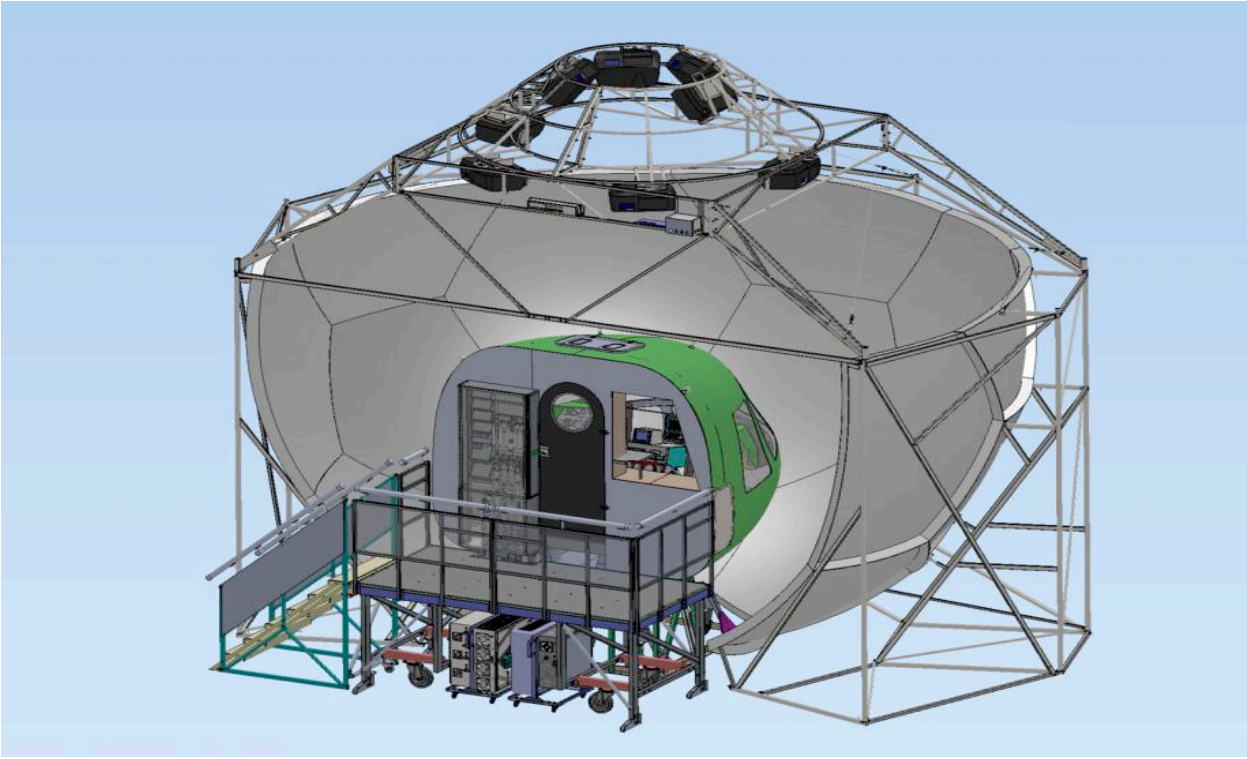
TECHNICAL PROPOSAL



Flight Training Device (FTD)
Mi-171 helicopter

2025

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1. PRINCIPAL PROVISIONS OF THE PROPOSAL

- Manufacturer reserves the right to engage contractors to perform contract works;
- Manufacturer provides the Customer with the full list of the engaged contractors and equipment, services and other components purchased from them;
- Manufacturer provides maintenance of the manufactured simulator in accordance with the Contract;
- Manufacturer provides training of the simulator maintenance staff (including instructors) in the scope necessary for its operation. The training site should be agreed with the Customer.
- Manufacturer provides uninterrupted technical support of the simulator within the period specified in the Contract. Technical support includes adjustment and tuning of the equipment and provision of information required for the simulator operation.
- Manufacturer provides the Customer with information on all updates, expansions and alterations made in the software and in the equipment of the supplied simulator.

2. GENERAL PROVISIONS

2.1. The helicopter simulator Mi-171 will be used as a simulation object.

2.2. The helicopter simulator Mi-171 will manufactured in compliance with the requirements of the EASA "CS-FSTD(H)" document as of 2012, Aeronautical Personnel Training Guidance Material (Doc. 9868 (ICAO)), Training Manual (Doc.9683 ICAO).

