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ESCORT HELICOPTER (BSH) CONCEPT AND OPERATIONAL ASPECTS

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Abstract

Major roles of airmobile forces within the army 2.000, their benefits and their major deficiency, i.e. vulnerability against ground based and airborne/helicopter threat will be outlined. GE army plans to enforce own airborne operations against this threat will be discussed: 1st generation "ESCORT" helicopter (BSH-1), BO 105 based ATAS (Air-to-Air STINGER) weapon system, including first results of BSH-1 field trials and BK-117 life firing with FZ rockets.
Covered will be R+D efforts to define future "ESCORT" helicopter weapon system with Air-to-Air, light attack, SEAD capabilities, including possible solutions PAH-2 or LHX based.

Session: Operational Aspects or Aircraft Design

1. MAJOR ROLES OF AIR-MOBILE FORCES WITHIN THE ARMY 2000

1.1 CONSTRAINTS

The Vienna negotiations on the reduction of conventional forces in Europe will include armed helicopters of both sides as well as tanks, artillery, and fighter aircraft. This may lead to the question: "is there any need for discussion on new combat helicopter developments at all?"

There certainly is, which I am going to explain.

If the Vienna negotiations aim at a numerical reduction of weapon systems mainly required for a major offensive in order to reach a balance of forces between NATO and the Warsaw Pact, both sides are still entitled to maintain their requirement for sufficient or adequate defence capability.

This defence capability must be credible in itself, that is, its ways and means must form an integral system consisting of carefully balanced subsystems based on a flexible, future-oriented concept so that their deployment can be successful in the event of war.

One of these subsystems for the ARMY is air mobility.

1.2 ARMY AIR MOBILITY

The demographic development in the Federal Republic of Germany, the expected numerical reduction of ground forces, and purely operational aspects such as resticted movements because of increasingly dense settlement, as well as considerably improved efficiency of military barriers, endanger the cohesion of forward defence and make it difficult to bring reserves in time to the places where they are needed.

Air-mobile forces, however, are fully present in peace time already; in crises and in war, they can quickly react to changing situations, they can quickly concentrate even over major distances and shift their concentrations. They can, broadly speaking, take over the tasks of command, reconnaissance, and combat against ground based and air-born enemies, close air support, as well as ambulance and logistic support missions.

Air-mobile forces keep their "reserve character" even during the mission, thus allowing the military commander to maintain or to regain its operative freedom of action.

With air-mobile forces, we can demonstrate - at the start of a crisis already, similar to NATO's AMF Brigade, but on a national level - the willingness to defend ourselves and be present where other forces cannot be immediately available - for whatever reason.

The concept of "army air mobility" was approved in 1988 for the Concept 2000 by the German Army Inspector. It was accepted as an overall plan by the General Inspector, and only a few months ago, it was expressly approved by the political command (figure 1).

Based on the above-mentioned tasks, the concept contains a helicopter plan where the Escort Helicopter plays a dominant role.

2. THE ESCORT HELICOPTER (BSH) WEAPON SYSTEM

2.1 THREAT/VULNERABILITY OF HELICOPTERS - CONSEQUENCES

If the concept of air mobility is to be as successful as planned, operations of air-mobile forces must be feasible even under threat from the ground or from the air. This threat starts with enemy infantry weapons, continues with the guns of armoured personnel carriers and tanks, and extends to the weapon systems of the enemy's air defence and electronic warfare.

The enemy's combat helicopter, which uses the same mission profile, is espectially dangerous.

The PAH anti-tank helicopter, for example, which has been designed exclusively for this task, will be efficient to a limited extent, if at all, under this threat, unless these general conditions are significantly changed.

Changes of the general conditions would be, among others: adaption of the mission procedures, for example a "mission against an enemy who penetrated the defence lines" or "mission in the back and at the flanks of the enemy" or "mission against an enemy's airborne operations deep within one's own territory"; but this also means mission optimation on the basis of safe, very recent reconnaissance data, improvement of command systems and technical equipment in general, but above all, the guarantee of active protection during the mission by the ESCORT HELICOPTER.

The essential characteristics required from this helicopter result from its "escort" or "protective" function: besides reduced detectability, high mobility, and long range, its armament must be designed to attack light armoured and unarmoured point and area targets on the ground as well as slowly and quickly moving airborne targets. If possible, it should be equipped with systems that thwart the effect of enemy electronic combat systems (figure 2).

The sensor equipment should be designed for maximum weapon deployment, and it should enable the escort helicopter to assume reconnaissance tasks, that is essentially battlefield reconnaissance, for own air-mobile operations of its partners.

2.2 THE FIRST-GENERATION ESCORT HELICOPTER (BSH-1)

From the mid-1980s, work increasingly concentrated on the concept of army air mobility. At that time, the first concrete steps towards a first-generation escort helicopter (BSH-1) were made. This BSH-1 will be used primarily against enemy combat helicopters and fighter aircraft as escort for the PAH-1 (figure 3).

In order to gain practical experience as fast as possible, it was decided to implement this weapon system on the basis of an existing helicopter - the MBB BO 105 - and a mission equipment consisting of the ATAS components prepared in the USA for air-to-air mission of the Stinger missile.

Work started in early 1987 and currently is at the end of the so-called "concept phase". In late 1989, the definite technical concept of the BSH-1 will be selected. From 1994 on, about 50 of these helicopters will be introduced.

The knowledge gained during the BSH-1 concept phase led to proposals that may expand the work to a larger application spectrum. Primarily, consideration was given to additional or alternative armament with unguided, yet "semi-intelligent" missiles like the FZ 100 or Hydra 70 (figure 4) and night combat capability, as specified for all major weapon systems from the mid-1990s onward. The latter aspect was granted, whereas studies for further weapon systems for the BSH-1 were separated both time and budget-wise (for the time being?).

An alternative carrier, more powerful yet largely identical for logistic reasons, was also under consideration. It would have fulfilled the specifications of the first-generation escort helicopter more efficiently than the BO 105 can ever do. This was the BK 117 (figure 5). But this idea had to be abandoned for financial reasons as well.

2.3 FIRST RESULTS OF THE CONCEPT PHASE

2.3.1 Firing tests with BK 117 and FZ 100

In what is seen today as too optimistic a move to find other, more efficient carriers for an alternative armament of a BSH-1, a weapon system to fire the "semi-intelligent" rocket ammunition FZ 100 was installed in a BK 117 under MBB leadership (figure 6). The core of this system was formed by the GRCS 28-FZ 100 fire control computer, a Crouzet reflex sight for the gunner, and a SFIM APX 334-25 (magnifying surveillance sight) with laser distance measuring equipment (DME) for the Systems integration was finished within a few months, which was quite remarkable.

In mid-1988, the system was demonstrated at Helchteren in Belgium to interested international observers.

Besides the comparatively very fast technical implementation of the project, the results of this demonstration firing were remarkable.

Rockets were fired in hover flight and in forward flight to the "wall-in-space principle", and the warheads of these rockets dispensed their submunition at a time calculated by the on-board computer to become effective in a narrow radius on the ground (figure 7).

Although the hits are relatively far apart in azimuth due to the helicopter yaw movement, hit accuracy controlled via elevation is very good (figure 8).

The azimuth hit precision can be improved without particular technical development risk by a yaw axis control (YCAS) similar to the system used in the PAH-1.

Another advantage of "semi-intelligent" rocket ammunition, besides its relatively low weight, is the development of the "Flechette" warheads of the FZ-122 ammunition (figure 9) which are especially effective against airborne targets at short range, for example in case of a surprise encounter. This includes dogfight situations which should in principle be avoided with helicopters but cannot always be excluded. The primary goal in a combat between helicopters must be to detect, identify, and fight the enemy at maximum distance. The Stinger missile has been developed for this purpose. BSH-1 field trials were to give some first indications on how far the requirements were fulfilled.

2.3.2 BSH-1 field trials (BO 105 with Stinger)

Flying Test Squadron No. 910 of the German Army Aviation under the command of the ATV special staff of the Army Aviation Weapon School conducted the "BSH-1 field trials" with various BO 105 (figure 10) testbeds and different equipment near Celle in Lower Saxony from February to June this year.

The trials mainly concentrated on defining the time probability and distances required for target detection and identification by the BSH-1 crew with and without optical equipment with different magnifications from 3.2 to 14 times.

Different system architectures (HUD, elevating ramp, search head control) were to help in defining the engagement ranges of the Stinger search head (BASIC) for targets within and outside the background area, as well as for fast and slow-flying, directly approaching, crossing and receding targets (figure 11, 12).

