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INTELLIGENCE MEMORANDUM

SURVEY OF ACTIVITIES IN EAST GERMANY RELATING TO CHEMICAL ROCKET PROPELLANTS

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~~WARNING~~

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CENTRAL INTELLIGENCE AGENCY

Office of Research and Reports

FOREWORD

Since World War II, East Germany has been the most important foreign supplier of chemicals to the USSR. Consequently, East Germany has long been regarded by this Office as a potential supplier of propellants and related chemicals for the Soviet programs for guided missiles and space exploration. The purpose of this memorandum is to examine the information available on East German activities relating to chemical rocket propellants in order to determine the nature and extent of the support, if any, which is being provided to the USSR.

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SURVEY OF ACTIVITIES IN EAST GERMANY RELATING TO CHEMICAL ROCKET PROPELLANTS*

Summary and Conclusions

East Germany apparently has not contributed substantially to the development or production of chemical propellants for the Soviet programs for guided missiles and space exploration.** East Germany appears to have provided some support to the USSR, however, by exporting certain intermediate chemicals for possible use in research or in production of propellants, by exporting plants for the production of LOX (liquid oxygen), and by providing facilities and the necessary manpower for experimental production and testing of propellants. These contributions, although seemingly unimportant in relation to the over-all Soviet program for propellants, probably have been useful to the USSR in supplementing supplies of some scarce materials and in relieving Soviet research and testing facilities of minor assignments in developing propellants for missiles.

An indication that the USSR may be using an amine fuel such as UDMH (unsymmetrical dimethylhydrazine) as the fuel for launching earth satellites, and perhaps long-range missiles as well, was provided by a report from East Germany which stated that dimethylamine, an intermediate for the manufacture of such fuels, was shipped to the USSR in 1957 for use in connection with the launching of the first sputnik.

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* The estimates and conclusions in this memorandum represent the best judgment of this Office as of 1 July 1959.

** This memorandum excludes products of the East German petroleum industry, such as kerosine or heavy naphtha fractions, which are suitable for use as rocket fuels.

I. Production and Exportation of Propellants and Related Chemicals

A. Liquid Propellants

1. Fuels

a. Hydrazine and Related Compounds

Hydrazine and related compounds have been considered promising rocket fuels since World War II, when the Germans used hydrazine hydrate as a major component of the fuel for their rocket-powered interceptor plane, the ME-163. After the war, East Germany shipped hydrazine hydrate to the USSR, apparently for research in developing missiles. These shipments probably were made principally from German wartime stocks because there is no reliable evidence that East Germany has ever produced significant amounts of this chemical, in spite of the reported intent to initiate large-scale production early in the Korean War at the chemical combine in Bitterfeld, which was then owned by the USSR.

Current production of hydrazine and its compounds** in East Germany is limited to small amounts produced at three or four plants. Reports indicate that expansion of capacity for production of these chemicals is planned, but the extent of the expansion and the scheduled completion dates are uncertain.***

Since the Korean War, there has been no definite evidence of Soviet interest in East Germany as a source of hydrazine and related compounds, although one source reported in 1958 that plans for the hydrazine plant**** at Leuna had to have Soviet approval. On the other hand, information from East Germany has indicated that the USSR may be using a hydrazine compound as fuel for launching earth satellites and perhaps long-range missiles also.

, reportedly stated that dimethylamine was shipped to the USSR in 1957 "for use in connection with the launching of the first sputnik." Dimethylamine is an intermediate chemical used in the manufacture of amine compounds

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** The only hydrazine compounds currently produced in East Germany are hydrazine hydrate and hydrazine sulfate.

*** For a summary of information concerning the production of hydrazine and its compounds, see Appendix A.

**** Probably a hydrazine hydrate plant.

such as UDMH,* which has been used by the US as fuel for launching its Explorer satellites.