2.3. The simulator allows flight crews to train all the flight modes, including emergency and abnormal situations (to simulate the equipment and system failures specified in the Flight Manual (FM)). The scope of training is determined by the curriculum and the flight crew training, recurrent and proficiency training programs elaborated by the Customer.

2.4. The simulator enables imitating operation of the full set of the onboard equipment.

2.5. The simulator provides management of the simulated ambient environment parameters (possibility to change wind direction and speed, temperature, pressure, visibility, etc. in the airport area and enroute).

2.6. The simulator enables performing the training using Line Oriented Flight Training (LOFT) and Crew Resource Management (CRM) programs.

3. SIMULATOR ACCEPTANCE PROCEDURE

- The simulator shall pass the factory tests at Manufacturer premises (Kremenchug).
- Participation of the Customer's representatives is obligatory.
- After the tests are completed, the bilateral Report shall be signed.
- The final installation (assembling, tuning and adjustment) of the simulator shall be performed on the End user's premises by the Manufacturer engineering and technical staff.
- After the simulator is installed, the acceptance tests shall be performed on the End user's premises.

4. SIMULATOR DESCRIPTION

MI-171 HELICOPTER Flight Training Device manufacture is an efficient means of the flight crew training and maintaining of its qualification level. It enables performing both special and individual training programs.

4.1 SIMULATOR CONCEPT

The following principles lie in the basis of the simulator construction:

A) **Open architecture**. It enables:
- using different IBM compatible computers and other standard components to enhance simulator reliability and performance characteristics
- using standard data exchange protocols
- organising the interaction of the simulator software modules with regard to the implemented configuration, including number of workstations and the performed procedures.

B) **Object-oriented development**. It enables:
- expanding the simulator functionality by adding the required hardware and by adjusting the software modules already available in the installed simulator environment.

C) **Integrated approach**. It enables:
- simulating a broad range of systems and equipment used in the helicopters operation;
- integrating several simulators into a single integrated training system.

4.2. SIMULATOR DELIVERY SET

The simulator delivery set includes:
- helicopter simulator cockpit
- control loading system
- instructor operating station (IOS)
- remote instructor operating station (RIOS)
- digital computer (DC)
- acoustic noises simulator (ANS)
- intercom simulator (IS)
- visual system (VS)
- video surveillance system (VSS)
- video signal transmission system
- electric power supply system (EPS)
- common software
- special software
- operational documentation
- spare parts, tools and accessories
- packing set

4.3. ACCOMPLISHED TASKS

The FTD enables practicing flight crew actions in normal, adverse and emergency flight situations on a real-time basis in accordance with the Mi-171 helicopter flight manual. The simulator **enables:**
- flight crew initial training
- conversion training and type rating approval
- periodic quarterly training
- operating crew members proficiency training
- seasonal training
- refresher training after interruption in flights
- pilot's licence renewal

At customer's option it is possible to realize formation flight.

The simulator is intended for **meeting the following objectives:**
- familiarization with the cockpit equipment