Several BO 105s were converted to testbeds:

- 2 BO 105s in PAH-1 configuration with APX 397 for the observation officer, a Thomson-CSF or Crouzet sight for the pilot and the gunner, an adjustable and a nonadjustable ramp for the launcher;

- 1 BO 105 in VBH configuration with reflex sight for the gunner and magnifying optical system/stabilized hand-held glass from Foujinon for the observation officer;

- 1 BO 105 in industrial version with high landing gear, a Lucas chin mounted turret for off-axis missile deployment controlled by a helmet-mounted sight from Ferranti for the gunner.

These "technology testbeds" provided by MBB were to deliver significant information on the most useful escort helicopter mission equipment, not alone for the BSH-1.

Test set-up

Two kinds of terrain were selected for the BSH-1 field trials:

- one with thick vegetation cover on broken, yet largely flat ground, and
- mostly open and slightly hilly ground with little vegetation.

The targets were simulated by BO 105, UH-1 D and CH 53, and their flight profile was 50 ft GND and 200 ft GND.

The test personnel came from the Army Aviation Weapon School, the Army Aviation mission units, Military Test Establishments, the Air Force, the combat and support troops of the 1st Corps, and from the technical support teams of the industrial firms concerned.

A few figures

Although only two days per week were reserved for flying during the field trials, with the remainder of the time required for preparatory work and evaluation, nearly 1000 test runs were performed on 27 days, corresponding to approximately the same number of flight hours (figure 13).

The search heads of the missiles converted for engagement trials were activated more than 1000 times each. No failure occured, although the seekers are not designed for more than 10 to 20 activations on average. After that, the missile is usually fired onto a target.

Some first experience

You will understand that I cannot give information on certain test results because they are subject to military security. A detailed discussion will be held on this subject in September in Celle during a NATO presentation.

The first evaluation of the field trials permits to make the following statements (figure 14):

- Target detection and identification performances of the helicopter crews are better than the military requirements;

- Performance can be further improved by preliminary target acquisition based on the direction of approach or when the approach and observation sector can be restricted to less than 160°;

- The observation officer and the gunner/pilot, who takes over the combat mission after target identification cooperated effectively without special training and within the time required to perform target lock-on.

- The BO 105 control responds is extremly high and thus is well suited to establish the desired lock-on and firing conditions including the "super elevation" required for the Stinger missile.

- The possibilities of the Stinger missile in air-to-air combat with helicopters are far from being fully exploited and can be extended by further technical modifications such as external search head control, off-axis application, and above all, the Stinger-RMP the introduction of which is planned for the early 90ies (figure 15).

- The field trials with Stinger Basic yielded informations like meteorological, technological and procedural prerequisites for a successful application within the military requirements.

On the whole, it can be said that the BSH-1 can be implemented so that it fulfils the military specifications within the given material, temporal, financial and technical frame.

The BSH-1 will be able of successful attacking its main enemy, the adversary's combat helicopter, as this picture shows (figure 16).

The BSH-1 thus is a first step towards closing deficiencies in the air-mobile forces. Our aim now is to gather further experience and knowledge quickly, not least in order to establish a basis for the decisions to be made in connection with the second-generation escort helicopter.

3. THE SECOND-GENERATION ESCORT HELICOPTER

Besides the knowledge gained with the BSH-1, studies and Army trials are going on the field, while national and international expert teams are defining the detailed requirements for the mission spectrum, the configuration, and the mission equipment of an escort helicopter of the second generation. These studies comprise conceptual, technical and logistic aspects, as well as structural, personal and economic/political viewpoints.

It becomes clear that the BSH-2 can hardly be implemented as an isolated project - that is as a completely new helicopter - for cost reasons. Therefore, studies rather concentrate on solution which can be realized with an existing system, or one under development, or with a basic system which can be optimized for a given mission. The essential criteria are: mission equipment concept, weapon system, special sensor and avionics equipment, elecronic warfare system, radar, laser, and missile warning, as well as possibilities for structural improvement to reduce radar-infrared noise and the helicopter signature in general. All these requirements result from the consideration that the BSH-2 will be the essential factor to close the efficiency gaps in the air-mobility subsystem (figure 17).

Its capabilities will have to reach from "armed reconnaissance" to "elecronic combat" and "air-to-air combat". The parallels to the American LHX are not mere coincidence. In unbiased analyses, the same considerations will generally lead to the same results. Are there possibilities of a transatlantic cooperation?

Our immediate neighbour, France, has been considering the escort helicopter longer than we did. These studies resulted - not always voluntarily - in the joint development of a basic helicopter, the HAP - Hélicoptère d'Appui et Protection (figure 18).

Could the BSH-2 be based on the HAP?

Political and financial reasons will be decisive in answering this question. When looking for an answer from the military viewpoint, the decisive criteria must be that the requirement for closing efficiency gaps, as mentioned before, is fulfilled by using the latest and expandable technology to allow a timely adaption to changing threats.

4. CONCLUSION

The escort helicopter is the helicopter weapon system of the future, its implementation and further fate being closely linked to that of the whole air-mobility and air-mechanization concept of the Army.

This helicopter must be more versatile than all former types. Altough dogfight is, at least not yet, part of the mission spectrum, it would be possible - already and especially - with the BSH-1 based on the BO 105 (figure 19).

