

T-72 tank dynamic integrated crew simulator



The main characteristics

- ◆ The design adequacy of the driving and fighting compartments
- ◆ Functional adequacy of the simulator's systems and equipment
- ◆ High quality of a visualization system
- ◆ 3D models of a tank driving range, a shooting range, and a tactical field
- ◆ 6DOF motion platforms
- ◆ Full package of exercises of the Driving Course
- ◆ Full package of exercises of the Gunnery Course
- ◆ Wide spectrum of scenarios for exercises and training events
- ◆ Unbiased evaluation of trainee's actions
- ◆ Training results documenting
- ◆ An interactive training class as part of the simulator's suite
- ◆ The capacity of combining tank units' simulators into single system

The simulator capabilities to train crews

individual training of tank commanders and gunners:

- ☐ weapon handling
- ☐ target reconnaissance
- ☐ firing from the tank weapon with all types of ammunition, including a guided projectile, against various types of targets, in the main and emergency modes, day and night, under various weather and ballistic conditions, on various terrain, from a spot and on move

tank driver-mechanic individual training

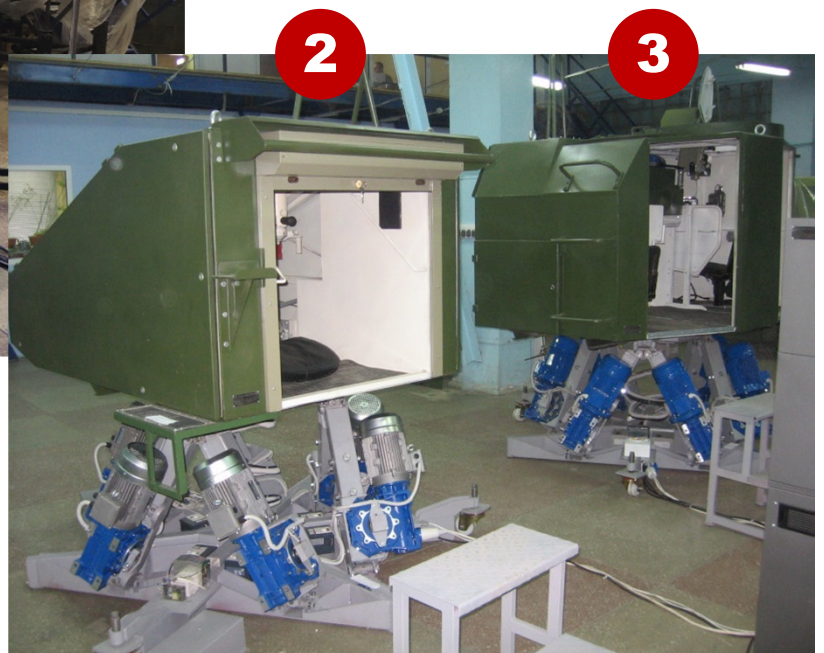
- ☐ driving in the full scope of requirements of the Driving Course
- ☐ driving tank on an unfamiliar terrain

crew collective training

- ☐ technical, reconnaissance, fire and tactical training of tank crews in the full scope of the combat training program
- ☐ performing a practicing and record exercises under requirements the Tank Gunnery Course
- ☐ performing of advanced fire and tactical exercises on a 3D model of a terrain under conditions of enemy return fire