Planned exports of dimethylamine from East Germany have risen considerably since 1955. From 1958 to 1959 these exports more than tripled, from 460 metric tons** to 1,400 tons.*** Although this pattern of export would be consistent with the increased demands of the Soviet program for rocket propellants, evidence linking these exports to the Soviet program is limited to the one statement

The amount actually exported to the USSR is not known and, furthermore, since dimethylamine has numerous other uses in modern chemistry, it could have been consumed for normal industrial purposes.****

b. Others

East Germany produces, in relatively large volume, several other chemicals which can be used as rocket fuels but which also have so many other uses that it is impossible to establish definitive patterns of consumption.† This group of chemicals includes ammonia, methanol, and ethanol. Because both methanol and ethanol are exported, the possibility cannot be ruled out that some of the exports may have been used to support the Soviet programs for guided missiles and space exploration, at least for testing purposes, or to replace Soviet supplies which may have been diverted to these programs.

2. Oxidizers

East Germany produces certain chemicals which are suitable for use as oxidizers with liquid rocket fuels, but there is no evidence

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* Dimethylamine itself also can be used as a rocket fuel, but in relation to UDMH it has low density-impulse values. Although the energy or impulse index of UDMH is not quite so high as that of hydrazine, UDMH can be produced more cheaply than hydrazine and holds greater promise as a storable rocket fuel. It also appears to mix better with some other inexpensive fuels, such as kerosine.

** Tonnages are given in metric tons throughout this memorandum.

*** For data on production and exports of dimethylamine, see Appendix C.

**** Dimethylamine is used in the production of detergents, pharmaceuticals (including antimalarials and antihistamines), dyestuffs, herbicides of the 2,4-D type, fungicides, insecticides, polyacrylonitrile (orlon-type) fibers, and accelerators for vulcanizing rubber.

† For a list of principal East German producers of chemicals which have potential uses as rocket propellants, see Appendix B.

that these chemicals are used for this purpose. Although nitric acid is produced on a large scale, there is no indication of its use, or of the use of any of the oxides of nitrogen, as oxidizers for rocket fuels. Hydrogen peroxide is made at one plant, but the process employed does not yield a product of sufficient concentration for use as an oxidizer in rocket propellants. Two plants produce fluorine compounds, but there is no indication that either plant has made or intends to make elemental fluorine, which can be used as an oxidizer with certain liquid rocket fuels.

Nevertheless, East Germany may be making a definite contribution in the production and handling of oxidizers by providing equipment to produce and transport LOX (liquid oxygen). The VEB (Volkseigener Betrieb -- People-Owned Enterprise) Chemische Maschinenbauwerke Rudisleben (VEB Chema) has produced insulated tanks for transporting LOX and also produces both mobile and stationary LOX plants, some of which have been exported to the USSR. Other LOX units reportedly have been installed in East Germany at locations referred to as Soviet or East German "missile bases." Sites mentioned include Strausberg, to the east of Berlin, the Ohrdruf-Arnstadt area near Erfurt, and Cottbus.

B. Solid Propellants

Some reports have indicated that late in 1957 or thereafter East Germany may have initiated production of unspecified types, or components, of solid propellants, probably for use in short-range rockets, in which East Germany is known to have some research interest. No evidence indicates that such production was actually begun. East Germany reportedly had a special agreement with the USSR in 1957 for the delivery of 700 tons of potassium permanganate per year. Although potassium permanganate has a number of industrial uses, it is known to have possibilities as an oxidizer in composite solid propellants.

II. Experimental Production and Testing

Numerous reports concerning testing or experimental production of rocket fuels in East Germany have been received, but only a few of the reports appear to be reliable. The apparently reliable reports refer to projects for developing short-range rockets rather than long-range missiles or space vehicles. Work is reported to be progressing on various aspects of rocket propulsion at VEB Chemie Kapen, near Dessau, with emphasis on "armor-piercing weapons " "very small rockets," and a "medium-range (20-kilometer) rocket." In 1957, research was conducted on "very small" rockets at VEB Chemisch-Technisches Labor (Chemical-Technical Laboratory) in Finowfurt. This laboratory reportedly expected to begin work on "remote-controlled rockets" with a

20-kilometer range, and "it was thought that work would be done later on intercontinental ballistic missiles." In 1957, this installation reportedly was working only with documents because it did not yet have equipment for practical experiments. In addition to the installations at Kapen and Finowfurt, an institute connected with the Dresden Technical Institute (Technische Hochschule) was reported to be working on the 20-kilometer rocket.