Incorporation of BSH and PAH

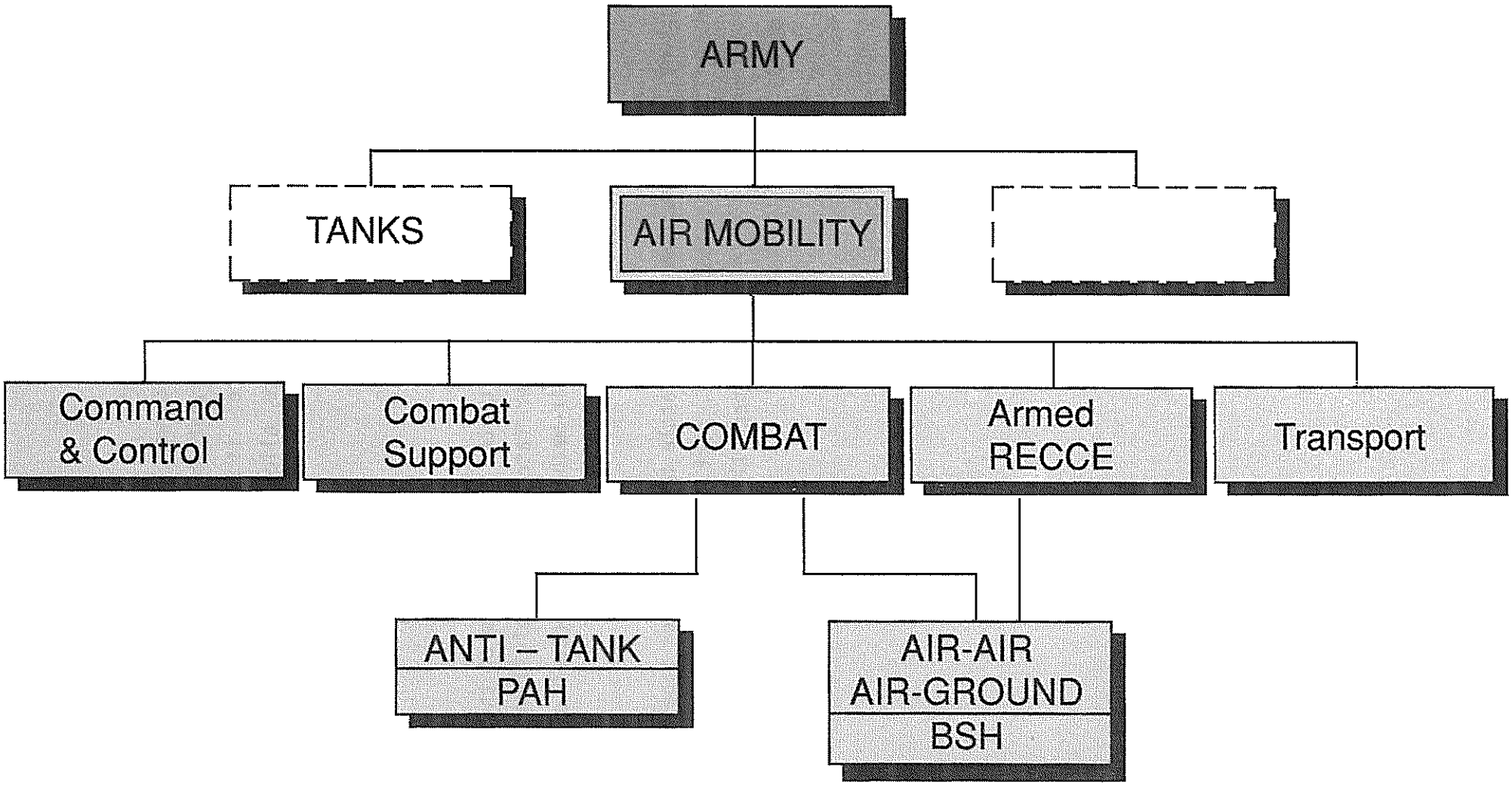


Figure 1
80 - 14

MI-24 HIND-D
Combat Helicopter

Figure 2
80 - 15

MBB

Advanced Rocket Control System on BK117 M

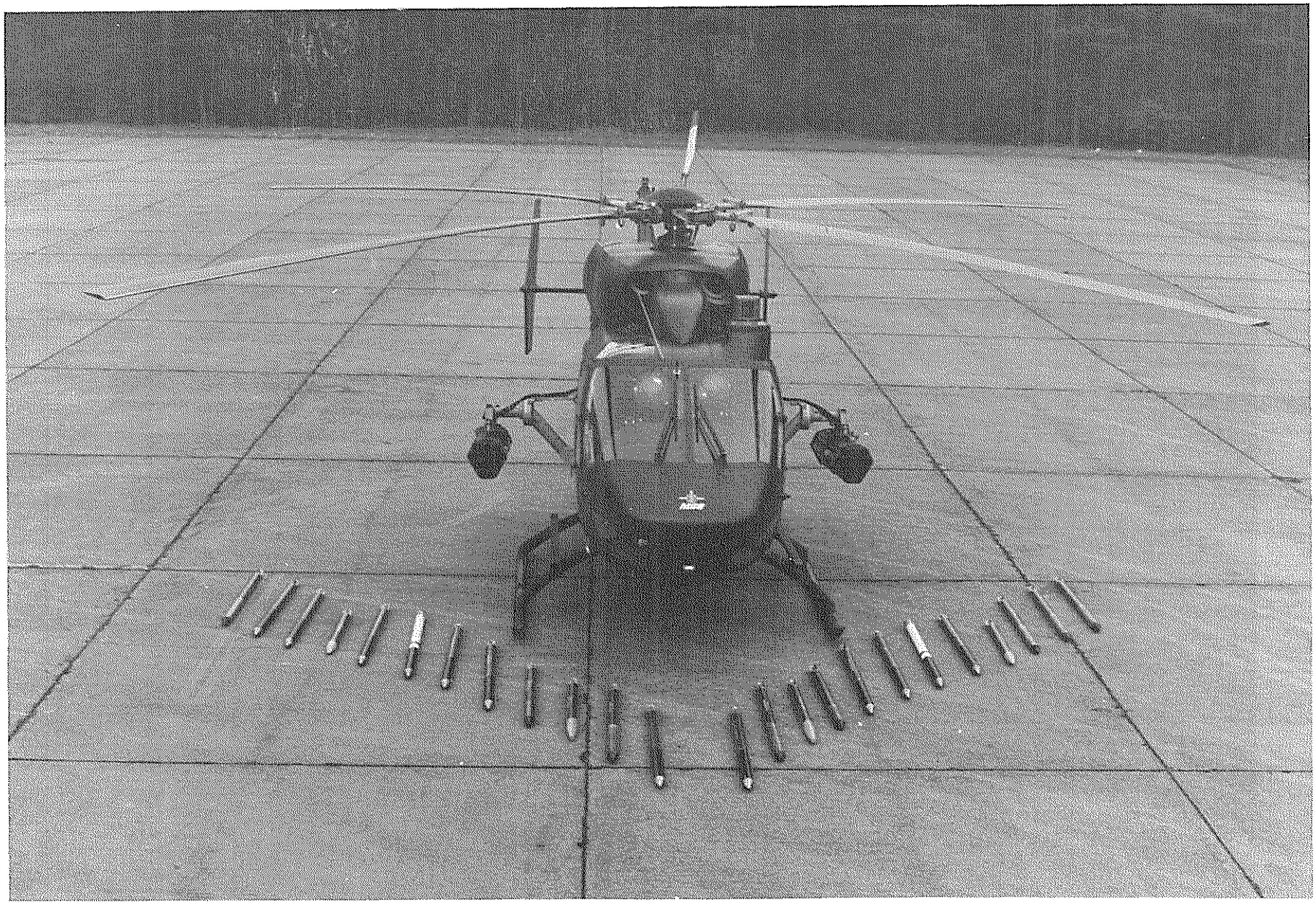
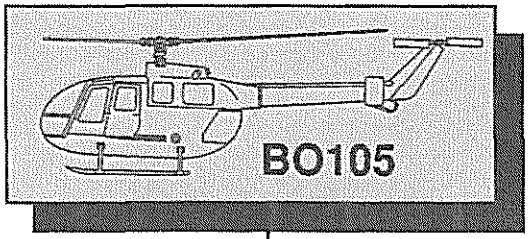


Figure 3
80 - 16

MBB

BSH-1 Project



Concept and Feasibility Studies (Industry)

Operations Research (German Army Aviation and Industry)

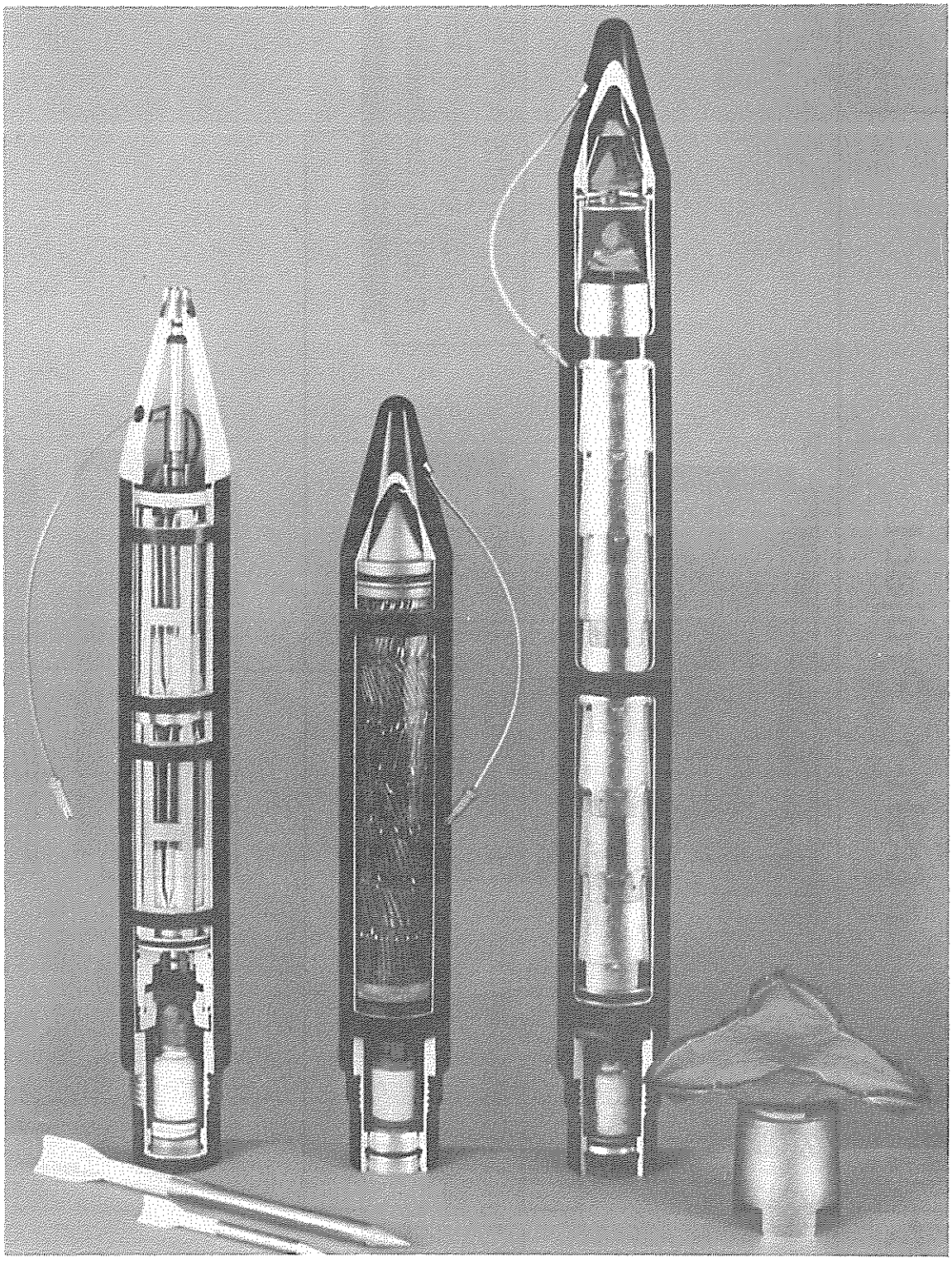
Field Trails with Four Test Carrier (German Army Aviation)

