DEPARTMENT OF THE ARMY
ARMY TRAINING BOARD
FORT MONROE, VIRGINIA 23651-5000

(487)
487

REPLY TO
ATTENTION OF

ATTG-B

05 MAY 1987

MEMORANDUM FOR DEPUTY COMMANDING GENERAL FOR TRAINING

SUBJECT: Summary of Future Combat Vehicle Concepts Briefing

1. On 30 April, Terry Covington (LTC, Ret.), a staff analyst with the RAND Corporation, briefed United States Army Training Board (USATB) personnel and other TRADOC staff on future combat vehicle concepts employing Artificial Intelligence and Robotics technology. Three major issues were discussed: long range system requirements, armor/anti-armor shortfall, and 4:1 line of sight battle. A copy of his briefing slides is at Tab A. Salient points of his presentation are discussed below.

2. A Defense Science Board study revealed that the United States was lagging behind the threat in combat vehicles. Specifically, we needed to stay ahead of the threat armor and we also needed to provide better armor protection for combat vehicles. The Defense Advanced Research Projects Agency (DARPA) funded a multi-year, over $200 million plus project which RAND Corporation is participating in as a subcontractor.

3. The object of the project is to develop an integrated weapons platform which features enhanced armor protection and munitions effectiveness. (Slide 2)

a. Armor protection consists of three levels: passive, reactive, and active. Passive armor consists of ceramics and metals which absorb the force of the anti-armor weapon. Reactive armor will divert the anti-armor round after the initial strike. Active armor will intercept the anti-armor prior to hitting the vehicle.

b. The concept is to develop a family of combat vehicles: light anti-armor, heavy anti-armor, unmanned anti-armor and a variant 2 piece articulated system. (Slide 3)

(1) The light anti-armor vehicle will be a 15 - 25 ton vehicle.

(2) The heavy anti-armor vehicle will be a 40 - 50 ton vehicle, and will be the next generation of the main battle tank.

(3) The unmanned anti-armor vehicle would be light (3 tons and up). It would be complementary to the other vehicles and would be used to establish initial defensive positions to attrit the threat armor. This would preserve the manned vehicles for offensive action.

(4) A picture of the 2 piece articulated vehicle system is at Slide 24.

c. Requirements for ammunition firing, vehicle speed, and fuel consumption have been developed using historical data for the M-1 tank. Threat vehicle capabilities were provided by the DA Assistant Chief of Staff for Intelligence, DIA and the CIA.

d. The Army plans to prototype the new generation of combat vehicles in the years 1990 - 92 and field them 1995 - 96.

4. The new generation of combat vehicles will increase combat capability -- in firepower, survivability and tactical and strategic mobility. (Slide 5)

a. The new firepower which incorporate lasers and microwave technology will have full tank defeat capabilities.

b. Survivability will be enhanced by the vehicle's smaller size, increased mobility, new tactics and improved armor.

c. The goal is to effectively double the protection level of the next generation of combat vehicles. (Slide 16)

(1) One requirement is to provide protection against threat's sub-munitions.

(2) An additional requirement is to consider frontal requirements versus cardioid requirements.

(3) RAND Corporation is considering trade-offs between crew survivability versus vehicle survivability.

5. The RAND Corporation approach is to reduce the crew to 2 personnel. (Slide 7) This requires advanced task and crew function automation techniques.

a. This can be achieved by man-aided Artificial Intelligence/Robotics technology.

b. No manpower savings will be realized as personnel will be required for electronic maintenance, etc.

6. The man-aided Artificial Intelligence/Robotics Station will be a cooperative expert system (integrated AI modules) which perform selected crew functions in "real time." (Slide 10, 14)

a. AI aided crew functions will include:

(1) Target acquisition and engagement. Improve stationary target acquisition using sensors such as thermal imaging, microwave radar, and laser tracker.

(2) Command and Control.

(3) Maintenance and supply status. Provide diagnostics and prognostics.

(4) Situation reports and assessments. Pass information and reminders to the crew.

(5) Security status. Provide sentry functions.

(6) Navigational aid. Independent route assessment which would consider time and terrain and recommend an optimal math solution.

(7) Systems control.

b. The crew station will support the 2 man crew with a sophisticated man-machine interface consisting of 7 supporting AI modules. (Slide 13)

7. The armament will consist of either a larger main gun (greater than 125mm), an EM gun, or a hypervelocity missile. (Slide 15) Considerations include:

a. The need for an autoloader.

b. The weapon will be located external to the combat vehicle.

c. The weapon will have limited traverse (no greater than 180 degrees or perhaps as limited as 120 degrees.)

d. Ammunition will be stowed both internally and externally.