The simulator structure

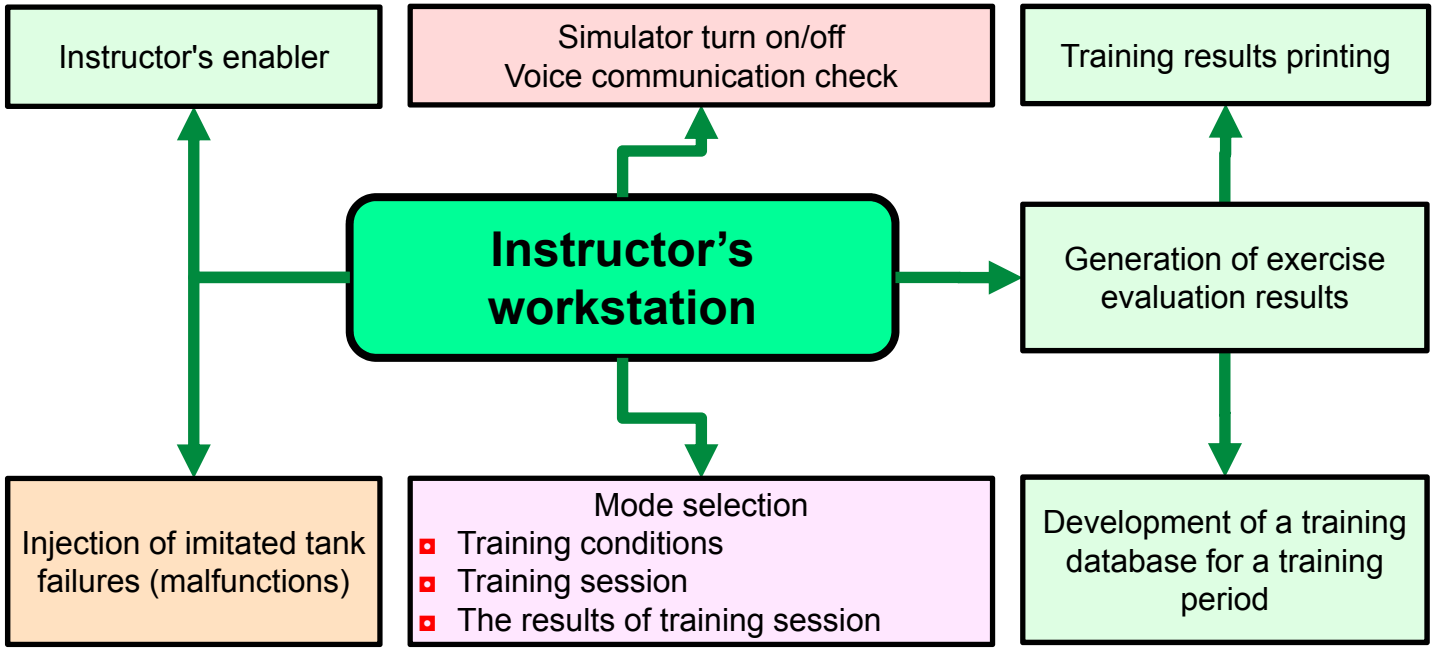
- 1 Instructor's workstation (including software and hardware suite)
- 2 Functional driving compartment mock-up
- 3 Functional fighting compartment mock-up