Evaluation (MOD, Procurement Office, GAA)

Figure 4
80 - 17

MBB

New Generation of Warheads



SUBAMMUNUTION

MULTI -DARTS	FLECHETTES	PENETRATION
AIR-TO-AIR	AIR-TO-GROUND	AIR-TO-GROUND
AIR-TO-GROUND	AIR-TO-AIR	

Figure 5
80 - 18

MBB

Multi-Role Helicopter BK117 M

Figure 6
80 - 19

MBB

Helicopter and
Military Aircraft

BK 117 M
The Military Multi-Role Helicopter

Figure 7
80 - 20

MBB

"Wall in Space" Concept
Air-to-Ground Engagement

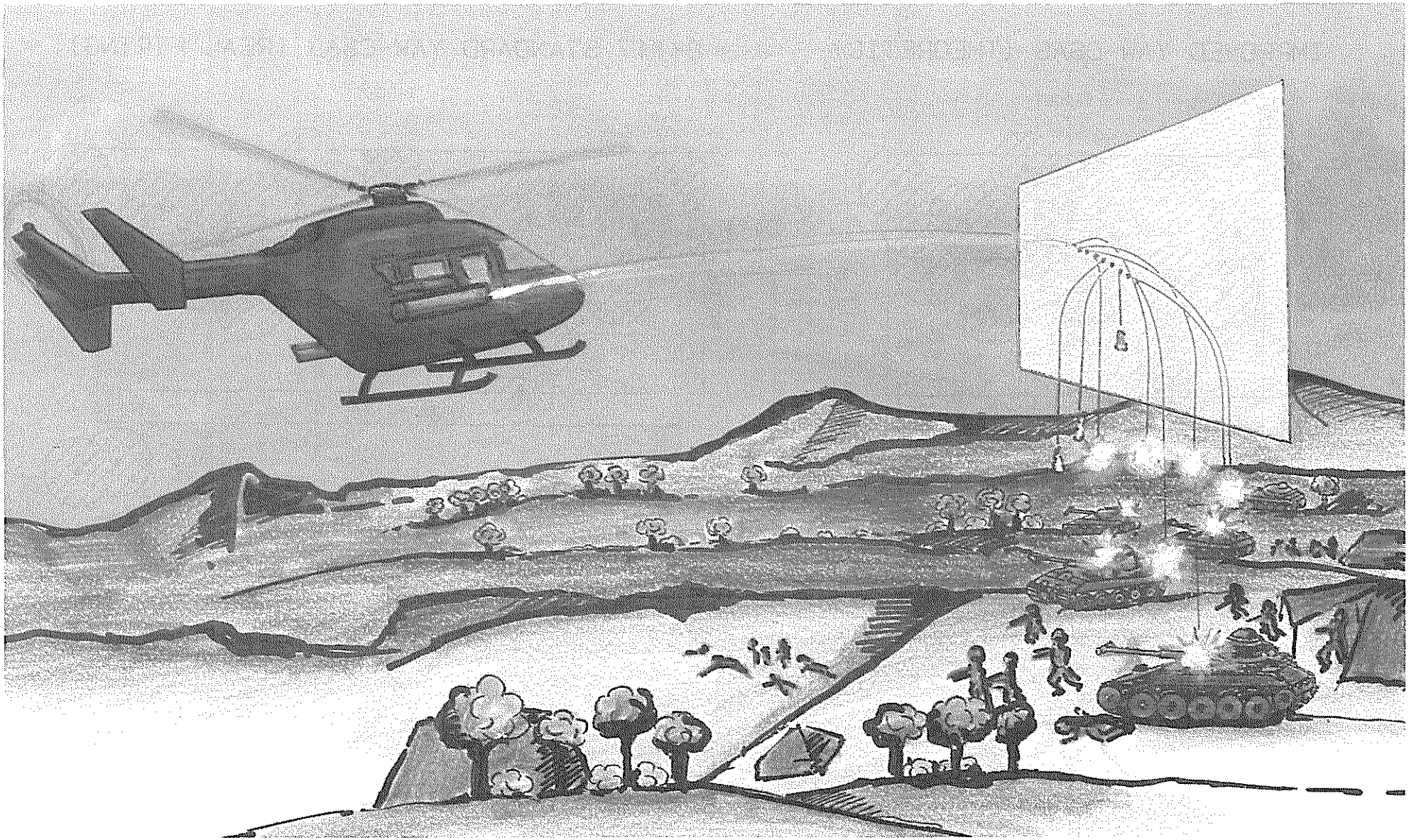
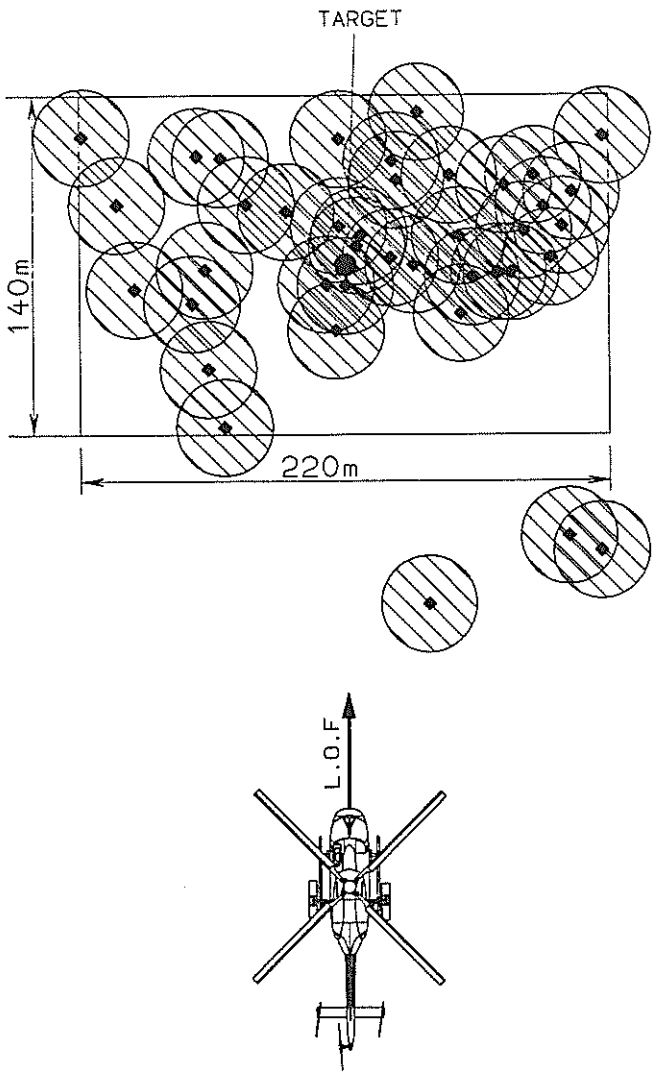


