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DEFENSE INTELLIGENCE AGENCY

SCUD B STUDY (U)

AUGUST 1974

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MISSILE INTELLIGENCE AGENCY
U.S. ARMY MISSILE COMMAND
REDSTONE ARSENAL, ALABAMA

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SCUD B STUDY (U)

ST-CS-10-399-75

DIA TASK NO. T74-10-04

AUGUST 1974

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PREFACE (U)

(S) This study presents an assessment of the Soviet SCUD B short range ballistic missile (SRBM) system. The scope of this study is intended to fulfill the requirements of all consumers for scientific and technical intelligence on the Soviet SRBM systems within the limits of the available information. Comments related to increasing the usefulness of the study are encouraged and should be forwarded to DIA (ATTN: DT), Washington, D.C. 20301.

(S) This study was prepared by the Missile Intelligence Agency of the U.S. Army Missile Command, Redstone Arsenal, Alabama.

TABLE OF CONTENTS (U)

SUMMARY (U)

Background (U)

~~(S-NFD)~~ [redacted] Among the weapons used for the first time was a Soviet short range ballistic missile (SRBM). This firing was the first combat use of a guided ballistic missile system since World War II.

~~(S-NFD)~~ [redacted] an SRBM was fired [redacted] The results of the exploitation and its significance are discussed in this study.

Data Sources (U)

~~(S-NFD)~~ The missile [redacted] exploited [redacted] consisted of tank skin and propulsion equipment from the aft portion of the missile. [redacted]

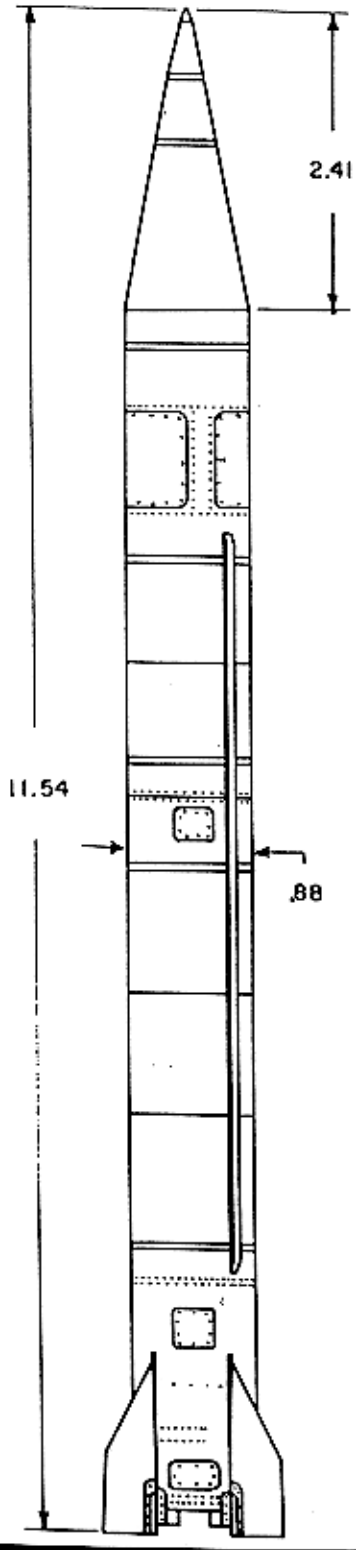
~~(S-NFD)~~ [redacted]

Conclusions (U)

~~(S-NFD)~~ The missile was probably a Soviet SCUD B SRBM system. [redacted]

~~(S)~~ The SCUD B SRBM is now assessed to have the capability to deliver a 2,200-lb payload to a range of 30 to 160 nm (60 to 300 km). The payload options are nuclear, high explosive, and chemical.

~~(S)~~ The propulsion system is a lightweight, bipropellant, turbopump fed, liquid rocket engine.



SCUD B Weapon System Characteristics (S)

[redacted]

Range (nm)	160 (300 km)
Payload Weight (lb)	2,200
Warhead	Nuclear, HE, CW
CEP (nm)	0.25 - 0.7
(meters)	480 - 1,300

[redacted]

Deployment	Ground Mobile
Employment	Offensive Tactical

NOTE:
DIMENSIONS IN METERS

[redacted]

SCUD B Missile Description (S)

Configuration	Single stage, nonseparating payload
Gross Lift-off Weight	13,000 lb (5.9 metric tons)
Guidance	Inertial
Control	Four jet vanes
Propulsion	Single nozzle, fixed position, liquid fueled rocket engine. Sea level and vacuum specific impulses are 226 and 258 seconds, respectively, Total thrust delivered at sea level is about 21,000 lb.