A number of sources have mentioned the establishment of a "plant" for experimental production of solid fuels at Gumnitz near Eggesin, in Bezirk Neubrandenburg. The reports from these sources are mutually corroborative and appear plausible. Nevertheless, it seems hardly credible that this "plant," which is a prison camp "staffed" by political prisoners reportedly serving only moderate terms of imprisonment, would be working on projects of strategic importance. Consequently, it appears unlikely that the fuel mentioned (described as a very finely powdered coal or carbon dust) can be intended for use in rockets of large size. One source has stated that the experimental work is on "fuel for jet engines and for medium types of rockets, designated type 'C'."

In addition to the reports of experimental work involving short-range rockets, several unconfirmed reports indicate East German experimentation with propellants for longer range rockets. The following are examples of these unconfirmed reports:

(1) Tests were conducted at VEB Leuna-Werke early in 1957 using various combinations of fuels and oxidizers, such as ethanol with liquid oxygen, benzene with liquid oxygen and ozone, hydrazine with liquid oxygen, isopentane with aluminum oxide and liquid oxygen, and alcohol (unspecified) with aluminum oxide and nitric acid.

(2) Tests were scheduled for October 1957, at the Wissenschaftliches-Technisches Buero 4 (Scientific-Technical Bureau 4) at Berlin-Adlershof, of a "hydrazine-fluorine bipropellant containing metallic beryllium."

(3) the Technical Institute for Chemistry (Technische Hochschule fuer Chemie) in Merseburg conducted experiments at the institute in November 1958 on the production of tetranitromethane overheard a remark indicating that they might be connected with research work on rocket fuels, possibly on behalf of the nearby VEB Leuna-Werke.

Results of research on rockets or propellants undertaken in East Germany certainly will be made available to the USSR. Thus East German efforts, however limited in scope, supplement the work done in the USSR and relieve Soviet research facilities of some of their minor research tasks. If the unconfirmed reports referred to above are true, the contribution of East Germany may be of some significance to the Soviet program.

APPENDIX A

PRODUCTION OF HYDRAZINE AND HYDRAZINE COMPOUNDS IN EAST GERMANY

Hydrazine (N_2H_4) is a colorless, fuming, highly reactive liquid, soluble in water. In water solution it forms hydrazine hydrate, containing 36 percent water. The hydrate is miscible in all proportions with water and with methanol. With sulfuric acid, hydrazine forms a salt, hydrazine sulfate. Conversely, hydrazine can be made from the sulfate under appropriate conditions. The sulfate can be handled and shipped easily, whereas special precautions are required with hydrazine and with the hydrate because of their explosive and corrosive qualities.

During World War II, Germany was experimenting with fuels containing hydrazine hydrate, but so far as is known the hydrazine hydrate was not produced in the area now comprising East Germany. It appears that plans were made for SAG (Sowjetische Aktien-Gesellschaft -- Soviet Joint-Stock Company -- now VEB) Elektrochemisches Kombinat Bitterfeld to start producing hydrazine hydrate in 1951, as a list of "new products" planned for 1951 includes 1,250 tons* of this product. Several subsequent reports cite large production figures for Bitterfeld for 1951 and 1952, but the source of these reports is apparently of dubious reliability. It is doubtful that much, if any, hydrazine hydrate was produced at this plant.

Nevertheless, not only hydrazine hydrate but also hydrazine and hydrazine sulfate are currently produced in East Germany, although on a limited scale commensurate with probable requirements for production of pharmaceuticals and for industrial uses.** Three plants are known producers, and a fourth possibly may produce small amounts.

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* Concentration was not indicated. On the basis of price data cited, it seems clear that the figure does not refer to 100 percent hydrazine equivalent.

** Principal pharmaceutical use is in the preparation of isonicotinic acid hydrazide, used against tuberculosis. Other applications may include use as a corrosion inhibitor in boiler feed water and as a blowing agent for rubber; also, in the preparation of aminoguanidine (used for dyes and explosives, including lead tetrazide), photographic developers, and agricultural chemicals, including insecticides.

The VEB Leuna-Werke "Walter Ulbricht" was scheduled to produce 1.6 tons of "hydrazine in solution" and 6 tons of hydrazine sulfate in 1956 (amounts expressed in terms of 100 percent hydrazine equivalent). A report dated June 1958 mentions an output of "a few hundred kilograms per month" of "hydrazine" at this plant, indicating that output probably had increased little if any since 1956.