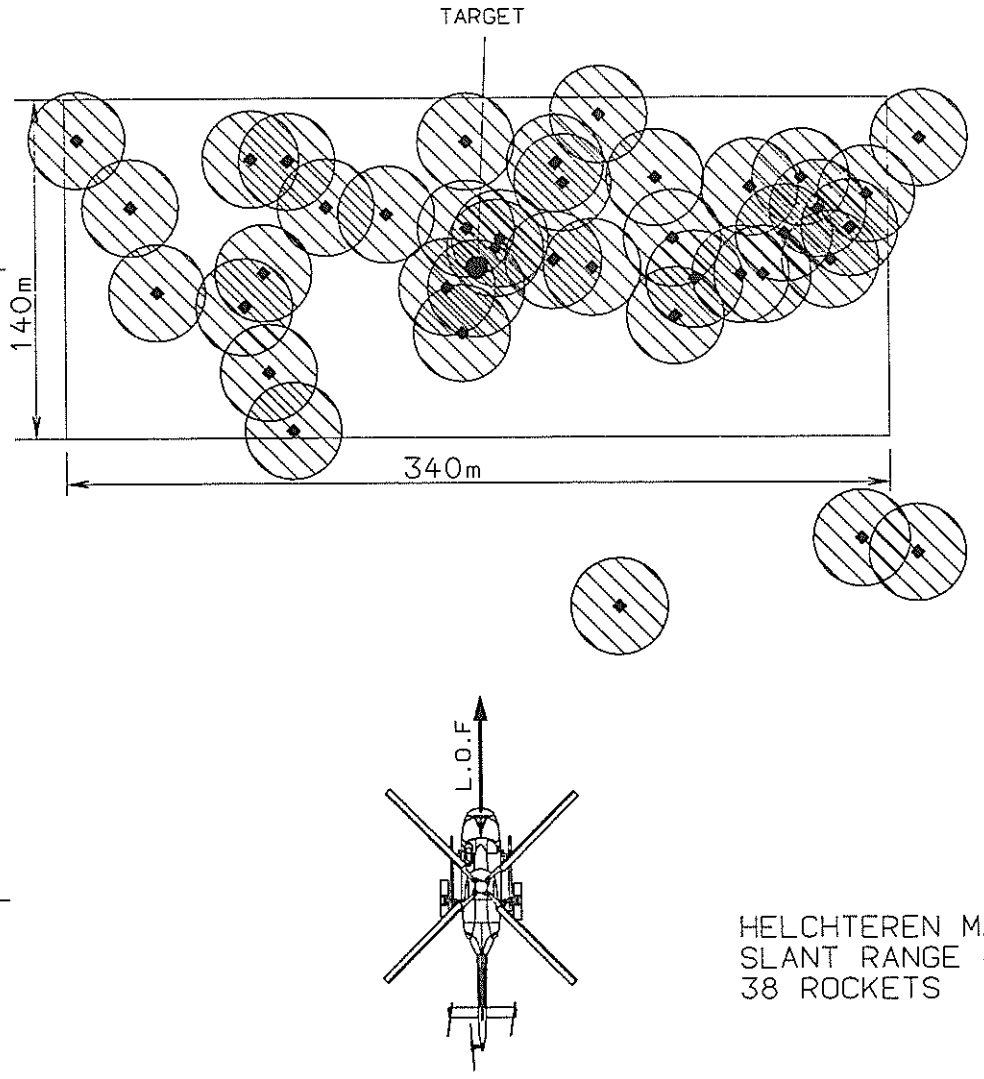
Figure 8
80 - 21

FZ100 Firing from BK117
Stab. Sight-Reflex Sight-LRF-FCC-CSAS

IMPROVED YAW-CSAS (THEORETIC)



BK117 STANDARD YAW-CSAS (REAL FIRING)