SECTION I

BACKGROUND (U)

1. Introduction (U)

~~(S NFD)~~ [redacted] a Soviet short range ballistic missile (SRBM) was fired to about 50 nm (100 km) [redacted]

~~(S NFD)~~ [redacted]

2. Major Exploitable Items (U)

~~(S NFD)~~ [redacted] Items which have been identified are as follows:

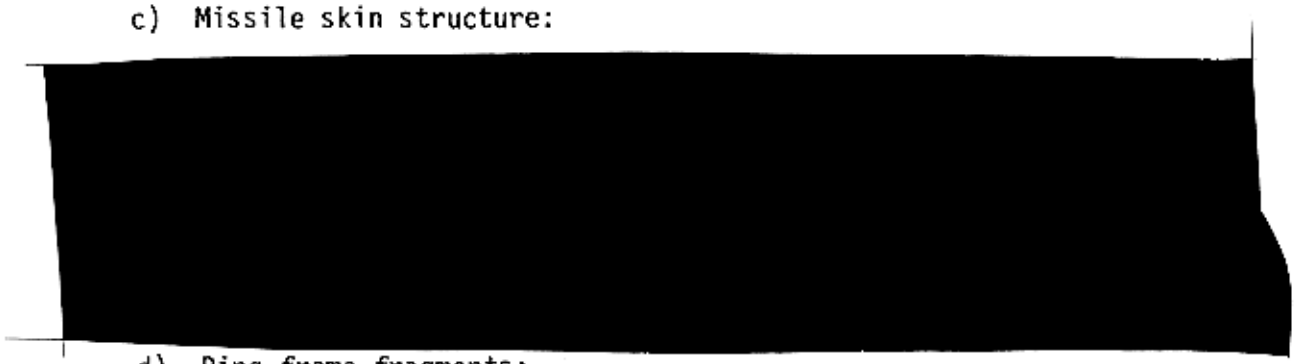
a) Combustion chamber - related:

[redacted]

b) Turbopump assembly - related:

[redacted]

c) Missile skin structure:



d) Ring frame fragments:

3. Exploitation Results (U)

~~(S-NFD)~~ As a result of the exploitation, the following is known about the missile:

a) It uses a skin of relatively heavy stainless steel.

b) The propellant tanks have no integral stiffeners.

c) It uses a turbopump propellant feed system.

d) The engine [redacted] is relatively small and lightweight.

e) The airframe is an [redacted] (SCUD B) airframe.

f) The gas generator uses a mixture of missile oxidizer and fuel rather than a separately stored propellant.

SECTION II

SYSTEM CONSIDERATIONS (U)

1. General (U)

~~(S-NFD)~~ From shortly after the Second World War until the late fifties or early sixties, [redacted] However, between 1957 and 1962, all new ground forces systems [redacted]

~~(S-NFD)~~ [redacted] the airframe of the system is probably a SCUD B airframe. However, because of the age of the SCUD B system, many changes could have been made to the original system with little or no external differences which would indicate a newer and a modified SCUD B system.

~~(S-NFD)~~ [redacted]

~~(S-NFD)~~ [redacted]

~~(S-NFD)~~ Because the SCUD A could deliver its nuclear warhead to a reduced range of 160 km (86 nm) versus a lighter conventional warhead to 300 km (162 nm), and since the SCUD B had about 7 percent more propellant tankage, it was assessed that the SCUD A had been modified (into the SCUD B configuration) in order to deliver a nuclear warhead to the full design range of the SCUD system, i.e., 300 km. [redacted] Thus, the SCUD B was estimated to be a simple outgrowth of the SCUD A, capable, [redacted] of delivering an 1,800-lb warhead section to the 300 km.

2. SCUD B Warhead Considerations (S)

~~(S-NFD)~~ There has never been any confirmation of the 1,800-lb SCUD B warhead section weight. [redacted]

~~(S)~~ [redacted]

[redacted]

(S) [redacted]

(U) An increase in the specific impulse (without changing the propellant combination) can be accomplished by increasing the vacuum specific impulse (Isp_V), or increasing the sea level specific impulse (Isp_{SL}), or a combination of both.

