENDIX E

SOURCES AND EVALUATION OF SOURCES

1. Evaluation of Sources.

The United Nations Relief and Rehabilitation Administration report, Estimated Post-War Import Requirements of Czechoslovakia for Chemicals and Allied Products, provided valuable, reliable, and comparatively detailed information concerning the fixed nitrogen industry of Czechoslovakia prior to World War II. Many of the statistics contained in this report were originally published as official Czechoslovak statistics.

Of the postwar intelligence reports, the most complete and reliable is a CIA SO document which has been translated by FDD. This CIA SO document contains miscellaneous official documents related to current and planned activities of the chemical industry in Czechoslovakia as of 1948. They were drawn up by a technical commission and are considered reliable except that many of the plans have been altered or have not been achieved on schedule. 25X1X7

Since 1949, information concerning this industry has been available largely as reports of activities at individual plants. The various 25X1X7 abstract services, including [redacted] have provided the most regular information of this type. Since 1951, defector interrogations have provided an increasing number of valuable reports concerning individual plants. FOIAb3

2. Sources.

Evaluations, following the classification entry and designated "Eval.," have the following significance:

Source of Information	Information
A - Completely reliable	Doc. - Documentary
B - Usually reliable	1 - Confirmed by other sources
C - Fairly reliable	2 - Probably true
D - Not usually reliable	3 - Possibly true
E - Not reliable	4 - Doubtful
F - Cannot be judged	5 - Probably false
	6 - Cannot be judged

"Documentary" refers to original documents of foreign governments and organizations; copies or translations of such documents by a staff officer; or information extracted from such documents by a staff officer, all of which will carry the field evaluation "Documentary" instead of a numerical grade.

Evaluations not otherwise designated are those appearing on the cited document; those designated "RR" are by the author of this report. No "RR" evaluation is given when the author agrees with the evaluation on the cited document.

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1. [redacted] 25X1A2g
2. [redacted]
3. [redacted]
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