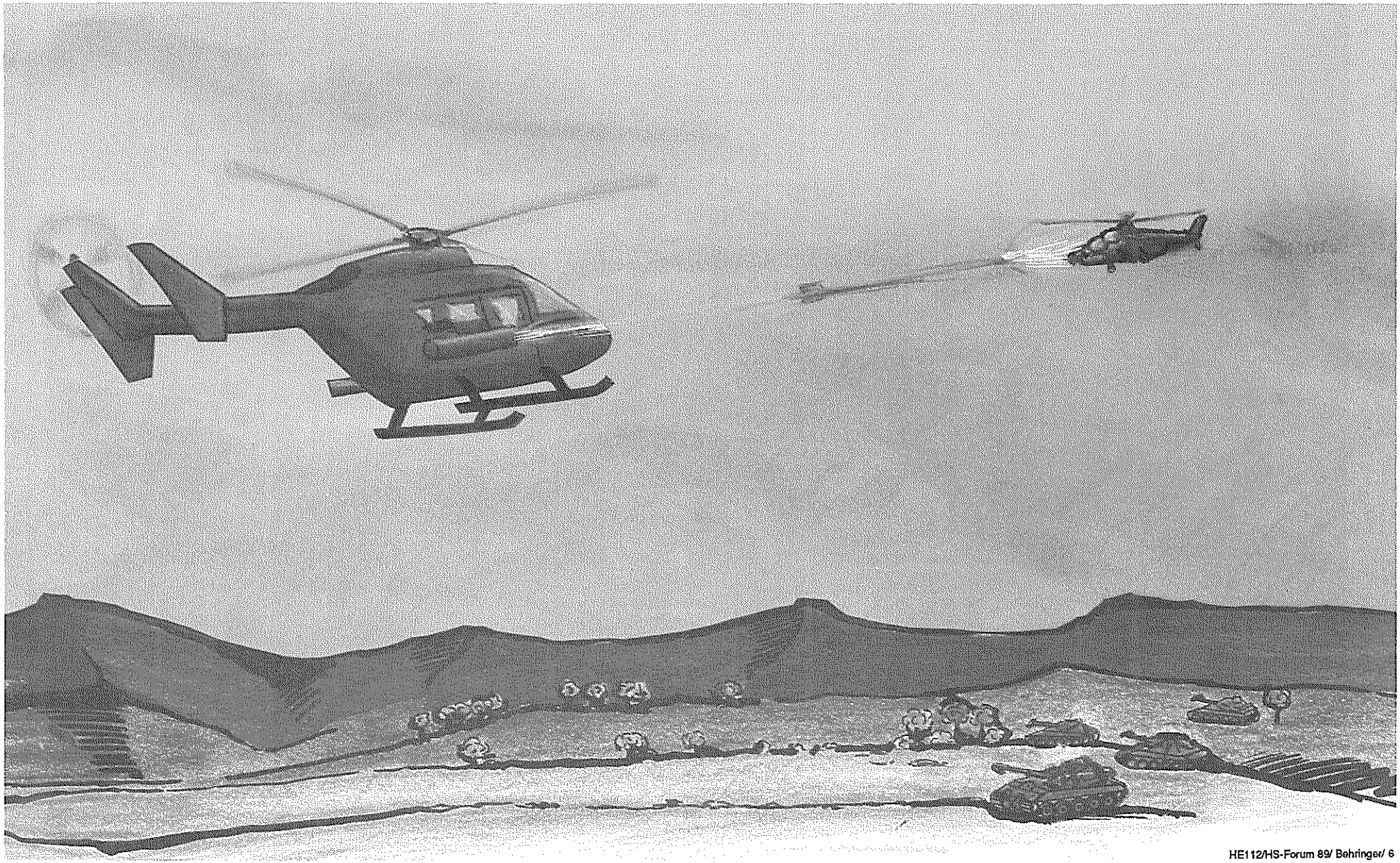


HELCHTEREN MAI 88
SLANT RANGE 4500m
38 ROCKETS

Figure 9
80 - 22

MBB

Time Controlled Ejection of Flechettes



HE112/HS-Forum 89/ Behringer/ 6

Figure 10
80 - 23

MBB

Escort Helicopter
Launch of STINGER

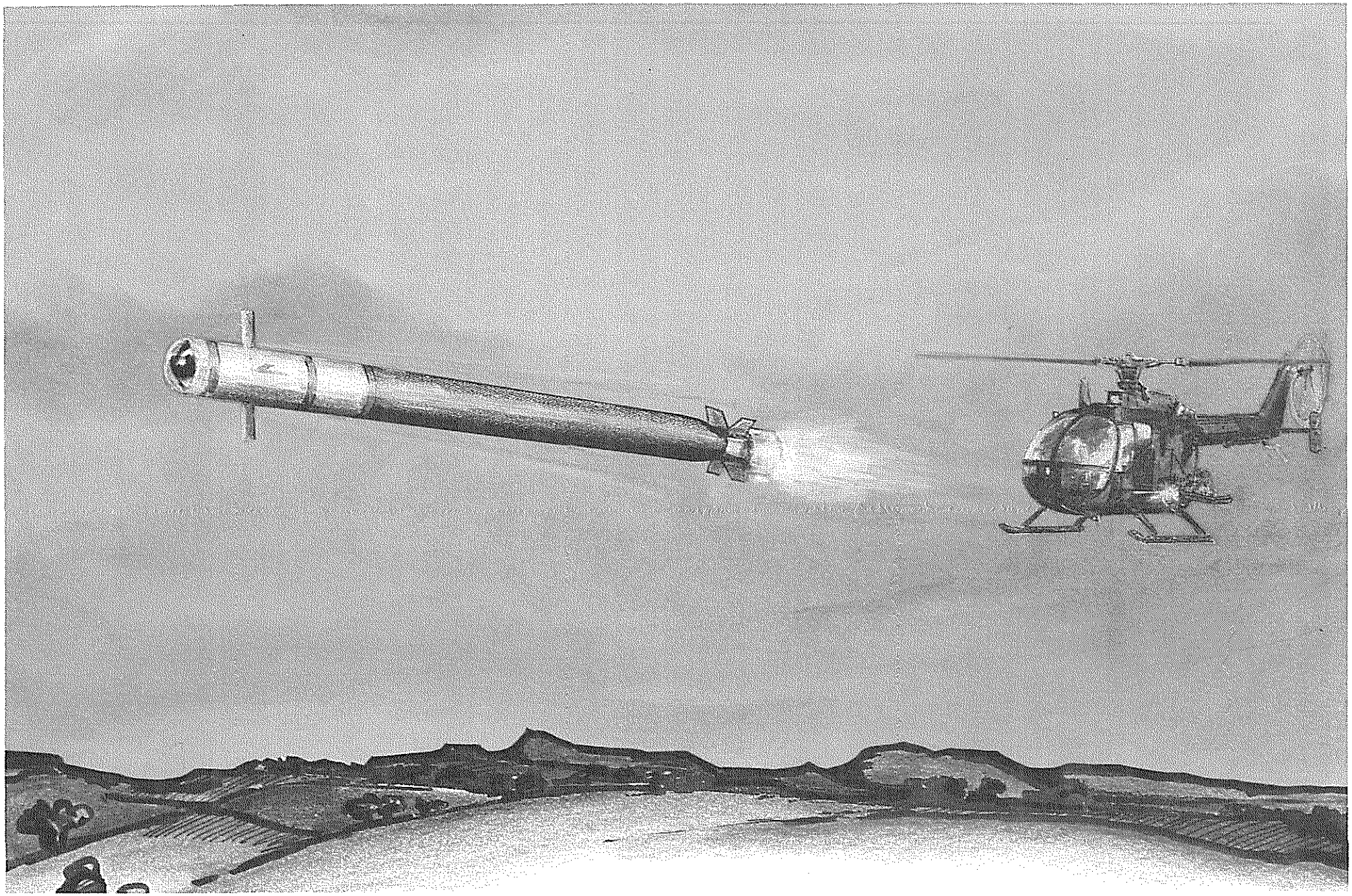
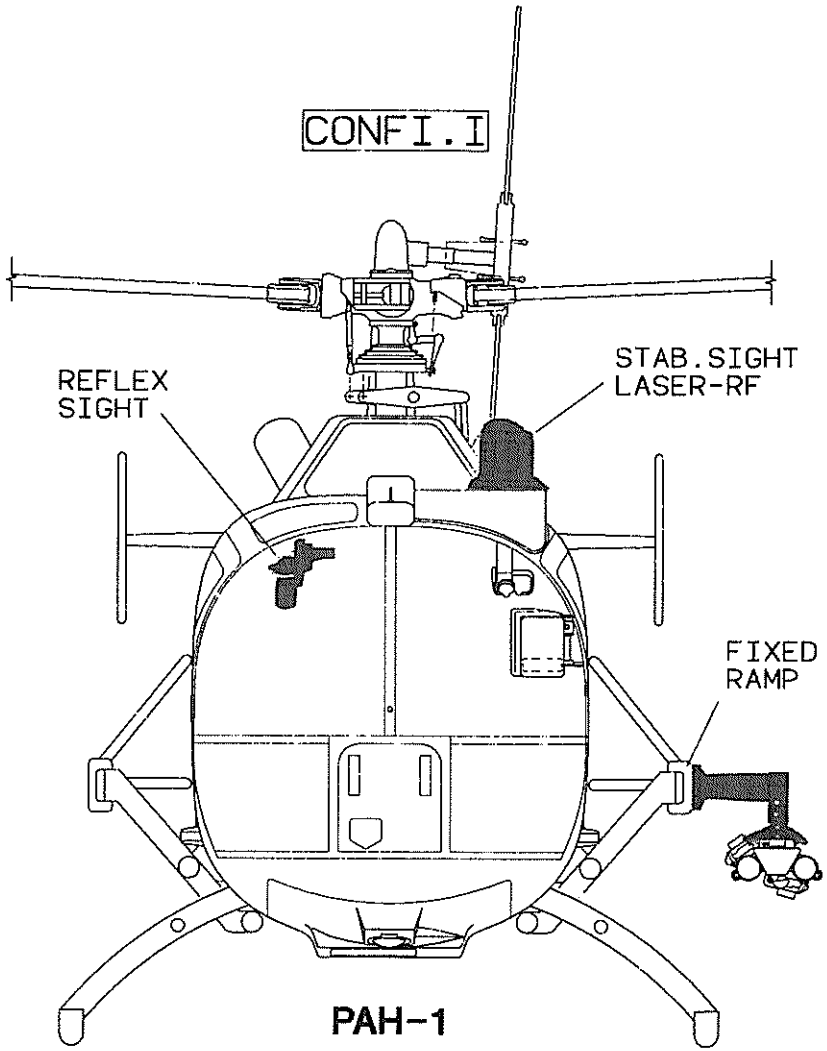


