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Central Intelligence Agency

Washington, D.C. 20505

MEMORANDUM FOR: Program Manager, Advanced Amphibious Assault Vehicle
Naval Sea Systems Command

SUBJECT: The Soviet Light Armored Vehicle Threat to the AAAV

Please find attached an intelligence analysis which we believe may be of interest to the Advanced Amphibious Assault Vehicle program (AAAV). This analysis briefly reviews the available intelligence and provides our assessment of the threat likely to be posed by Soviet light armored vehicles to a US light armored vehicle such as the AAAV in the post-2000 time frame. Your comments and questions are welcome and should be addressed to the

Director
Scientific and Weapons Reserach

Attachment:
SW M 90-20021

CIA SW 90-20021 M

Warning Notice
Intelligence Sources or
Methods Involved

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DIRECTORATE OF INTELLIGENCE

APRIL 1990

THE SOVIET LIGHT ARMORED VEHICLE THREAT TO AAAV

Summary

In the post-2000 time period, Soviet-designed light armored vehicles will pose a substantial threat, in terms of both armament and protection, [ ] *We expect the Soviet Union and East European countries to continue exporting armored vehicles of good quality to many Third World customers. Vehicles likely to be fielded in the Third World in significant numbers include BMP-3, BMP-2, and BTR-80. This paper presents our assessment of the capabilities of these vehicles, with emphasis on their armor protection and armor-defeating systems*

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This memorandum was prepared by Office of Scientific and Weapons Research. Your comments and questions are welcome and may be directed to the author or to the Chief

SW M 90-20021

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Overview of Soviet Light Armored Vehicles, Post-2000

[redacted] For the foreseeable future, Soviet-designed vehicles will set the standard world-wide, both in quality and in numbers fielded. We expect the principal threat light armored vehicles to be:

- The BTR-70 and BTR-80 wheeled armored personnel carriers (APC; Russian: BTR) in large numbers, and probably a new BTR with a medium-caliber cannon;
- The BMP-2 tracked infantry fighting vehicle, in large numbers;
- The BMD-2 Airborne Infantry Fighting Vehicle (with 30-mm gun), in a few countries;
- BMP-3, successor to the BMP-2, in significant numbers.

BTR-70 and BTR-80

Both of these 8x8 wheeled APCs are fitted with the same 14.5-mm heavy machinegun as the BTR-60, but have somewhat thicker armor than the latter. They may mount the AGS-17 30-mm grenade launcher externally. No antitank guided missile (ATGM) is fitted to the vehicles, but BTR troops carry the man-portable AT-7 ATGM (range 1,000 meters). Romania is currently the only non-Soviet producer and exporter of BTR-70s; it may eventually make BTR-80s. The Soviets have switched almost exclusively to BTR-80 production and have begun selling them to East Germany and Czechoslovakia. By the year 2000, the Soviets also are likely to have fielded and begun to export a new BTR with a medium caliber cannon (eg. 30-mm).

BMP-2

The BMP-2, which has a 30-mm automatic cannon and launches the AT-4 or AT-5 ATGMs, began replacing the BMP-1 (73-mm gun, AT-3 ATGM) in Soviet forces in 1980-81. The Soviets have produced about 14,000 BMP-2s between 1980 and 1989, at a rate of 1,800 to 2,000 in 1989 (about triple the maximum rate at which the United States has produced the M2/M3 Bradley Fighting Vehicle). The Soviets have provided BMP-2s to East Germany and Czechoslovakia, and began exporting them outside the Warsaw Pact in 1985. Afghanistan, Algeria, Angola, Cuba, Finland, India, Iraq, Jordan, Kuwait, and Syria have received BMP-2s to date. Czechoslovakia is producing BMP-2s under Soviet license and has begun exporting them to Third World countries. In addition, India has begun coproduction of BMP-2s under Soviet license for domestic use.

BMD-2

The BMD-2 was first noted in Soviet Airborne Assault units in 1988. It has the same 30-mm cannon as BMP-2, and carries an external launcher for the AT-4 or AT-5. Following the pattern of the BMD-1, which has been exported to Libya, Syria, and Cuba, BMD-2 also may be exported by the post-2000 era to a few countries.