8. Propulsion. (Slide 18)

a. The combat vehicle will be powered by either a 1500 horsepower gas turbine engine or by an AIPS diesel engine.

05 MAY 1987

ATTG-B
SUBJECT: Summary of Future Combat Vehicle Concepts Briefing

Private industry leans towards the diesel.

b. Auxilary power will be provided by a 100 horse power gas turbine or rotary engine.

c. The engine will mounted in the rear. Mounting the engine in the front will cause the crew to lose most of their ability to directly observe outside the combat vehicle.

d. Half of the vehicle's fuel will be carried externally. When the vehicle goes into combat, the internal tanks are topped off and the external tanks are dropped.

9. Fire control will done by using thermal imaging, microwave radar, and/or laser tracking. Stabilization control will be undertaken. There are problems, yet to be solved, with indirect viewing, both for fire control and for vehicle operation. (Slide 20)

10. The RAND Corporation is continuing to work on the above seven modules to determine the best alternative for implementation. They expect to have a strawman completed before the end of the year and that additional actions will occur at that time.

Encls

BENJAMIN W. COVINGTON, III
COL, USA
President

I S S U E S

- Armor/Antiarmor Shortfall
- Long Range System Requirements
- 4:1 Line of Sight Battle

Slide 1

DARPA ARMOR - ANTIARMOR PROGRAM

- Armor Protection
  - Passive
  - Reactive
  - Active

- Munitions Effectiveness
  - Kinetic Energy
  - Chemical Energy
  - Enhanced Velocity

- Integrated Weapons Platforms

Slide 2

CONCEPT DEVELOPMENT

Light Antiarmor	15 - 25 Tons
Heavy Antiarmor	40 - 50 Tons
Unmanned Antiarmor	3 - ? Tons

Variant 2 - Piece Articulated System

Slide 3

CONCEPT DEVELOPMENT

Threat

Service Requirements

Technology

Concept Definition

Concept Analysis

Slide 4

INCREASED COMBAT CAPABILITY

- Firepower
  - -Full tank defeat capabilities
  - -Improved weapons array
- Survivability
  - -Smaller size
  - -Mobility
  - -Tactics
  - -Improved Armor
- Tactical/strategic mobility

Slide 5

RELATED PROGRAMS

Armored Family of Vehicles Study

M-1 Block III Program

U. S. ARMY Teleoperated Vehicle Programs

USMC Gator Program

Robotic Command Center Program

DARPA Autonomous Land Vehicle Program

Autonomous Ground Vehicle Technology

DARPA EML Program

Hypervelocity Missile Program

Sensor & Low Observables Technology

Slide 6

APPROACH

- Dramatic improvements in combat vehicle systems only by major reduction in crew size

- Requires advanced task and crew function automation techniques

- Achievable by man-aided AI/robotics technology

Slide 7

CURRENT CREW FUNCTION

Tank CMDR	O Leadership O Command & Control O TGT, ACQ, & TGT, Selection O Navigation
Gunner	O TGT, ACQ, & Engagement O Observation
Loader	O Loading
Driver	O Driving O Observation
All	O Maintenance O Refuel & Re-arm O 24 Hour Security

Slide 8

BMS INFORMATION NEEDS

(SURVEY)

- Critical Situatuion Alert
- Concept of Operation
- IFF
- Heading Reference
- Situation Reports
- Mission Orders
- Enemy Disposition
- Maintenance Status
- Supply Status

