DYNAMIC CREW SIMULATOR OF BTR-3E1 ARMOURED PERSONNEL CARRIER

Intended use

APC BTR-3E1 Dynamic Crew Simulator is designed to execute BTR-3E1 crewmember's training objectives of units, equipped with armored personnel carriers, supporting the following:

a) Crewmembers individual training: familiarization with BTR-3E1 design, shaping of steady skills in preparation of APC's for intended use, target acquisition, BTR-3E1 armament firing, under all weather conditions, and various types of terrain;

b) Acquiring basic and advanced skills by drivers in driving over various types of terrain, visibility and weather conditions;

c) Simulator is intended to practice and master BTR-3E1 operator's and commander's skills in use of 30mm automatic gun, 7.62mm MG (PKT), 30mm Grenade launcher and ATGM firing;

d) Tactical training and synchronization of combat efforts of mechanized units in close to real battle conditions, including force-on-force battle;

e) Mechanized units training before tactical and field exercises with use 3D virtual terrain models;

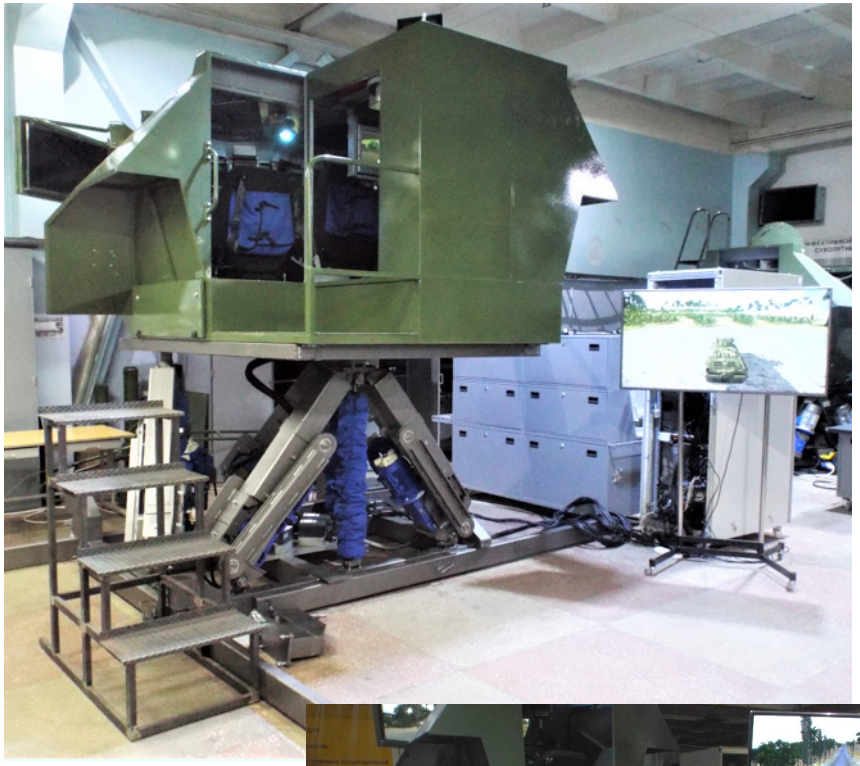
f) Intensity of combat training and increasing training level;

g) maintaining the necessary level of mechanized sub-units combat readiness during the whole training period.

Structure

Structure of the simulator

- Crew cabin simulator with 6DOF motion platform
- Instructor's workstation



Crew cabin simulator assembled in cabin frame is correspondent to BTR-3E1 APC fighting and driving compartments dimensions.

Instructor's workstation ensures control of training complex, communication with trainees, monitoring of trainees actions and managing training process

Motion system provides reproducing of APC hull inclinations during starting, breaking, turning, road running and overcoming of natural or manmade obstacles with respect to terrain, speed and dynamic characteristics of BTR-3E1 APC.