BMP-3

The BMP-3 entered full-scale production in 1989, and, based on BMP-2 patterns, we would expect the Soviets to begin exporting BMP-3 to the Third World by the mid-1990s. [redacted] indicates that BMP-3 will have a new, medium-caliber cannon, a laser-guided ATGM, and improved armor over that of BMP 2. [redacted]

"BMP-4"

Assuming the Soviets still have a requirement for an infantry fighting vehicle in the post-2000 period, a successor to the BMP-3, presumably called "BMP-4," is likely to be fielded by then with Soviet troops. In the early post-2000 years, the Soviets would begin to export the BMP-4 in gradually growing numbers. However, there are considerable difficulties in projecting specific capabilities much beyond the BMP-3. [redacted]

Because of continued growth in the threat from Western infantry vehicles, the Soviets may decide to field a "heavy" BMP, ie. non-amphibious, with weight similar to that of main battle tanks; [redacted] We would expect a heavy BMP to be vulnerable only to tank main-gun-fired kinetic energy penetrators and advanced antitank guided missiles, not to medium-caliber cannons (25-60mm) mounted on amphibious light armored vehicles. In addition, a heavy BMP could mount a medium-to-large-caliber cannon (50-125mm, depending on the trade-off between ammunition load and number of infantrymen), greatly overmatching the protection of any amphibious vehicle. Therefore, as a result of the uncertainties involved, we have not attempted to project the characteristics of BMP 4, although we will provide such assessments when we are able to do so.

Figure 1

Small-to-Medium-Caliber Armor-Piercing Rounds

14.5-and 12.7-mm APDS Rounds

[redacted] in the late 1970s, the Soviets developed APDS (Armor-Piercing, Discarding-Sabot) rounds for 14.5-mm and 12.7-mm machineguns. [redacted]

We assess that these rounds entered production in the early 1980s, although we have not received information on their production or deployment status. The 14.5-mm round would be particularly threatening to Western light armored vehicles because it could be fired by the more than 16,000 BTR-60, BTR-70, and BTR-80 APCs and 4,500 BRDM-2 reconnaissance vehicles in Soviet forces, as well as the many thousands of these vehicles that have been exported. It is likely that the Soviets will export these rounds to the Third World by the mid-to-late 1990s, if not before.

We [redacted] consider it highly likely that, like recently-fielded US and Chinese 12.7-mm APDS rounds, they are tungsten alloy. We estimate that 12.7-mm tungsten alloy APDS rounds could perforate about 40 mm of steel rolled homogeneous armor (RHA) at zero degrees obliquity at muzzle and that a similar 14.5-mm round could perforate about 45-mm RHA under the same conditions. At the same time, the high density and strength of tungsten alloy would make Soviet 14.5-mm and 12.7-mm APDS penetrators much more effective against aluminum armor than the previous rounds of these calibers, which are made of tungsten carbide or steel.

Soviet BMP-2 30mm Rounds

We estimate that the Soviet BMP-2 full-caliber steel AP-T rounds can perforate 50-55 mm RHA at zero degrees obliquity at muzzle and about 40 mm RHA at zero degrees at 1,000 meters range. [redacted].

[redacted] at least an APDS round exists for the BMP-2, and we believe that the Soviets have developed or are developing an APFSDS (Armor-Piercing, Fin-Stabilized, Discarding-Sabot) round with greater armor penetrating capability than the APDS round. These projectiles would almost certainly be made of tungsten alloy or depleted uranium alloy. The current US estimate of the performance of an APDS round fired from the BMP-2 30-mm gun is that it could perforate about 66 mm RHA at zero degrees obliquity at muzzle. [redacted] It is likely that at least the APDS round will be exported to the Third World by the mid-to-late 1990s.

Figure 2 shows estimated perforation of RHA at 60 degrees obliquity for 30-mm AP, APDS, and APFSDS rounds.

1991

Figure 2

Soviet 30-mm AP, APDS, and APFSDS Projectiles: Estimated Armor-Perforation Capabilities Versus Range