(U) The Isp_V can be increased by increasing the expansion ratio at the expense, however, of increased nozzle weight and more importantly a decrease in Isp_{SL}. Obviously this method is self-defeating.

(U) The Isp_{SL} can be increased by increasing the chamber pressure. Everything else being equal this causes a reduction in the throat area. Obviously, this step requires a major engine modification or, strictly speaking, forces the adoption of a new engine.

(U) To increase both Isp_V and Isp_{SL}, both methods stated above would have to be used. In this case, however, the designer must be careful such that the increase in Isp_V, obtained by increasing the expansion ratio, does not at the same time reduce the Isp_{SL} more than the increase in chamber pressure raises the Isp_{SL}.

(U) Ultimately, to increase the specific impulse it becomes necessary to adopt a new engine.

(S) There is a third method to provide more energy to the sytem; i.e., by changing the propellant combination [redacted] The remainder have approximately the same characteristics.

(U) Therefore, the most probable and practical method to increase the total system energy is to provide a new engine.

(S) [redacted]

(S-NFD) The [redacted] engine assembly was the only item exploited from which some missile operating characteristics could be obtained. [redacted]

(S) If the assumption is made that the missile exploited and the SCUD B are the same, then the use of the [redacted] engine provides the SCUD B the capability to deliver a 2,200-lb (1 metric ton) warhead section to the 160-nm (300 km) design range. A range versus payload trade-off is involved and the system will carry more weight to a shorter range, or achieve a greater range with a lighter payload. Thus, by using the [redacted] engine, the SCUD B can deliver a metric ton payload to 300 km, [redacted]

3. Missile Skin Considerations (U)

(S-NFD) [redacted] The material of the propellant tank has a probable yield stress of about 142 KSI. Thus, the maximum tank pressure is about 650 psi. [redacted]

Therefore, the SCUD B with the [redacted] engine must have a turbopump feed system.

(S) However, a majority of turbopump systems operate with tank pressures of 75 to 100 psi. [redacted]

(S) [redacted]

(S-NFD) [redacted]

(S-NFD) [redacted]

(S-NFD) At present it seems that the last postulation is the most plausible

of the three for the following reasons:

[redacted]

4. Conclusions (U)

~~(S NFD)~~ Thus, at present it seems that the [redacted] engine assembly was part of the original equipment on the SCUD B and that the missile fired [redacted] was probably the SCUD B.

SECTION III

[redacted] AS THE EXPLOITED MISSILE ~~(S-NFD)~~

~~(S-NFD)~~ There exists a limited possibility that the [redacted] missile might be the [redacted]

1. Background (U)

~~(S-NFD)~~ In 1961, a Marshal of the Soviet Ground forces made reference to a need for a 600-km Army missile system and also for a 1,000-km FRONT missile system. Because the SS-12 (SCALEBOARD) program which evolved from the FRONT missile requirement was the most visible SRBM, the requirement for the Army missile system was essentially downplayed to the extent that it was lost from view. The fact remains, however, that the need for two systems was recognized. The position and authority of the individual recognizing the requirement are such that at least some design work on these systems is indicated.

~~(S-NFD)~~ [redacted]

~~(S-NFD)~~ [redacted]

~~(S-NFD)~~ The first public appearance of the MAZ-543 TEL occurred in 1965. At that time the missile which the TEL was carrying was identified as being a SCUD B missile. [redacted]

~~(S-NFD)~~ Since the SS-12 probably attained IOC in 1965, and since the SS-12 was probably part of a dual development program; i.e., a 600-km system and a 1,000-km system (the SS-12) [redacted]

~~(S-NFD)~~ There have been reports about SCUD missiles having ranges considerably above the ranges presently assessed. [redacted] Additionally, the longer ranges reported are inconsistent with one another. [redacted] While the latter system is the SS-12, the former system

system is an unknown missile.

2. Conclusions (U)

~~(S NFD)~~ [redacted] is a basic SCUD B booster with a lighter warhead, 1100 lb (0.5 metric tons), capable of obtaining a range of 275 to 325 nm (500 to 600 km).

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13. ABSTRACT
~~(S-NFD)~~ This study presents an assessment of the SCUD B weapon system which was fired [redacted]

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SCUD B [redacted] SRBM Payload						

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