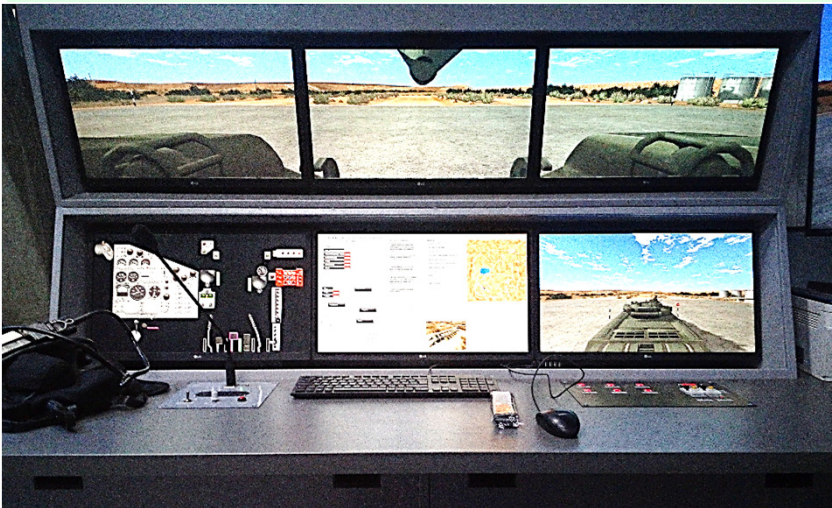
Simulator technical characteristics

№ seq.	Characteristics	Unit of measurement	Parameter's value
1	Quantity of simultaneously trained learners	---	3 (driver-mechanic, gunner, commander)
2	Minimum area of training class	m ²	40
3	Premises type	---	Classroom
4	Actuation time	min	up to 5
5	Duration of continuous work,	hours	at least 12
6	Electric	Voltage	220±10%
		Frequency	50±1
7	Maximum consumed power	kW	18
8	The range of operating temperatures	degrees C	from +5 till +40
9	Diagnostic system	---	In-build semiautomatic
10	3D model of tank driving range	km	4x4
11	3D model of tank firing range	km	2x5
12	Tactical field dimensions	km	8x8
13	Evaluation of trainees' actions and its documentation	Automated, following criteria and values of the Driving and Gunnery Courses	
14	The possibility to edit tactical scenarios	With the use inbuilt editor	
15	Number of video monitors at the manager's workstation	pcs.	6
16	Training scenarios (terms and conditions)	Day, night, winter, summer, dust storm, fog, various optical visibility range, temperature range from - 20° C up to +50° C	
17	Capability to enter (inject) tank equipment failures and malfunctions	---	Is implemented
18	Error-free running time	hours	at least 1000
19	Specified lifetime	years	at least 10
20	Warranty period	years	3

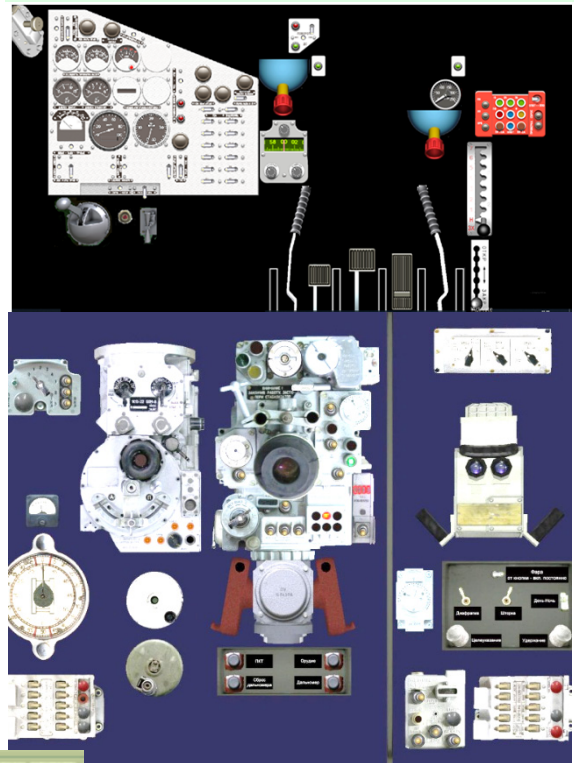
Instructor's workstation



Instructor's workstation monitors



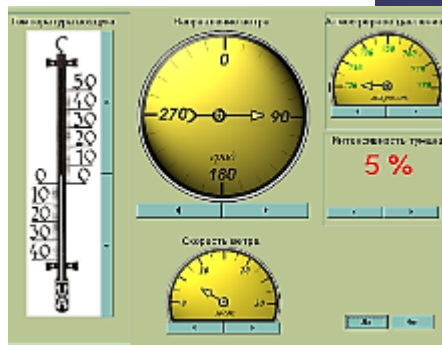
The monitor of the state of controls and indication means



External controllable camera view display at the Instructor's work station



Meteorological conditions setting menu



Functional driving compartment mock-up

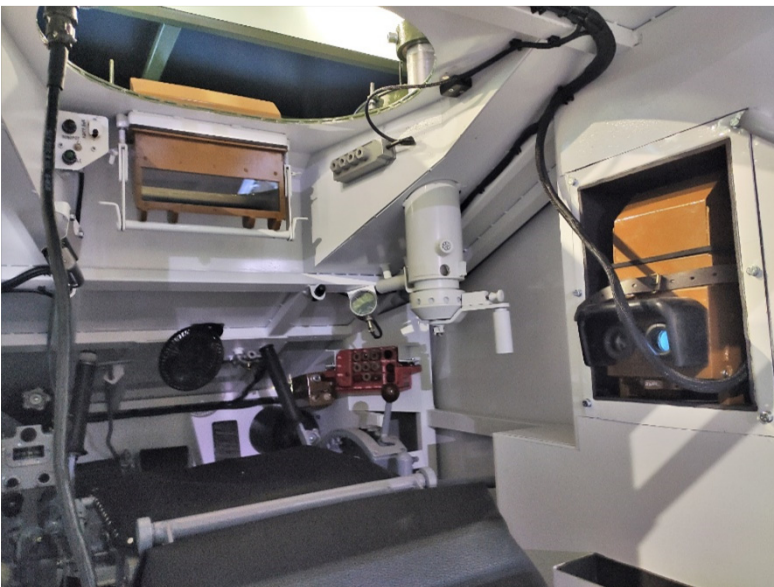
It is a cabin that is structurally and functionally adequate to the driving compartment of the T-72 tank, equipped with mock-ups of observation devices, controls, indication and signaling means.