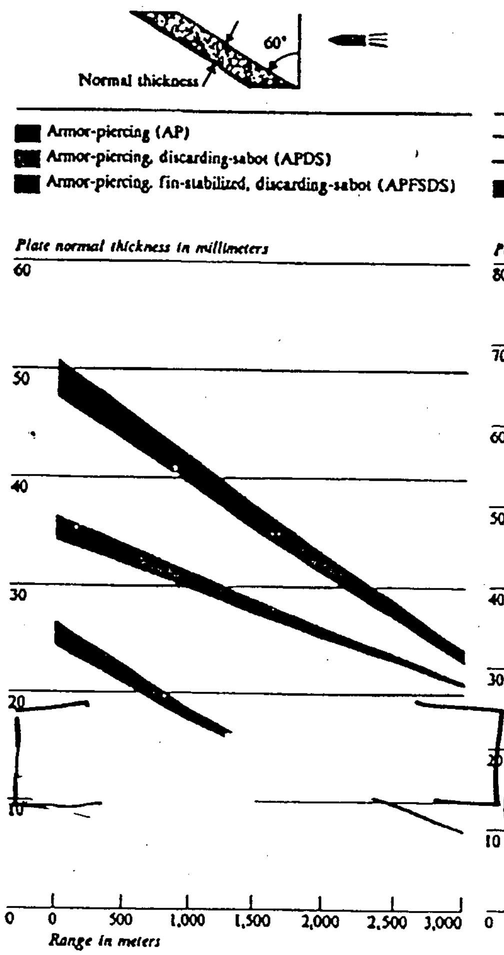
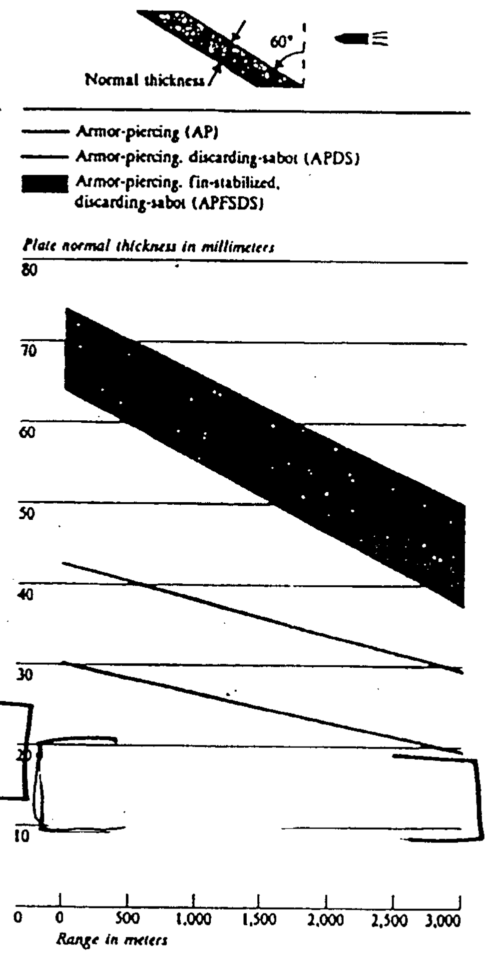


Figure 3

Current 35-mm AP, APDS, and APFSDS Projectiles: Estimated Armor-Perforation Capabilities Versus Range[a]



[a]Data based on the Swiss Oerlikon 35-mm cannon.

1992

The BMP-3: 37-40mm Cannon

[redacted] indicates that the BMP-3 has a larger cannon [redacted] BMP-3's gun is likely to be a rapid-fire, automatic cannon capable of engaging light armored vehicles, unarmored targets, and helicopters.

We consider it highly likely that the Soviets have developed APDS and/or APFSDS ammunition for the BMP-3. [redacted] we note that current Western weapons, such as the Oerlikon 35-mm cannon, can fire tungsten alloy APDS and APFSDS rounds capable of perforating 103 mm and 124 mm RHA, respectively, at zero degrees obliquity at muzzle (muzzle velocity: 1,400 meters per second). Figure 3 shows estimated perforation of 35-mm AP, APDS, and APFSDS rounds through RHA at 60 degrees obliquity. The actual performance of the Soviet guns may differ significantly from this, depending on the gun and ammunition design. We do not have information on modern 37-40 mm guns, but even a 35-mm cannon would be a major threat to all current Western light armored vehicles.

[redacted] the Soviets are developing depleted uranium (DU) armor-piercing rounds, and this effort probably includes ammunition for the BMP-3. DU penetrators may have better performance than tungsten alloy, especially against spaced armor arrays, such as add-on reactive armor designs.

Armor Protection Levels

BTR-60, BTR-70, BTR-80

The Soviets have progressively increased the armor protection of their wheeled APCs, as shown in Table 1. BTR-60 and BTR-70 hulls are made of high-hardness armor (HHA), and we believe BTR-80 also uses HHA. BTR-80 protection is now close to that of BMP-1 and BMP-2 (without add-on armor). The Soviets fitted BTR-70s and BTR-80s with metal side armor in Afghanistan, but so far we have not seen this armor elsewhere. They are likely to use add-on armor on BTRs only where amphibious capability is not required.

BMP-1 and BMP-2

[redacted] the armor appears to be slightly thinner but of higher [redacted] quality steel than that of the BMP-1. [redacted] it is made of a highly refined steel, probably made through electro-slag remelt (ESR) processing. In chemical composition, BMP-2 armor closely resembles a US engineering alloy steel designated 300 M, and is fairly close to 4330 or 4340 steels (except for the roof plate, which is similar to US RHA). The use of a high-quality steel permits the armor to be treated to high hardness levels (Rockwell C 48-51), while retaining excellent strength, ductility, and toughness.