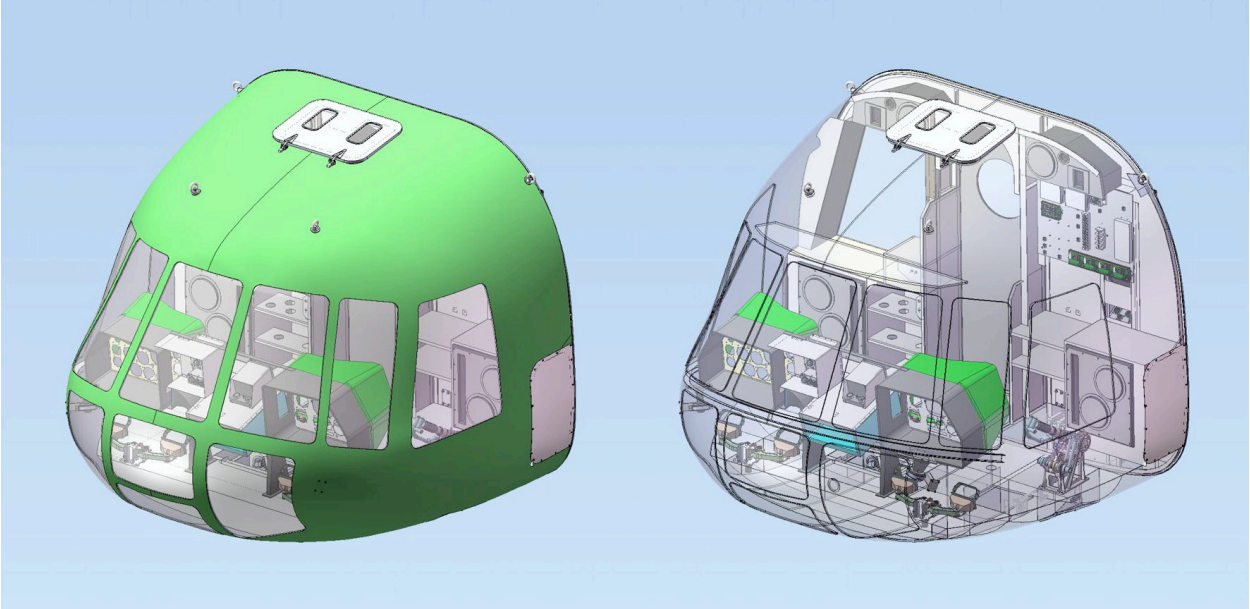
- avionics sets and systems operation at all flight stages
- practicing the attention allocation skills when performing different flight stages (including IFR)
- practicing the attention allocation skills when performing different flight stages (including IFR).
- practicing the visual reference skills during the enroute flight
- enroute flight using the radio and radar aids
- navigation management while performing the VFR and IFR flights
- duplex radio communications with the ground control station and other crews
- landing area selection from the air for landing in the day- and night time, and also in the mountains
- landing with regard to the wind direction in the day- and night time, and also in the mountains
- landing using flight and navigation aids, radio and radar aids in different visual conditions
- practicing crew actions in adverse weather conditions
- practicing crew actions in emergency and difficult flight situations, including the rare ones and those dealing with the onboard equipment, systems and instrument failures

The simulator ensures practicing the actions at the following **flight stages:**

- pre-flight checkout and cockpit inspection
- launch preparation
- engines start
- taxiing
- takeoff
- climbing
- level flight
- hovering
- helicopter handling
- enroute flight using radio navigation aids
- descent
- emergency descent
- holding pattern
- approaching
- landing
- engines stop

4.4. SIMULATOR COMPONENTS

4.4.1 COCKPIT WITH INSTRUMENT PANELS



The simulator cockpit represents a full-scale cockpit replica (standard cockpit) of the simulated helicopter as to its type, shape and arrangement of:

- crew seats (including the safety belts)
- controls
- equipment, systems and instrument panels (including their lighting)
- cockpit illumination
- windshield components

4.4.2 CONTROL LOADING SYSTEM

The control loading system ensures feasibility of feels and tactile cues applied to the controls.

The controls displacement on the simulator shall correspond to that on the aircraft.

4.4.3 IOS/RIOS

The Instructor operating station is situated inside the cockpit behind the pilots' seats and enables observing their actions. From the IOS it is possible to edit the exercises in the course of their performance, to enter the failures, to change the weather and to fulfil other components of the training tasks.

The Instructor operating station (remote) is installed outside the simulator cockpit and ensures the capability to perform an overall control over the exercise creation and editing, inputting the failures, and performing the training exercises. The RIOS allows displaying the flight visualization from different angles, instrument panels, and performing the video surveillance over the pilots.

There is a capability to use IOS and RIOS simultaneously; the priority shall have commands and actions received latter.

IOS consists of:

- a monitor
- a headset

RIOS consists of:

- monitors for displaying:
- data from the video surveillance system
- beyond-the-cockpit field
- instrument indications
- flight map
- weather conditions
- a list of failures and abnormal flight situations
- computers
- a printer
- audio system with speakers, microphone and a headset.

From the RIOS an instructor can fulfil the following tasks

- to create a new exercise
- to select an earlier created exercise

- to select the means for performing the exercise (including radio aids)
- to set up the departure time and date, the route
- to set up the aircraft performance characteristics (take-off weight, fuel weight, center-of-gravity parameters)
- to set up the weather conditions:
  - visibility
  - wind direction and speed, windshear
  - amount and shapes of the clouds
  - the clouds base and top temperature and pressure
- to set up hazardous weather conditions
- to generate the aeronautical situation:
  - to set up and edit the route waypoints;
  - to set up the motion paths and positions of other aircrafts

During the exercise there is a capability:

- to pause and to resume the exercise
- to exercise an overall control over the exercise fulfilment process (position of the controls, readings of the flight and navigation devices and engine monitoring instruments, etc.)
- to change positions and routes of other aircrafts, to manage them during the exercise fulfilment (to move any aircraft to another position at one's own choice and to set up the required speed)
- to enter faults and failures of the onboard systems
- to change and manage the weather conditions
- to stop the exercise conduct

After the exercise has been completed, there is a capability:

- to use the flight data recorder for analysing the results of the session and of the exercise completed by each trainee
- to stop the playback of the completed exercise in any place of interest and resume the playback from this point at any workplace, or save the situation as a new exercise

The IOS/RIOS ensures the following communication modes:

- communications between the instructor and the flight crew
- auditing of the flight crew conversations between each other
- auditing of the onboard systems audible warning by the instructor/ operator

4.4.4 DIGITAL COMPUTER

The Digital Computer (DC) is based on IBM compatible technologies which enable high reliability, low cost and easy to handle with maintenance. Dynamical interhost
connection is based on standard network devices that provide the required rate of information transmission in real time mode.

The DC consists of:

- system units
- a KVM switch
- a network switch
- a computer rack
- licence keys.

The DC hardware is installed in a computer rack situated in a server room separate from the simulator cockpit. The computers are launched automatically with turning on of the supply system, and turned off from the instructor operating station or from the service panel situated in a computer rack. For ease of maintenance, each computer name is written on the front side of the system units and on their rear

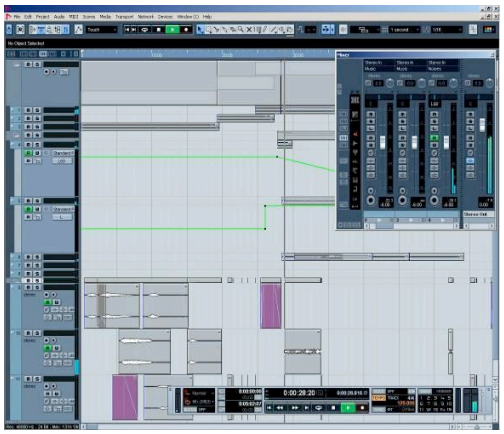
panels inside a computer rack. A software protection dongle plugged in a USB connector and permitting the supplied licensed.

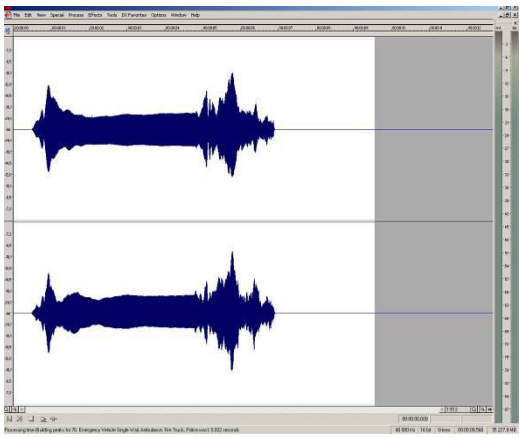
A software protection dongle plugged in a USB connector and permitting the supplied licensed simulator software to be used on this computer shall be installed on each computer.

A KVM switch has only a service panel, containing a monitor, a keyboard and a touchpad, which can be connected to any computer.

4.4.5 ACOUSTIC NOISES SIMULATOR

The acoustic noises simulator provides realistic reproduction of sounds and noises in accordance with the acoustic noises model, as well as the simulated flight conditions and failure situations.





The simulator consists of:

- a computer equipped with a soundboard
- sound amplifying equipment
- acoustic noises projectors (speakers)

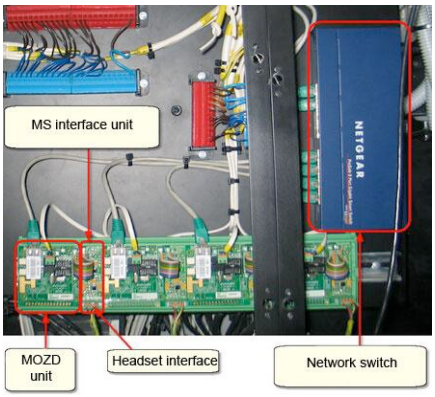
The acoustic noises projectors shall be allocated in the simulator cockpit with regard to the direction of sound propagation on the actual helicopter and shall not dislocate the cockpit interior.