The mock-up is mounted on a motion platform that reproduces the inclinations and accelerations characteristic of a tank movement under various terrain conditions.

The view of the functional mock-up of the driving compartment during classes



Placement of controls and indicators in the driving compartment mock-up



Driving compartment mock-up composition

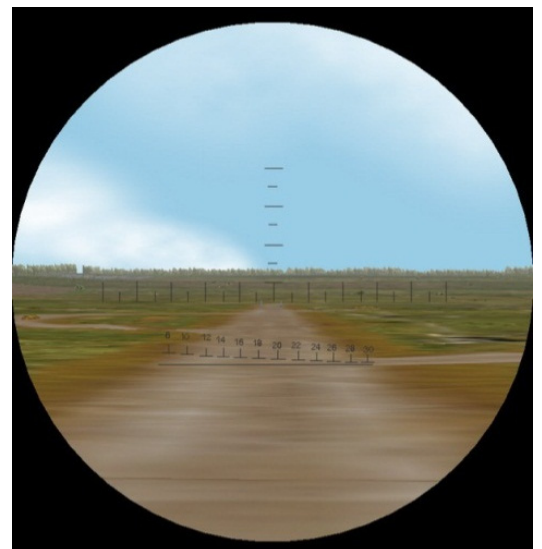
№	Title	Quantity pcs.
1	<i>The Simulator of Driving compartment</i>	1
2	<i>Controls and indicating means mock-ups, set</i>	1
	TNPO-168 observation device	1
	TVNE-4B night vision device power box	1
	Instruments panel	1
	Compressed air cylinder	2
	Hand fuel supply pump	1
	Fuel supply pedal	1
	Turning operating lever	2
	clutch pedal	1
	Throttle Pedal	1
	Gear shift lever	1
	parking brake	1
	Jalousie drive handle	1
	Fuel distributing cock	1
3	<i>Equipment, set</i>	1
	Combat vehicle crewman communications helmet	1
	Driver's seat	1
	Interior lamp	1
	Fan	1
	Audio system	1



Functional fighting compartment mock-up

It is a cabin that is structurally and functionally adequate to the fighting compartments of the T-72 tank, equipped with mock-ups of observation devices, controls, indication and signaling means.

The fighting compartment mock-up is mounted on a motion platform that reproduces the inclinations and accelerations characteristic of a tank movement under various terrain conditions.



The composition of the functional mock-up of the fighting compartment

№	description	Quantity pcs.
1	Controls and instruments mock-ups, optical observation and aiming devices mock-ups, indicating means mock-ups, set, including	1
	1A40-1 sighting system with stabilizer command console	1
	1K13-32 sight-aiming device (or night sight TPN3-49)	1
	Distribution box left	1
	Autoloader control box	1
	KA-1C block	1
	Control panel of Smoke grenade launch system	1
	Hand wheel of gun lifting mechanism	1
	Hand wheel of turret traversing mechanism	1
	Turret stopper	1
	Rounds of ammunition quantity indicator	1
	Azimuth pointer	1
	Breech assembly with breech block wedge handle	1
	Commander's observation device TKN-3B	1
	Autoloader command console	1
	Distribution box right	1
	Adjustments potentiometer	1
	R-123 (full-scale mock-ups) radio station	1
	Intercommunication system box	1
	PKT machine gun receiver	1
2	Equipment, set, including	1
	Headset with breastplate switch	2
	Commander seat	1
	Gunner seat	1
	doom interior light	2
	Fan	2

Motion platform

The 6DOF motion platform provides reproducing of tank tilts during movement following the terrain relief, gun-firing, as well as accelerating effects when pulling away, speeding up, deceleration and turns, collisions and when the tank mock-up is hit by an enemy fire



Characteristics of the 6DOF motion platform

№	Designation	Value
1	The the type of drives of motors	Asynchronous with short-circuited rotor
2	Driving motor Controls	Frequency by speed and position
3	Pitch angle	+/- 20 degree
4	Angle of heel	+/- 20 degree
5	Heave	+/- 100 mm
6	Angle of rotation around vertical axis	+/- 30 degree
7	Surge	+/- 300 mm
8	Sway	+/- 300 mm
9	Angular speed of movement along the axes	0-20 degree/sec
10	Accuracy of control signals processing	< 0,2 degree at the corners
		<10 mm positionally
11	Maximum consumed power, kW	6PD8 9.8
		6PD11 11.4