The VEB Berlin-Chemie produces hydrazine sulfate. One report estimates production at this plant at 250 kilograms per day in 1957, which, in terms of 100 percent hydrazine equivalent, amounts to roughly 60 kilograms per day, or 18 to 20 tons per year. The report indicates that the hydrazine sulfate is shipped to pharmaceutical plants.

The VEB Farbenfabrik Wolfen makes hydrazine for use in photographic developers. Production of 4.6 tons was planned for 1956.

The VEB Stickstoffwerk Piesteritz produced hydrazine sulfate during World War II and reportedly, on Soviet orders, undertook production on a laboratory scale in 1950. This plant is not known to be producing any hydrazine compounds at present.

An increase in capacity is planned at the Leuna installation, but the extent of the increase is not known. The earliest reports of the expansion, dated 1955 and 1956, imply that only a very small-scale project was anticipated. Two reports received in 1958 indicate a much larger installation but cite no figures for capacity. One report mentions 4.3 million DME (Deutsche Mark East)* worth of equipment for a "hydrazine" plant to be completed by spring 1959, and the other report states that work on the plant began in 1958 and that first production is scheduled for 1962, with final completion of the installation in 1965. On the other hand, a third report in 1958 states that the Leuna research program for 1958 includes a "hydrazine pilot plant," for which only 2,000 DME** have been allotted.

* Approximately US $1.1 million.

** Approximately US $500.

APPENDIX B

PRINCIPAL EAST GERMAN PRODUCERS OF CHEMICALS
POTENTIALLY USEFUL AS ROCKET PROPELLANT COMPOUNDS

Product	Principal Producers	Remarks
Hydrazine compounds	VEB Leuna-Werke "Walter Ulbricht," Merseburg	Produces hydrazine hydrate and hydrazine sulfate
	VEB Berlin-Chemie, Berlin-Adlershof (formerly VEB Schering Adlershof)	Produces hydrazine sulfate
	VEB Farbenfabrik Wolfen, Wolfen	Produces hydrazine for use in photographic developers
Dimethylamine	VEB Leuna-Werke "Walter Ulbricht," Merseburg	Also produces other amines including monomethylamine and diethylamine
Ammonia	VEB Leuna-Werke "Walter Ulbricht," Merseburg	
Ethanol	VEB Chemische Werke Buna, Schkopau	
	VEB Gaerungschemie Dessau, Dessau	
Methanol	VEB Leuna-Werke "Walter Ulbricht," Merseburg	VEB Gaerungschemie Dessau formerly produced methanol but is believed to have ceased production.
Hydrogen peroxide	VEB Eilenburger Celluloid-Werke, Eilenburg	

Product	Principal Producers	Remarks
Fluorine compounds	VEB Fluorwerke Dohna, Dohna	
	VEB Schwefelsaeure- und Superphosphat- werk Coswig, Coswig	
Nitric acid	VEB Elektro- chemisches Kombinat Bitterfeld, Bitter- feld	
	VEB Farbenfabrik Wolfen, Wolfen	
Potassium permanganate	VEB Elektro- chemisches Kombinat Bitterfeld, Bitter- feld	

APPENDIX C

PRODUCTION AND EXPORTATION OF DIMETHYLAMINE BY EAST GERMANY
1953 and 1955-59

Metric Tons

Year	Planned Production		Planned Exportation
	Gross	Net [a]	
1953	371 [b]	N.A.	65 [c]
1955 [d]	360	150	120
1956	1,440 [e]	689 [f]	250 [g]
1957	N.A.	N.A.	460 [h]
1958	1,400 [i] [j]	930 [j] [k]	460 [l]
1959	1,800 [m]	N.A.	1,400 [n]

a. Sales.
b. Reported as "production capability."
c. Quantity for which export contracts reportedly had been negotiated.
d.
e.
f.
g. Actual exports amounted to 470 tons.
h.
i.
j. Expected actual production, estimated in July 1958.
k.
l.
m. Reported as "production capability".
n.

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APPENDIX D

SOURCE REFERENCES

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

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

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

Except for finished CIA intelligence, all sources used in this memorandum are evaluated RR 2 unless otherwise indicated.