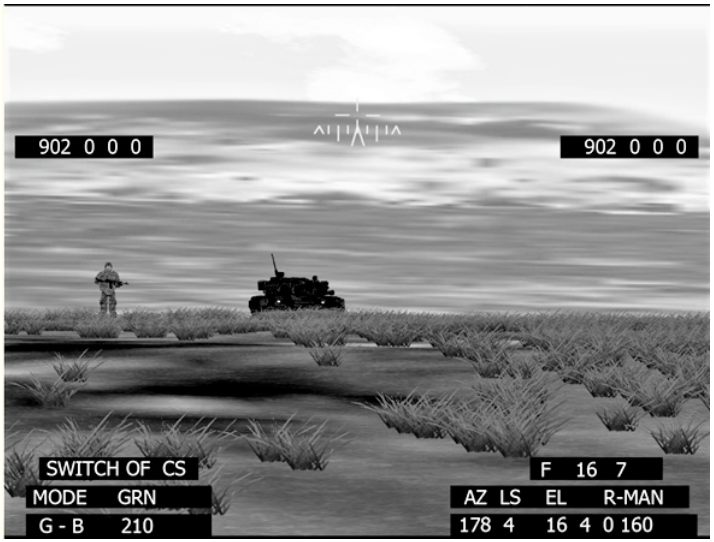
Feature	6DOF platform
Motor types	Asynchronous, short-circuit rotor
Motor drives control	Variable-frequency, velocity and position control
Pitch angle	+/- 24 deg.
Roll angle	+/- 24 deg.
Yaw angle	+/- 39 deg.
Heave displacement	+/- 110 mm
Surge displacement	+/- 300 mm
Sway displacement	+/- 300 mm
Axis stroke angle rate	0-20 deg./s
Steering signal accuracy	0,2 deg. per angle
	10 mm per position
Power consumption (mean)	6,20 kVA

Driver’s cabin compartment

Item, designation	Q-ty, pcs.
Controls and instruments mock-ups of Driver’s workplace	
Driver’s hatch	1
Driver’s observation port cover plate	1
Handle of driver’s observation port cover plate	1
Periscopic observation device TNPO-115	5
Removable night observation device TVNE-4B	1
Hydraulic distributor (block directional control hydraulic valve)	1
Windshield wiper	1
Fuel supply tap handle & fuel drain tap handle	1
Device RTS-27-3M	1
Dome light	1
Steering wheel	1
Driver's instruments board	1
Gear selector	1
Gear shift of TGC	1
Front axles and differential lock selector	1
Counter-roll system control	1
Parking brake lever	1
Foot-throttle	1
Brake pedal	1
Air pressure valve	1
Control unit of air pressure in tires	1
Unit BV-35T of driver’s communication set	1

Commander’s workplace

Item, designation	Q-ty, pcs.
Commander’s observation port cover plate	1
Handle of Commander’s observation port cover plate	1
Unit BV-34T of commander’s communication set	1
Periscopic observation device TNPO-115	1
Periscopic observation device TNPO-160	4
Commander’s observation monitors	2
Commander’s monitor (television-optical sight of fire control system)	1
Commander’s control console	1
Commander’s instruments box	1
Radio-station full-size replica	1
Fuse box	1
Device RTS-27-3M	1
Communication helmet	3
Fan	3
Sound system	1