Figure 11
80 - 24

BSH-1 Test Configurations



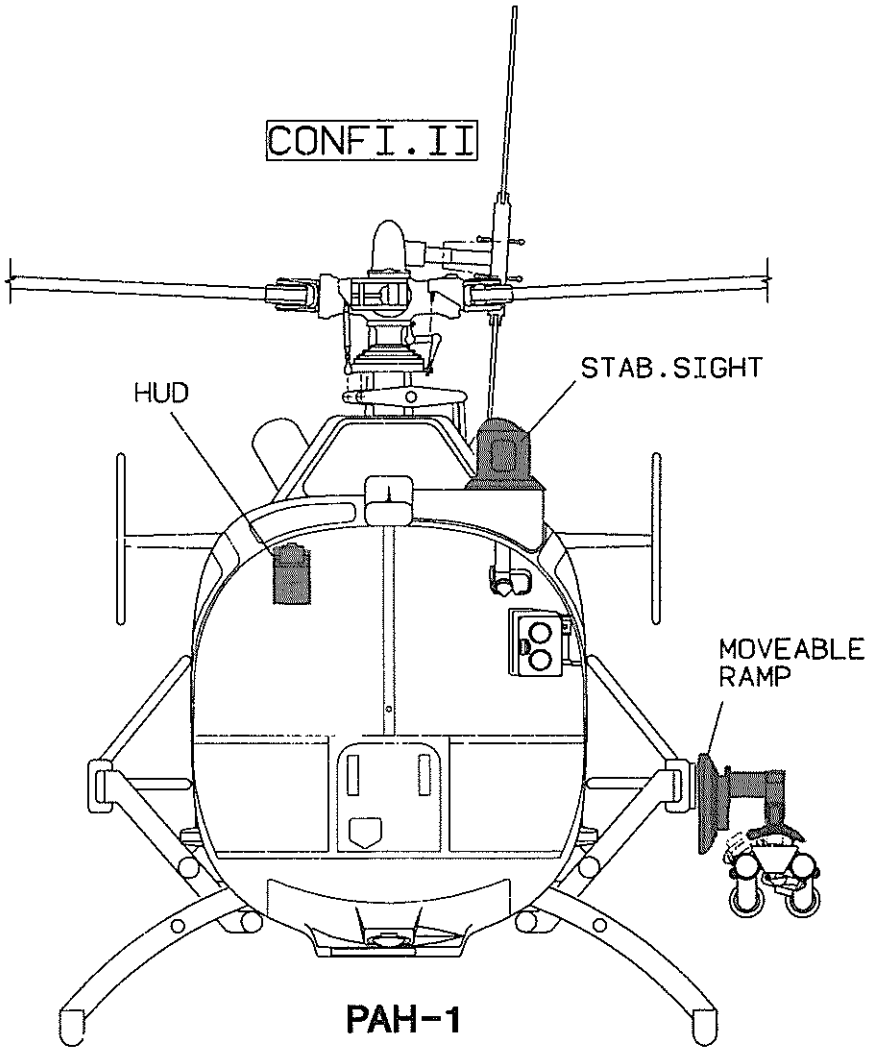


Figure 12
80 - 25

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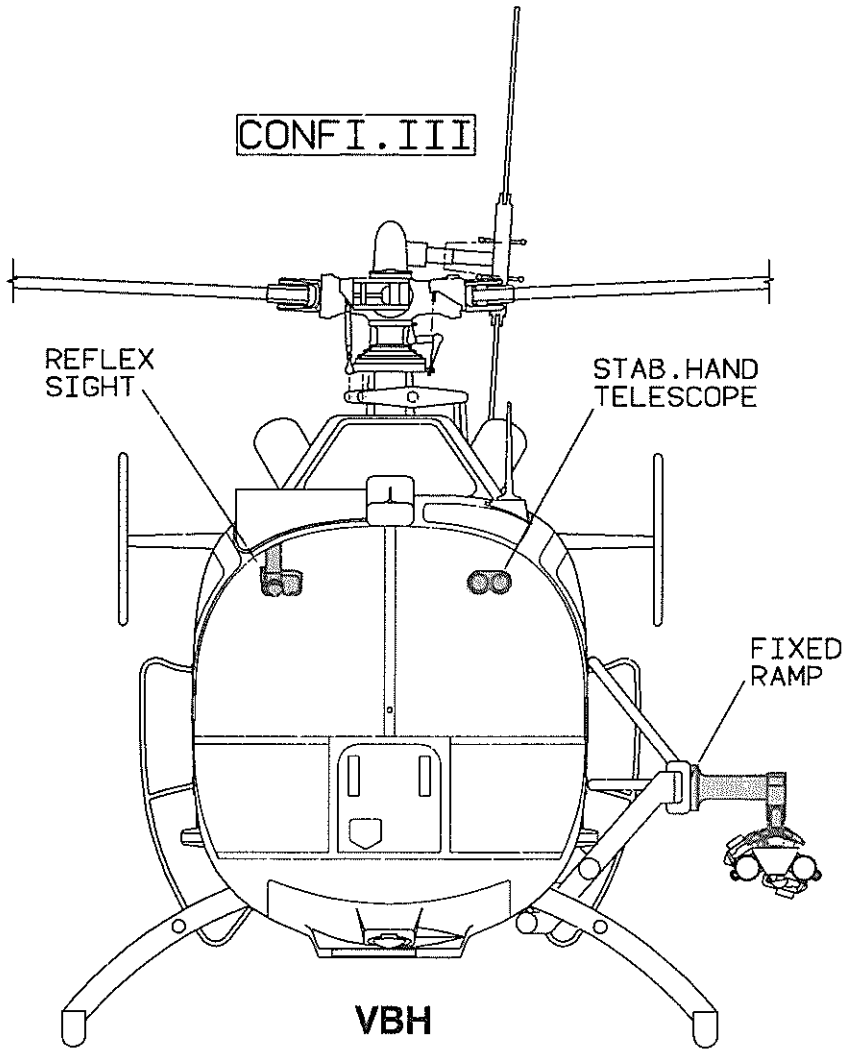
BSH-1 Test Configurations



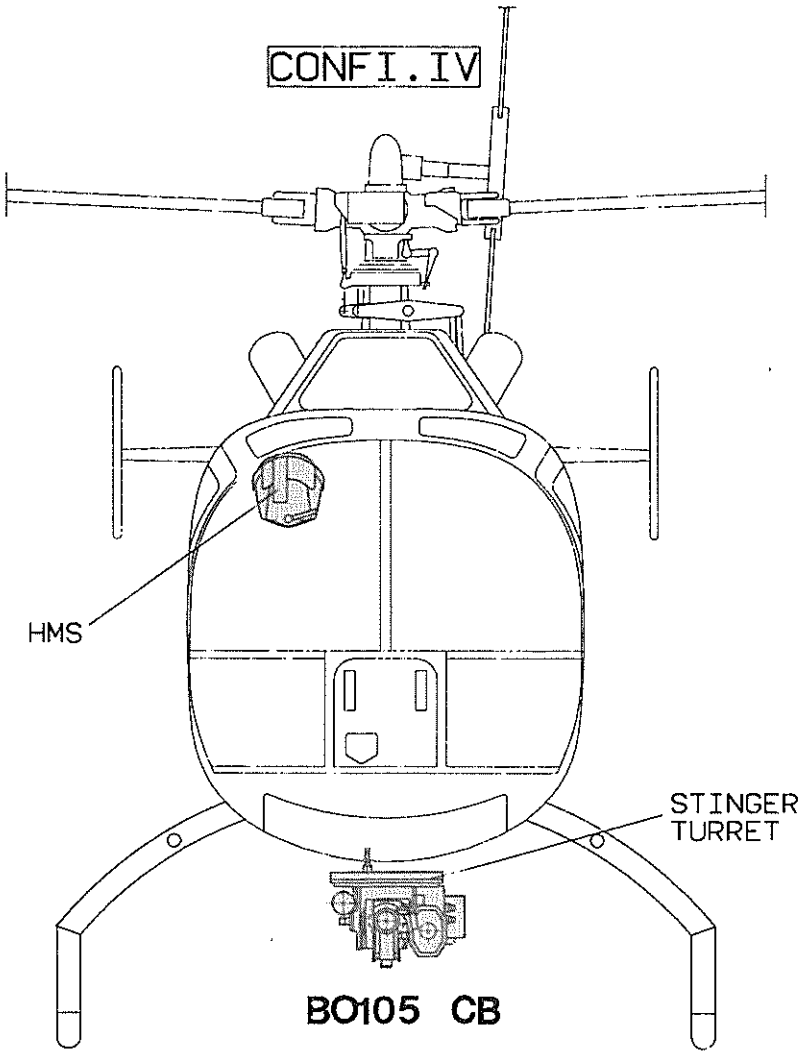


Figure 13
80 - 26

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Performance of Field Trails

~ 1000 Test Runs

~ 1000 Flight Hours

~ 1000 Seeker Head Activations

Figure 14
80 - 27

MBB

First Results and Experience

- Target detection and identification better than military requirements
- Operation without special crew training
- Lock-on within required time
- High manoeuvrability of BO105 excellent matched to ATAS engagement