Adequacy

The simulator ensures the performance of at least 90% of the actions of the driver, commander and gunner of the T-72 tank

The design adequacy

- ☐ the correspondence of geometric dimensions of the compartments and the placement of mock-ups of observation and aiming devices, units and equipment of the T-72 tank simulator
- ☐ full resemblance of the front panels of devices and equipment mock-ups to the real ones, correspondence of equipment illumination, instrument scales, and tags to the T-72 tank
- ☐ the correspondence of ranges of movement, efforts and reaction of levers, pedals, switches, flywheels in the simulator to the characteristics of the T-72 tank
- ☐ the reproduction of tilt angles of the tank hull during movement and acceleration effects when speeding up, braking and turning, hull oscillations when overcoming obstacles and colliding with objects using the 6DOF motion platforms
- ☐ the use of a circular rotation turret race ring in the design of the motion platform of the fighting compartment cabin, which, in combination with 6DOF, ensures complete similarity of the rotation of a tank turret and an operation of a weapon stabilizer during scanning for targets, target designation and firing
- ☐ Implementation of all tank's optical prism observation devices and sights, including night vision devices

The functional adequacy

- ☐ adequacy of instruments' and equipment's functional algorithms on the T-72 simulated tank in the operating and emergency modes and the simulator response on controlling actions of trainees;
- ☐ the adequacy of the tank movement model, following a terrain features, type of soil, condition of the road surface; the adequacy of the dynamic characteristics of moving objects (targets) and the simulated tank
- ☐ the adequacy of a main gun and machine gun firing models, based on the correct accounting for the effect of barrel wear, type of ammunition, wind speed and direction, atmospheric pressure, air temperature and charge on the range of projectiles and bullets;
- ☐ conduct of surveillance with use of optical and optoelectronic devices and all kinds of ammunition firing following optical visibility, obscuration of optical observation devices field of vision, the hull inclinations during movement and gun firing;
- ☐ adequacy of visual, sound and dynamic effects of simulator operating and firing of various types of ammunition
- ☐ accounting of terrain conditions, time of a day, season, air temperature

Reliability

The simulator ensures reliable operating during whole exploitation period (warranted and post-warranted period)

Reliability-assurance program is based on the following principles:

- use of proven by exploitation, the best quality and reliable components together with their incoming control
- program solutions development that exclude conflicts between specific and general software, as well as conflicts between software and hardware elements
- multiple repeated check of design solutions that provide long-term lifecycle of mechanical nodes
- Application of design solutions, ensuring protracted work of mechanical nodes
- functional and phased check of quality of mechanical and electrical simulator assembly
- use of non contacting angle of rotation sensors (based on magneto sensitive microchips)
- use of protective means of print boards of electronic devices and connectors from environmental affects
- use of industrial computers
- Use of uninterrupted power supply units
- ensuring of required simulator hardware thermal conditions
- providing power margin of power supply equipment

Service life and warranty period

- Service life of Simulator (the life cycle of Simulator) is 3 years, under condition of strict adherence of Operational Rules, and proper maintenance and repair in accordance with Operational Documentation.
- Service life of Simulator is 10 years, under condition of strict adherence of Operational Requirements, proper maintenance and repair in accordance with Operational Manual.