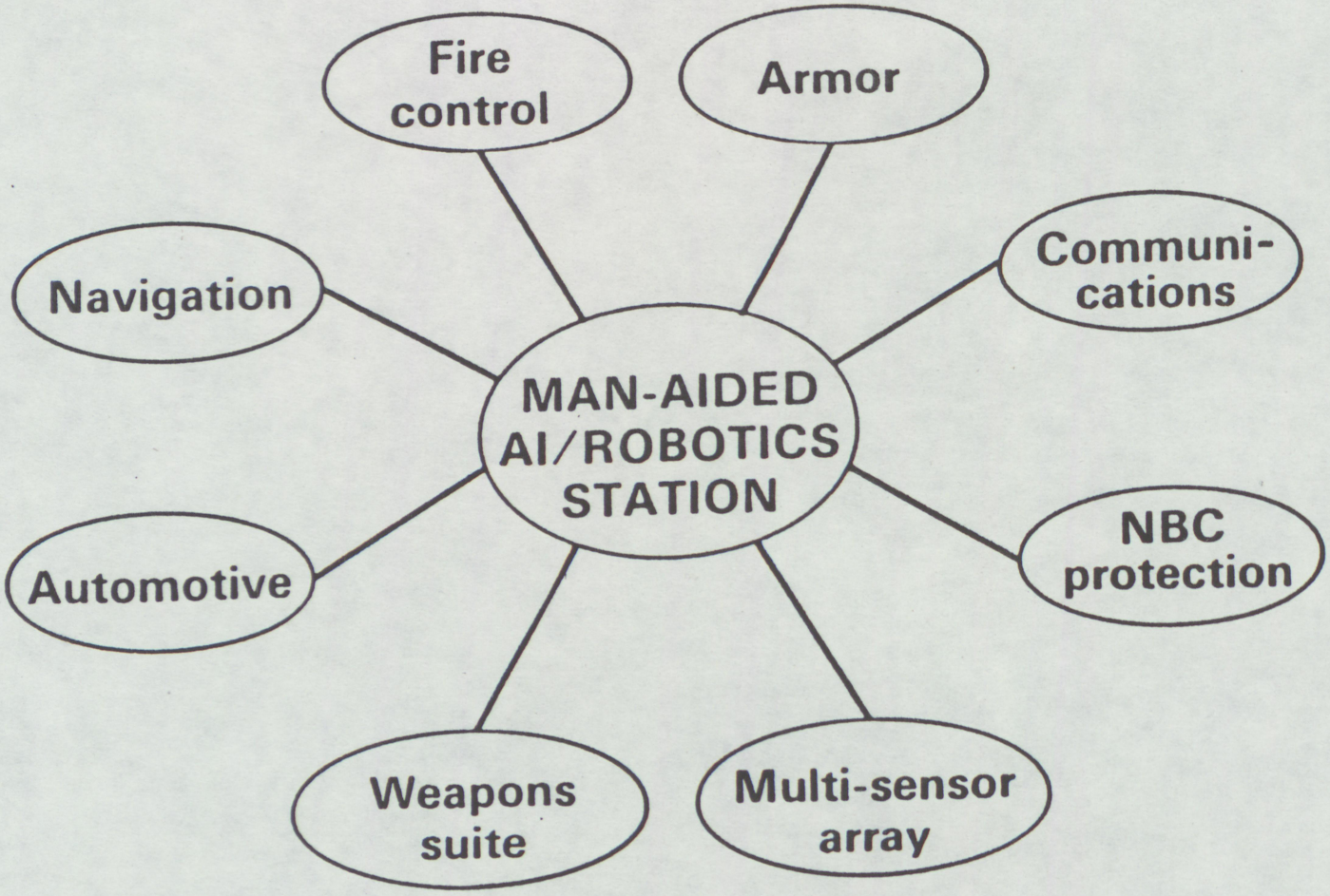
Slide 9

MAN - AIDED AI/ROBOTICS STATION

Co - operative expert systems (integrated AI Modules) which perform selected crew functions in "Real Time."

- Target Acquisition and Engagement
- Command and Control
- Maintenance and Supply Status
- Situation Reports and Assessments
- Security Status
- Navigation Aid
- System Control

TECHNOLOGY AREAS



Slide 11

TECHNOLOGY ASSESSMENTS

- Armament
- Survivability
- Propulsion
- AI/Robotics
- Fire Control

Slide 12

CREW STATION

2 Man Crew

Sophisticated Man-Machine Interface

7 Supporting AI Modules

100% Redundant Crew Positions

Slide 13

A I / R O B O T I C S

Target Acquisition and Engagement

Command and Control

Maintenance and Supply Status

Situation Reports and Assessment

Security Status

Navigation Aids

System Control

Slide 14

ARMAMENT

- Bigger Gun
- EM Gun
- Hypervelocity Missile
  - Auto Loader
  - External Weapon
  - Limited Traverse
  - Compartmented Ammo Stowage