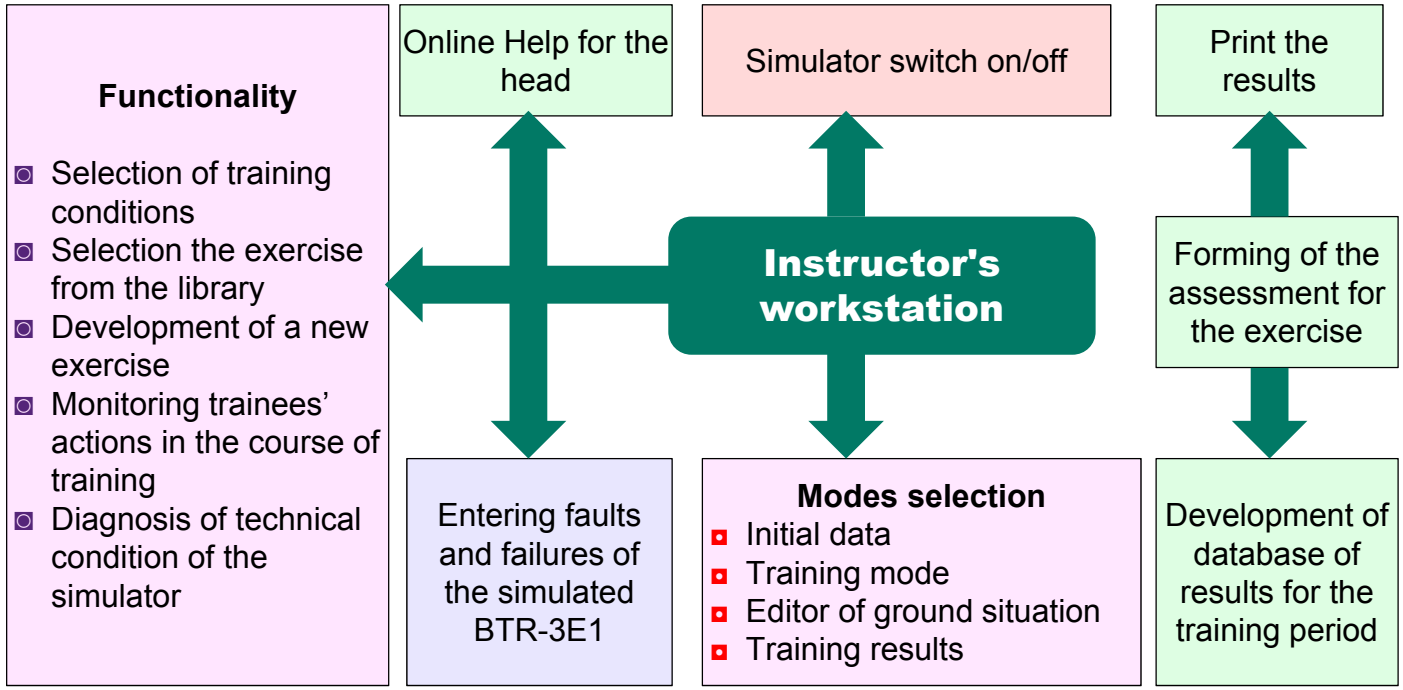


Operator’s workplace

Item, designation	Q-ty, pcs.
Operator’s monitor (television-optical sight of fire control system)	1
Operator’s instruments box	1
Operator’s control panel	1
Unit BV-35T of operator’s communication set	1
Air conditioner control unit	1
Fuel supply tap handle (fuel drain tap handle)	1
Equipment, set, including:	1
Communication helmet	3
Fan	3
Sound system	1

Instructor's workstation

The software of computing complex works under the Microsoft Windows operating system and has simple graphic interface.



Instructor's workstation provides

►Selection of training conditions and modes
►Registration of trainees
►Monitoring of trainee's actions and managing over the training process (corrective actions in the course of exercise, reiteration of exercise phases and tactical situations, change of training conditions)
►Forming the evaluation mark upon completion of the firing and driving exercises
►Analysis of trainee's actions during the training, performance evaluation of decisions taken by trainee during training
►Analysis of dynamics of trainee's skills
►Development of individual training programs
►Objective evaluation of crews' training level

Instructor's workstation monitors

Instructor’s workstation

Instructor’s table with big screen

UPS and computers in server cabinet

Controls on the Instructor’s workstation

Technical features

Adequacy

Simulator provides no less than 90% operational efficiency of ATC crew combat performance

- adequacy of training complex and real BTR-3E1 cabin dimensions and controls simulators and equipment arrangement
- full range of reproducible features of observation and sighting devices, controls and indications of APC
- adequacy of training complex travel ranges, efforts, steering, levers, pedals and hand-wheels responses to features of real APC (adequacy of human factors and body fields of training complex and real APC crew workspaces)
- adequacy of operation algorithm of devices and equipment in simulator in basic and emergency modes and feedback of trainee's actions
- rounds and bullets flight trajectory computation, based on ballistic characteristic of 30 mm automatic gun, 30 mm grenade launcher, PKT machine gun, ATGM and ammunition used
- AT guided missile flight trajectory computation in accordance with missile control loop features
- ground target hit accounting during simulation of firing of BTR-3E weapons
- target visibility computation, based on optic and electro-optical observation and sighting devices features
- adequacy of motion model of BTR-3E1 APC (engine power on different gears, transmission features, APC weight), considering the terrain relief (type and condition of a ground).
- adequacy of training complex and real BTR-3E1 engine run and firing sound effects
- reproduction of APC displacement angles during driving and acceleration effect during speeding up, breaking and turning

Driving cabin interior

Gunnery cabin interior

High quality of terrain and target conditions visualization

Training complex provides possibility of surveillance and firing with respect to optical visibility, range, target types and weather condition