® Simulator ensures continuous operations for 12 hours a day

® Error-free running time is 1000 hours

Visualization

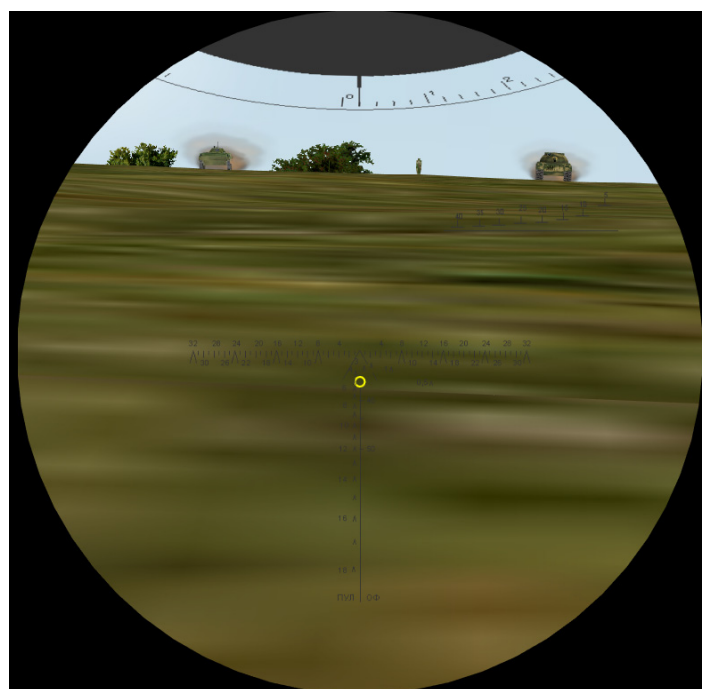
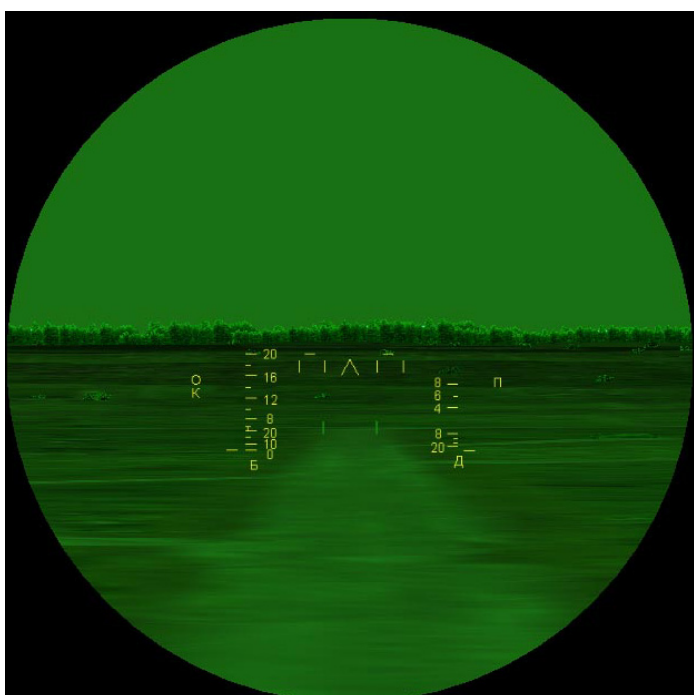
The simulator provides the possibility of visual observation and shooting, taking into account optical visibility, range and type of targets, weather conditions

High quality visualization of the target and background environment is achieved due to:

- extensive capabilities of the visualization program for creating dynamic scenes
- the use of liquid crystal monitors and high-resolution matrices in simulators of optical aiming and observation devices
- creating three-dimensional detailed models of real terrain areas with summer and winter textures, as well as detailed three-dimensional models of tanks, IFV and APC, infantry groups, anti-tank systems and artillery pieces, grenade launchers and machine guns
- matching the color gamut of terrain textures and objects to real colors and contrast, matching angular dimensions, shapes, local objects, vegetation, ground targets to real objects in the field of view of optical observation devices
- close to the real display of the external situation in the field of view of optical observation devices and aiming of the driver, gunner and commander in statics and in dynamics at the driving range, a shooting range, at the tactical field
- displaying aiming marks and service information in the field of view of optical sights and observation devices, taking into account their optical characteristics, visibility range, weather conditions, time of year and day
- reproduction of physical effects (dust, traces of caterpillars, flame of a shot, tracers of shells) during simulation of the movement of tank firing on the terrain

Field of view of night sight TPN-1-49

Field of view of gunner's 1A40 sight on instructor's workplace



Examples of visualization of terrain and objects in sights and observation devices of Simulator

View from the external camera on the instructor's workplace





**Simulator developer and manufacturer:
Research and Production Company "Energy 2000"
94A Povitroflotskyi ave., Kyiv, 03151, Ukraine
info@simulator.ua
www.simulator.ua**

The developer and manufacturer of the simulator provides:

- ☐ manufacturing of the simulator and its delivery to the place of use for the intended purpose
- ☐ assembly, adjustment (tuning) and acceptance tests of the simulator on the site of use
- ☐ training of technical personnel of the Customer
- ☐ warranty service
- ☐ post-warranty service, subject to a separate contract