Slide 15

ARMOR PROTECTION

Frontal - More than 200%

Cardioid Protection

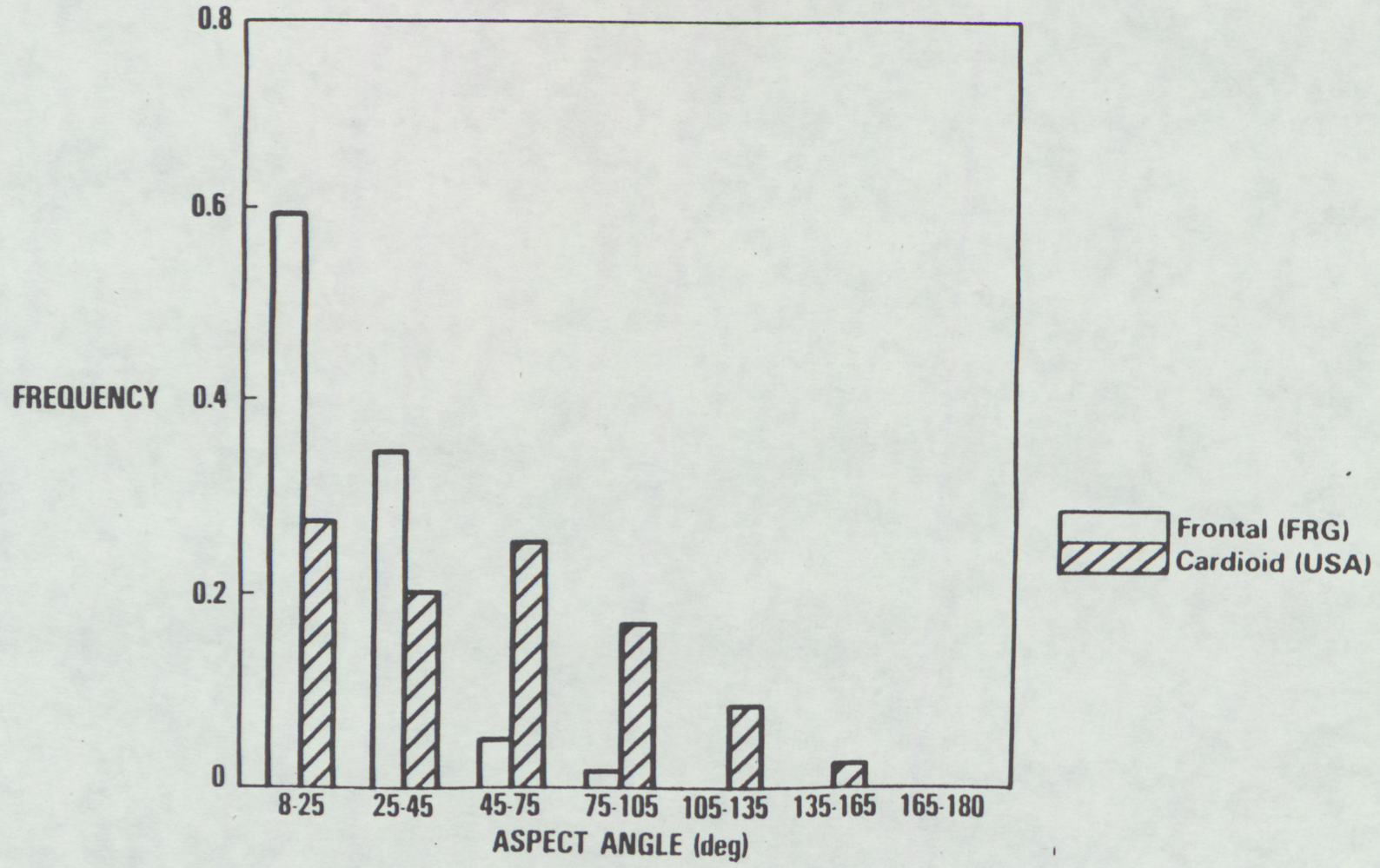
Top Protection for Threat

Internal Crew Protection

Slide 16

ATTACK ANGLE DISTRIBUTIONS

FRONTAL (FRG) VS CARDIOID



Slide 17

PROPULSION

Main Engine - 1500 HP Gas Turbine/AIPS Diesel

Aux Power - 100 HP Gas Turbine/Rotary