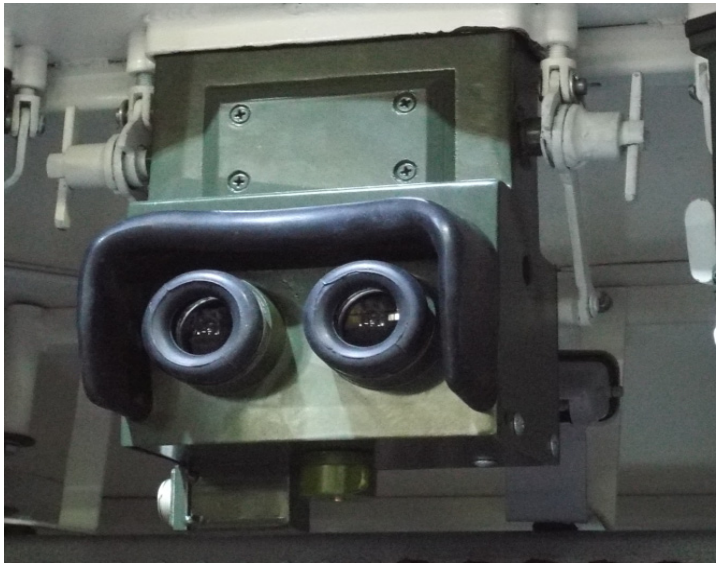
High quality visualization of background and target conditions achieved by following:

- using of LCD-monitors and HD matrix (1280x1024, 1920x1080, 2048x1536) in structure of optical aiming devices simulators
- detailed development of terrain relief
- compliance of color palette with the real background
- compliance of the angular dimensions, shape, color, contrast of local objects, plants, land targets with the real objects in the ATC optical devices field of view

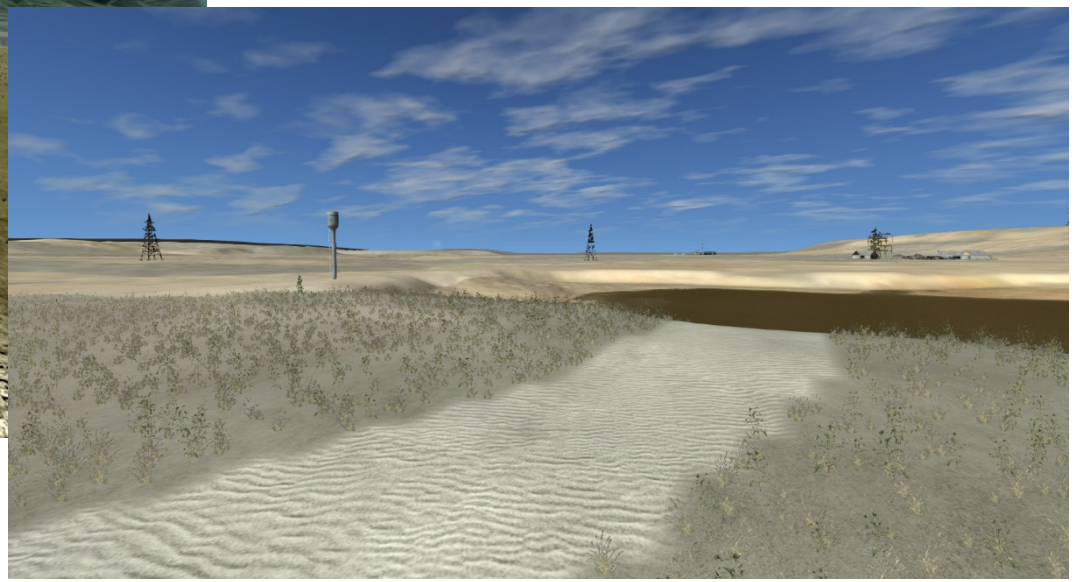
Commander sight

Driver's lockout view

Driver's night vision device



Visualization of the terrain in the simulator (examples)



Reliability

Simulator provides fault-free performance throughout operating life (warranty - 1 year, post-warranty – 7 years).