Figure 15
80 - 28

MBB

Stinger Improvement Program

STINGER BASIC
1980

STINGER POST
(Passive Optical Seeker Technique)
1985

STINGER RMP
(Reprogrammable Memory Processor)
1990

Figure 16
80 - 29

MBB

"Knock-Out" of Threat

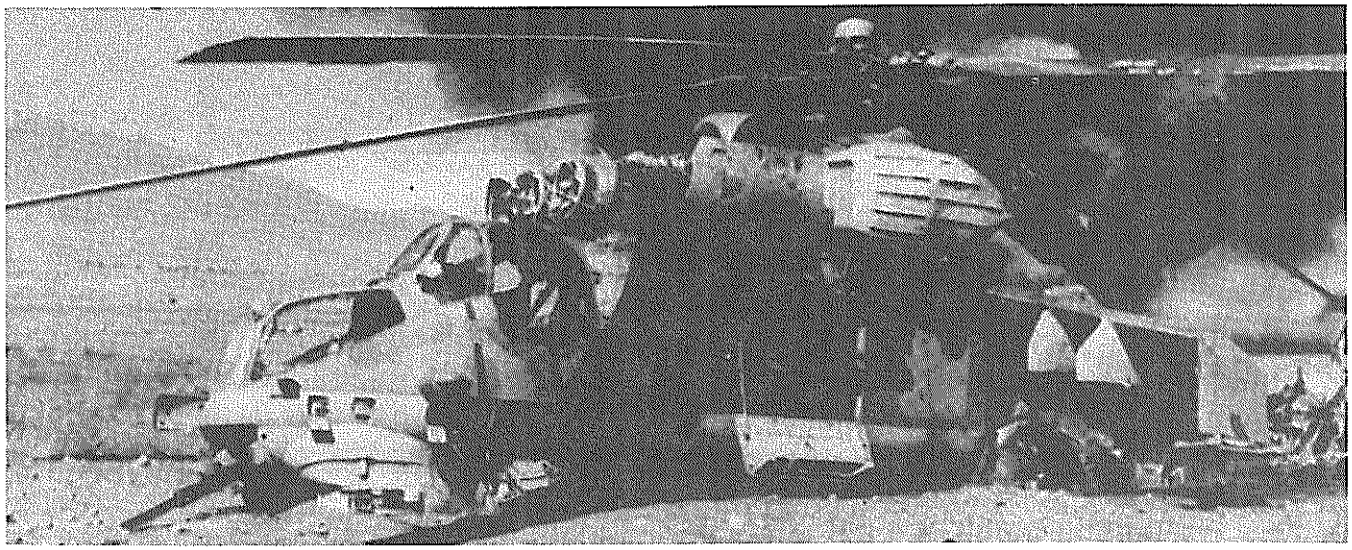


Figure 17
8C - 30

MBB

Escort HC with Ait-to-Air Weapon-mix

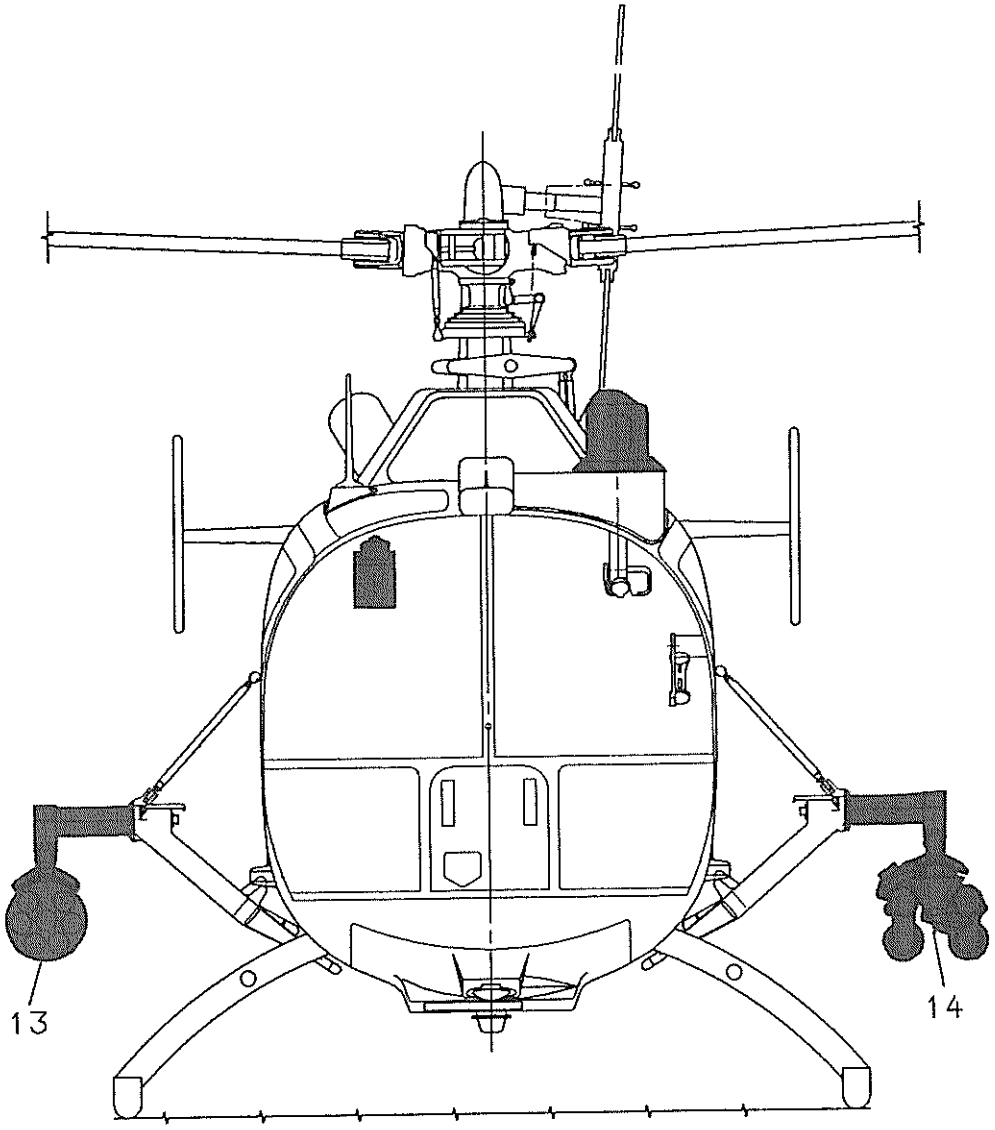


Figure 18
80 - 31

SCAT Generic Missions (BSH-2)

Scout Role with Multi Sensor Package
- Target Search, Detection, Recognition Identification
- Automatic Target Acquisition
- Automatic Multiple Target Hand-Off

Attack Role with Rockets / Missiles
- Air Defence Suppression
- Area Target Suppression
- Air-to-Air Combat

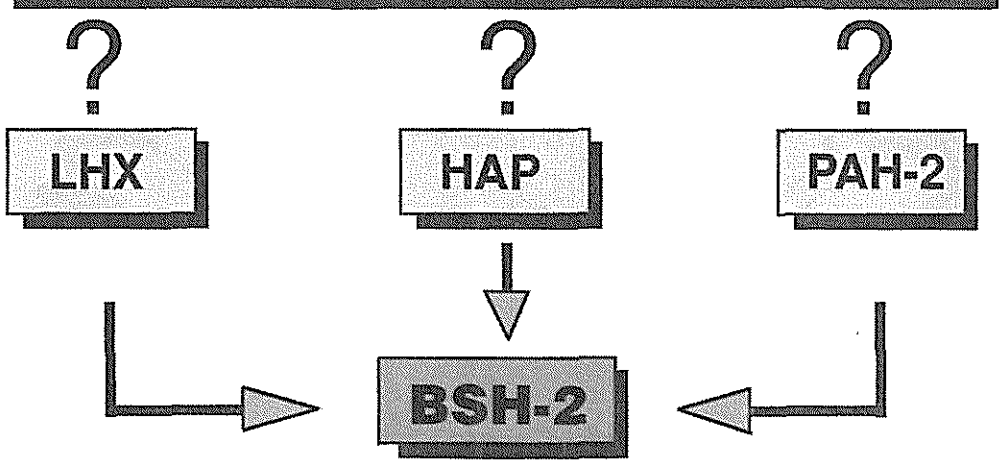
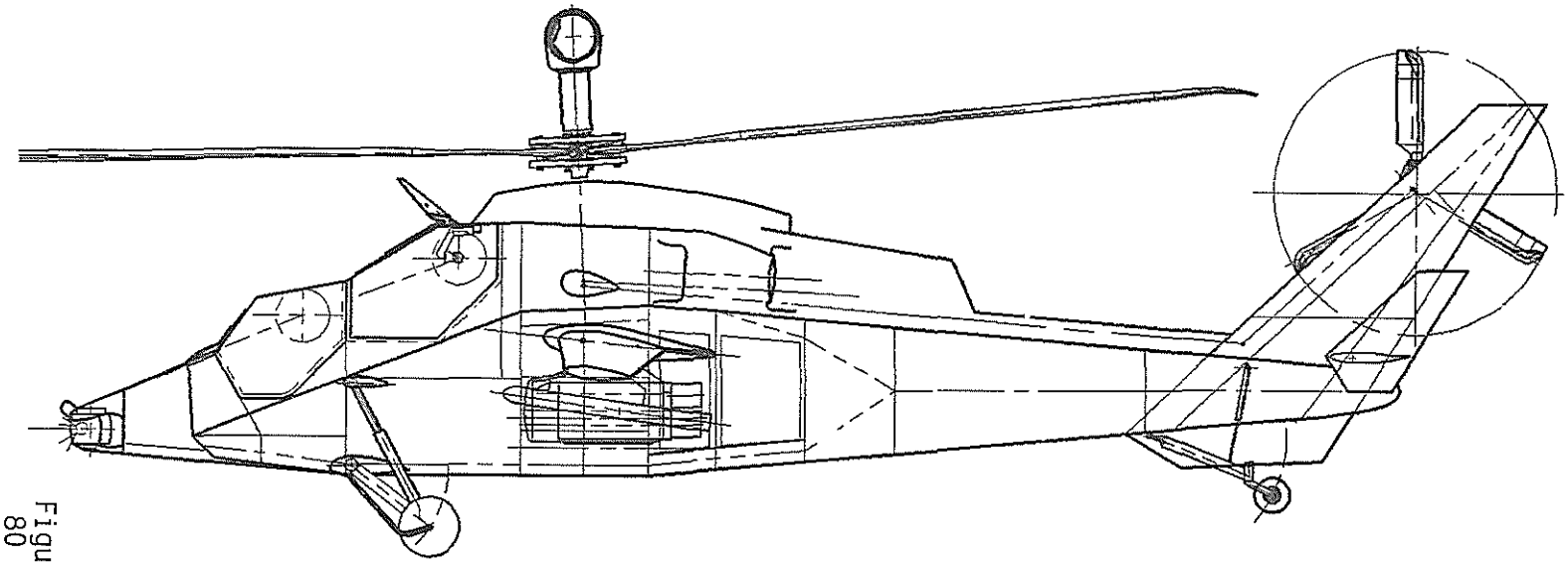


Figure 18
80 - 32

BSH-2 Based on PAH-2



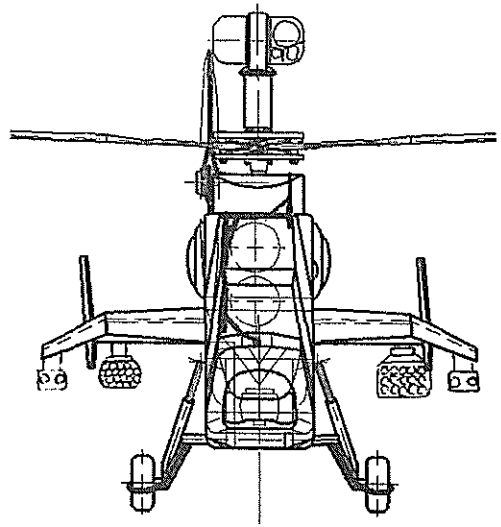


Figure 20
80 - 33

Armament

- Unguided Rockets with Subammunition
- Hyper Velocity Missiles
- STINGER

Self Protection Systems

- Chaff/Flare Dispenser
- RW / LW
- IR Jammer
- Missile Detection System

Sight and Control Systems

- Stab. Sensor Platform
- PVNS
- HUD
- HMS /D