TABLE 1: SOVIET BTR PROTECTION LEVELS	Date Fielded	Weight (Metric)	Frontal Armor Thickness/Obliquity*	Protected Against: Front/Side
BTR-60	1963	10.5t	9mm / 47 deg	7.62mm AP/7.62mm Ball
BTR-70**	1976	11.5t	13mm / 50 deg	.50 Cal AP/7.62mm AP
BTR-80	1984	13.6t	18mm / 50 deg (est)	14.5mm AP/7.62mm AP

* Obliquity is the fallback angle from the vertical.

** At least some Romanian-produced BTR-70s have armor about the same thickness as Soviet-made BTR-60s.

TABLE 2: BMP-2 PROTECTION LEVELS	Obliquity (Deg)	Areal Density (mm RHA)	Equiv. LOS** (mm RHA)	ERA* LOS** (mm RHA)	Total LOS** (mm RHA)
Turret	44	20.7	28.8	12-30	40.8-58.8
Hull	57	16.6-25	30.5-46	12-30	42.5-76 (est.)

* ERA = explosive reactive armor mounted to outside of base armor.
** LOS = line-of-sight thickness = areal density/ cos(obliquity).

The above are minimum levels for the basic BMP-2 and are sufficient to provide complete protection against .50 cal AP rounds in the frontal arc. [redacted] The lower bound for the hull (16.6mm) represents recent data on Czech-made BMP-2s. [redacted].

BMPs with add-on armor may have reduced vulnerability to the current 25mm rounds. Soviet BMP-2s made since 1984 appear to have a 6-8mm steel plate added to the lower glacis (corresponding to the 25mm in the table) and add-on armor on the turret. [redacted] the turret add-on armor [redacted] appears to be non-metallic, 25mm thick. [redacted] have reported it to be for ballistic protection. If this add-on armor is a low-efficiency material [redacted].

We have included the effective thickness of explosive reactive armor, which we consider likely the Soviets will field on at least some BMP-2s, as they have on nearly all types of tanks. In US testing, we have confirmed the feasibility of defeating man-portable antitank rockets (eg. US LAW) and degrading medium-sized missiles (eg. US Dragon and basic TOW) with reactive armor fitted to a BMP-type hull. The table above reflects two designs, the heavier being more effective against medium warheads. Against armor-piercing rounds, the ERA only acts as spaced add-on armor and does not explode.

It seems highly likely that, by the year 2000, the Soviets will have begun exporting their add-on passive and reactive armor technology to the Third World. Even if the Soviets do not export their armor, comparable technology is currently available from Israel and other countries.

BMP-3

[redacted] Soviet designers moderately increased the width, length, and possibly height of BMP-3 over the dimensions of the BMP-2. The resulting greater displacement of the hull in water would permit an increase of 60 to 80 percent in the areal density of BMP-3's armor over BMP-2, while retaining an amphibious capability.

We believe that the Soviets also are incorporating advanced laminate armor technology into the BMP-3 chassis. [redacted] indicates that the Soviets are using aluminum oxide and silicon dioxide, among other materials, in their fielded armor, and these materials would be good candidates for use in BMP-3. Further, we consider it highly likely that the Soviets will field explosive reactive armor on BMP-3, with roughly the same effectiveness against antitank weapons as described above for BMP-2.

Table 3 shows our estimates of BMP-3's armor protection levels, taking into account the higher areal density, ceramic armor, and the likelihood of reactive armor being fitted to the vehicle. We have used mass effectiveness figures of 1.50 and 1.55 for aluminum oxide and silicon dioxide, respectively -- relatively conservative figures since both materials have demonstrated effectiveness up to 2.0 in optimized designs. [ ]

]

TABLE 3: ESTIMATED BMP-3 PROTECTION LEVELS

	Obliquity (Deg)	Areal Density (mm RHA)	Em*	Equiv. Thickness (mm RHA)	Equiv. LOS*** (mm RHA)	ERA** LOS (mm RHA)	Total LOS (mm RHA)
Turret	45	37.5-41	1.5-1.55	56-64	79-90	12-30	91-120
Hull	57	31-34	1.5-1.55	47-53	85-97	12-30	97-127

* Em = mass effectiveness, the ratio of weight of steel to weight of a second material to provide an equal level of protection. Em = 1.0 for steel armor.

** ERA = explosive reactive armor.

*** LOS = line-of-sight thickness = areal density/cos(obliquity).

We have developed some candidate aluminum oxide and silicon carbide targets representing BMP-3 turret and hull armor for testing purposes, which we can provide if desired.

Figure 4