Training complex reliability assurance program based on following strategy:

- Use only proven and reliable parts (components), and its incoming inspection during manufacturing
- Development of program solutions, which make impossible collisions between special and general software and hardware
- Multiple inspection of developed engineering solutions
- Using of engineering solutions, witch provide mechanical engineering assemblies sustained
- Operational and phased quality control of mechanical and electrical assembling
- Using only contactless rotation and motion sensors (based on magnet sensitive microcircuits)
- Use of environmental protection means for electronic devises printed circuits and connector pins
- Use of industrial (protected) computers
- Use of uninterrupted power supply units for computers
- Maintaining necessary operating temperature conditions for training complexes facilities
- Providing the reserve power for power supply

Warranty and operating life

- The training complex guaranteed use period is 1 year considering restrictions for rules of operation and maintenance according to Operating Instructions Manual.
- The training complex operating lifetime is 8 year considering restrictions for rules of operation and maintenance according to operating instructions.

® Training complex provides continuous running within 12 per diem

® Training complex time before failures consist no less than 1000 hrs.

Operational characteristics

Simulator is designed for training, and it is easy to operate and maintain

No	Indicator name	Unit	Rated value
1	Minimum required space for setting	m^2	40
2	Type of premises	---	Classroom
3	Readiness upon actuation	minutes	Less than 15
4	Running time	hours	No less than 12
5	Electric supply: voltage	V	220±10%
	frequency	Hz	50±1
6	Peak demand	kVA	11,96
7	Average power consumption	kVA	9,94
8	High and limit temperature	°C	Up to +35
	Low temperature		Up to +5
9	Relative humidity at +25°C	%	Up to 80
10	Diagnostic system	---	Built-in, semi-automatic
11	Time before failures	hours	No less than 500
12	ON/OFF control	---	From instructor's workplace
13	SPTA set	---	Individual and common (per 10 training complexes)
14	Maintenance	---	Inspection, daily maintenance, MNT-1 (half-yearly), MNT-2 (annually)
15	Lubrication fluid	---	Motion platforms gear motor synthetic oil
16	Trainees' and service personnel' electrical safety	---	Avoiding dangerous voltage inside compartment simulators (DC, +5V, +12V, +24 V). Short-circuit protection
17	Accounting of operating time		Machine hour program counter
18	Assembled weight	kg	3 600
19	Operating instructions	---	Data sheet, operation manual, installation and field setting manual, SPTA Set List

Educative and methodical features

Educative and methodical features :

- APC drivers' individual training
- APC gunners' individual weapons practice
- Joint crews weapons practicing and tactical training

Possibility for development of training scenarios:

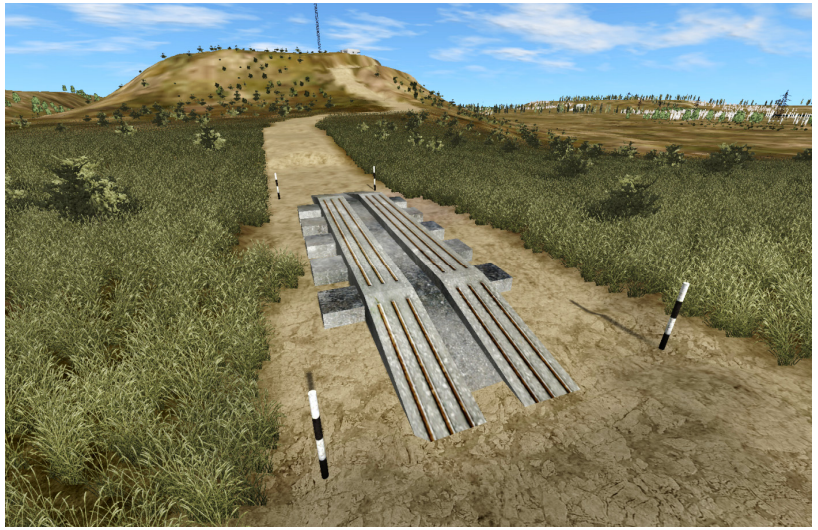
- 3D terrain model dimension: 8x8 km
- types of terrain: normal terrain, mountain terrain, gaunt landscape
- road types: soil, hard-surfaced, cross-country
- the time of day: daytime, twilight, night
- weather conditions: solar weather, overcast, rain, snow, wind with different velocities and directions
- season– summer, winter at the customer's request, according to conditions of geographic area of training)

Simulator synthesized terrain examples:
APC on the training area

Driver training features:

- Performing an exercises in full range of Driving Course, with automatic evaluation of trainee's actions
- Driving under different road conditions and in condition of cross-country during performing fire and tactical missions