Power Conditioning & Power Distribution System

Rear Mounted Engine

Hydropneumatic Suspension

50% External fuel

Slide 18

MOBILIYT/SURVIVABILITY

- Shorter dash times (200 meteres - 17 Seconds) result in reduced exposure time

  -Fewer shots fired

  -More missile aborts

  -Increased system errors against gunner-lead fire control systems

Slide 11

F I R E C O N T R O L

Thermal Imaging

MMW Radar

Laser Tracker

Stabilization Control

Indirect Viewing

Slide 20

F I R E C O N T R O L

Thermal Imaging

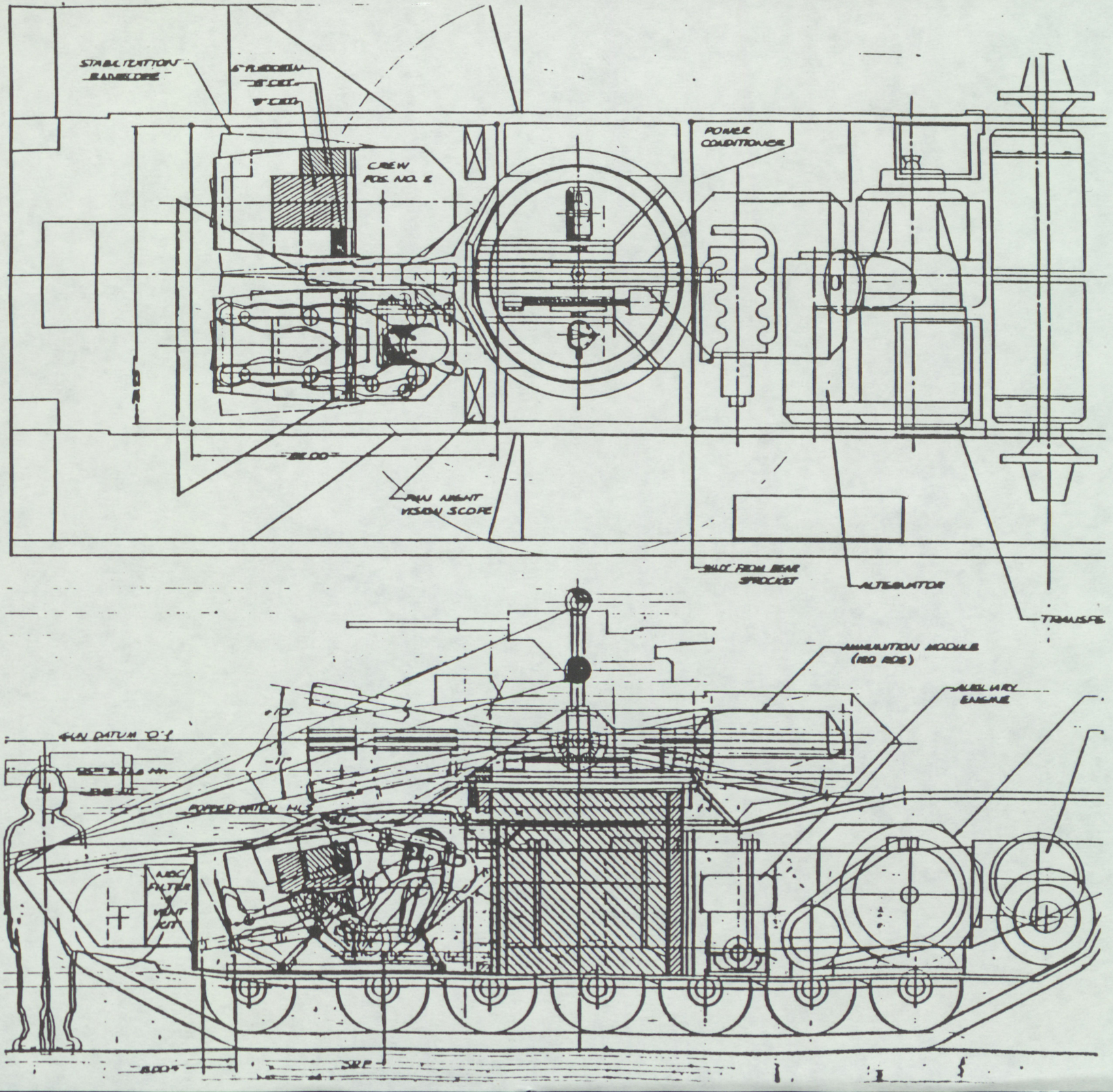
MMW Radar

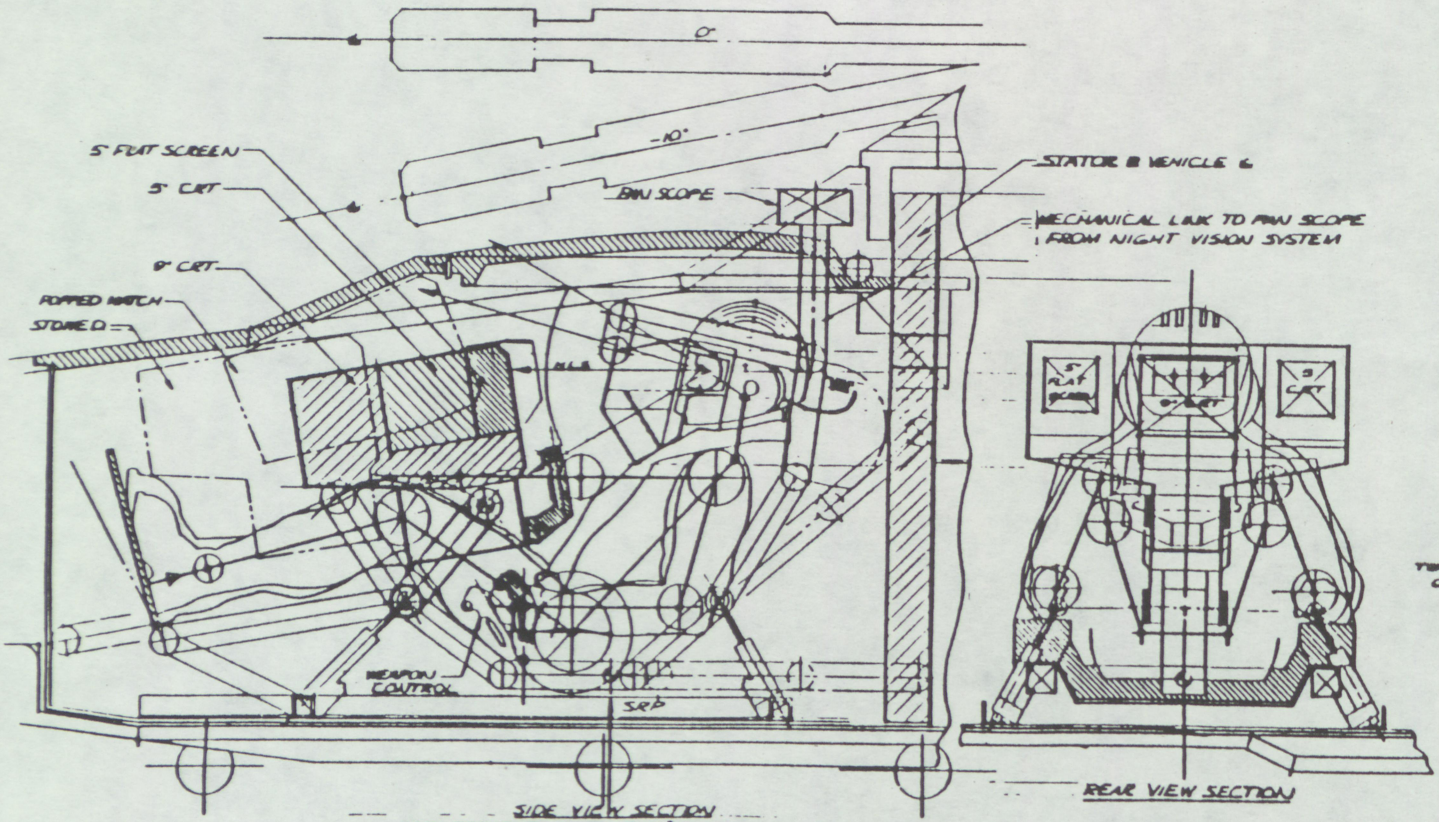
Laser Tracker

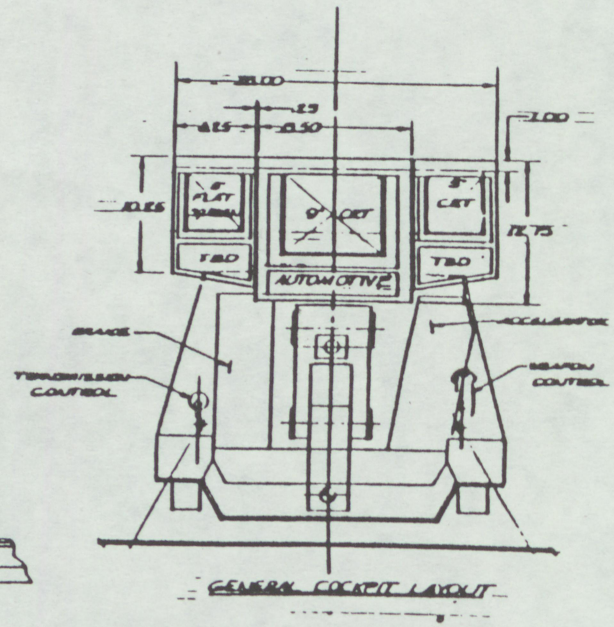
Stabilization Control

Indirect Viewing

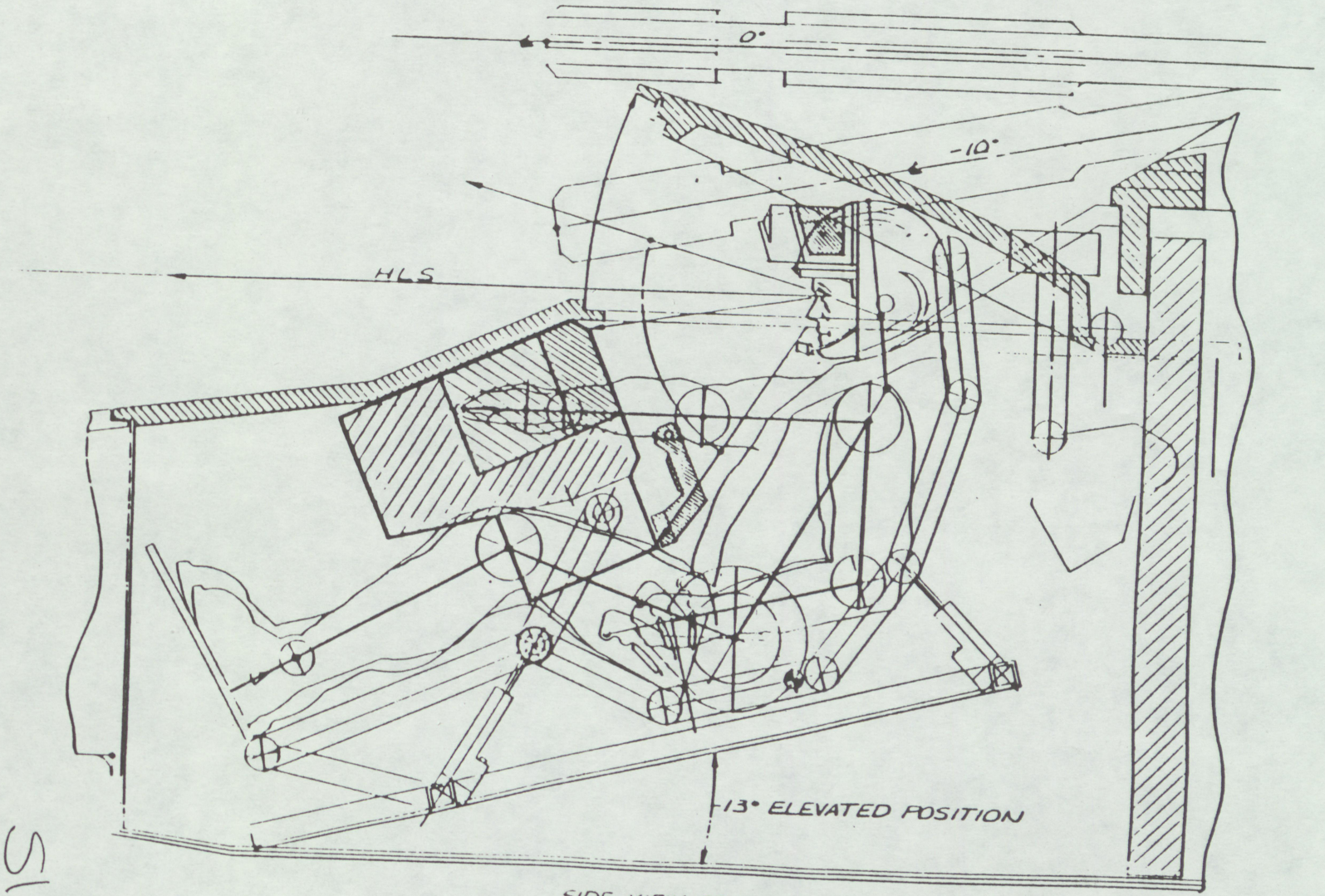
Slide 20


STABILIZATION BANDLOOP
CREW POS. NO. 2
POWER CONDITIONER
GUN NIGHT VISION SCOPE
AUXILIARY ENGINE
Slide 21


0°
-10°
5" FLAT SCREEN
5" CRT
9" CRT
POPPED HATCH
STOWED
PAN SCOPE
STATOR @ VEHICLE 6
MECHANICAL LINK TO PAN SCOPE
FROM NIGHT VISION SYSTEM
WEAPON CONTROL
SIDE VIEW SECTION
95TH PERCENTILE MALE IN CLOSED HATCH MODE
REAR VIEW SECTION