Simulator synthesized terrain examples :
obstacle for driving



Gunners training features :

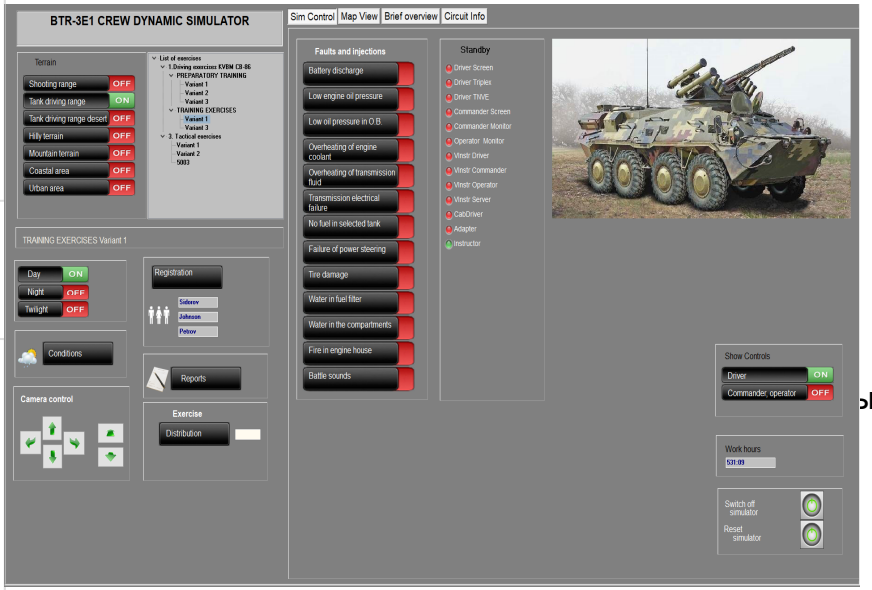
- performing an exercises in full range of Gunnery Course, with automatic evaluation of trainee's actions
- Dry shooting with gun, machinegun, grenade launcher, AT missile firing under various condition

Educative and methodical features

Trainees actions control features:

- by current positions of drivers' or gunners' controls and indicators
- by doubled drivers observation devices field of view
- by doubled gunners aiming devices field of view
- by position of APC from external camera
- by position of APC on the surface of a training area
- by drivers' and gunners' individual weapons training history
- by trainee's reports via communications means

Instructor's main menu



Evaluation of trainees actions features :

- automatic evaluation of driver's actions during performing driving exercises according to Driving Course' criteria
- automatic evaluation of gunner's actions during performing an exercises according to Gunnery Course' criteria
- subjective evaluation of trainee's actions based on all (or selected) control means analysis results

Gunner's controls monitoring display
(on instructor's workplace)

Creating of training conditions features:

- Selection of weather conditions for firing
- Selection of standard or development of new fire or tactical exercise
- Type of terrain, time of the day and season selection
- Enemy actions type selection
- Reiteration (multiply, if necessary) of exercise or situation
- Simulation of APC's equipment faults and failures

- Results documenting in e-format (printing, if necessary)
- Results archiving per day or per period

Utilization efficiency for mechanized units combat training

Fielding of training complex provides the following advantages:

1. Combat training basic principles realization

- Conduct technical, fire and tactical APC crew training of all motorized units, providing the educative and training process management
- Excluding pro forma during studies and trainings
- Development of training scenarios with conditions close to combat actions
- Providing the intensive training of all units personnel
- Ensuring the managerial and methodological relation of studies and training with the complex and field maneuvers, including live firing
- Providing the objective control of crews training and units coordination level
- Providing the study principle “from simple to complex”, realization of individual training approach, providing the study and training continuity

2. Combat training tasks solution

- Providing the real opportunity to shaping and maintaining required level of APC crew skills and combat coordination
- Teaching crews with use of different methods of combat operations in the unit, effective use of armament under complex conditions of combat situation, day and night
- Shaping commander’s skills to exercise control over units and firing control in the battle
- Preparing units for execution of effective and coordinated actions in modern battle
- Ensuring necessary level of crew proficiency throughout training period
- Training unit to conduct effective battle actions

3. Decreasing the expenditures for combat training by 70-80%, while keeping conditions of achievement of required training and combat coordination (cohesion) level