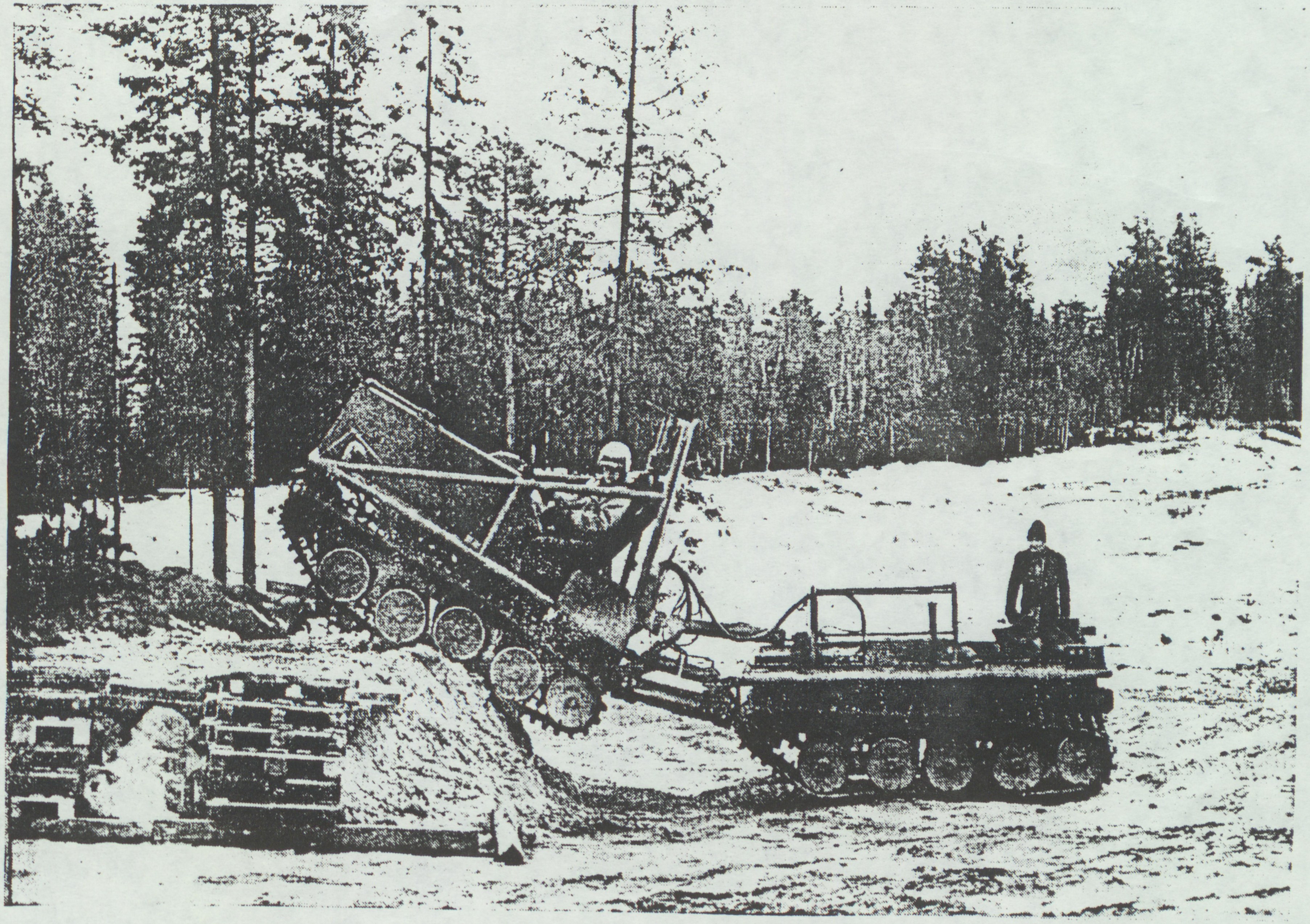

5" FLAT SCREEN
9" CRT
5" CRT
T.B.D.
T.B.D.
AUTOMOTIVE
BRAKE
ACCELERATOR
TERRAIN/USER CONTROL
WEAPON CONTROL
GENERAL COCKPIT LAYOUT

Slide 22



SIDE VIEW SECTION
95TH PERCENTILE MALE IN "POPPED HATCH" MODE

Slide 23



Slide 24