4.46 INTERCOM SIMULATOR

The intercom simulator is intended for imitation of the internal and external communications, and for the output of the simulated voice warning system.
The simulator consists of:

- GSSh-A-18E standard helicopter headsets with interface devices
- MODZ units and MS interface units
- intercom communications network switch.

MOZD units, MS interface units and the intercom network switch shall be accommodated in a box behind the left pilot.



Intercom simulator technical characteristics:

- Number of the crew members using the intercom shall be not more than 4.
- The frequency range of the internal and external communication paths shall be 300-400 Hz.
- The system is supplied with 12-24 VDC.
- Power consumption is 10 W.

4.4.7 VISUAL SYSTEM

The visual system provides realistic presentation of beyond-the-cockpit field while performing the exercise.
The system components are as follows:

- Aurora software
- System of projectors
- Dome projection screen
- Visual channels alignment software
- Visual system computers

Aurora software
The software provides:

- a detailed and realistic landscape presentation based on the map data, aerial survey and a large surface and objects database, which allows modelling of different types of the terrain surface in various seasons;
- visual presentation of runways and taxitracks with the appropriate marking, informative signs, runway edge lights, airport buildings, aprons, hangars and the airport equipment;
- high density of the scene objects;
- visual effects of atmospheric phenomena: rain, snow, fog, etc.;
- visual effects of clouds of different types and density;
- modelling of the time of day, including celestial bodies location, realistic reproduction of sunrises and sunsets, reference to the lunar phase and eclipses;
- modelling of the water surface with realistic effects of waves, reflection, flares, sun and moon glades;

The visual system provides modelling of static and dynamic objects images, generated from the object libraries.

Static objects

The scene can be supplemented by an unlimited number of static objects. At the moment, the database contains more than 7000 virtual 3D models. Most of them are type buildings, bridges, berths, port and airport facilities. To achieve high realistic representation and recognition of the area, unique objects can be created on the photo and video basis. Approximately 100 static objects can be viewed in the visible area.

Dynamic objects

The dynamic objects can move along the scene during the exercise performance. Movement can be performed enroute or in compliance with any scenario. Approximately 30 dynamic objects can be viewed in the visible area.
The dynamic objects include:

- fixed and rotary wing aircrafts;
- ground transport modes;
- sea and river vessels, etc.

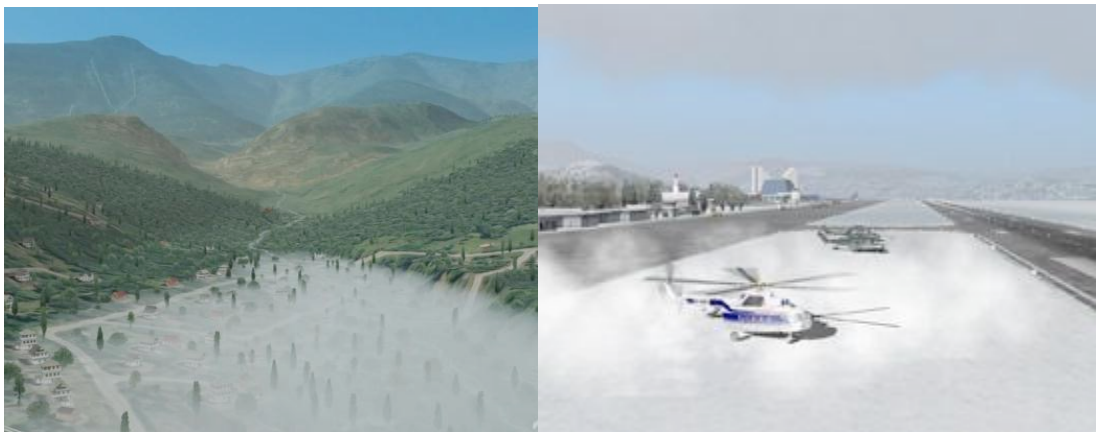

Illumination

Change from day to night, and the other way round with twilight in between is gradual and realistic. The objects in the displayed scene are viewed with shades appropriate to the time of the day, distance from the own helicopter and visibility level (visibility dependent shading).


Sun dependent shadowing
All objects in the scene (including the sea surface, but except the lights) are shadowed depending on the sun position, with regard to its elevation, and the object's azimuth and orientation.

Lights
Lights have the following parameters: colour, sectoring, flash characteristics and visibility range. Light intensity and size change according to the distance from the helicopter itself and visibility conditions.

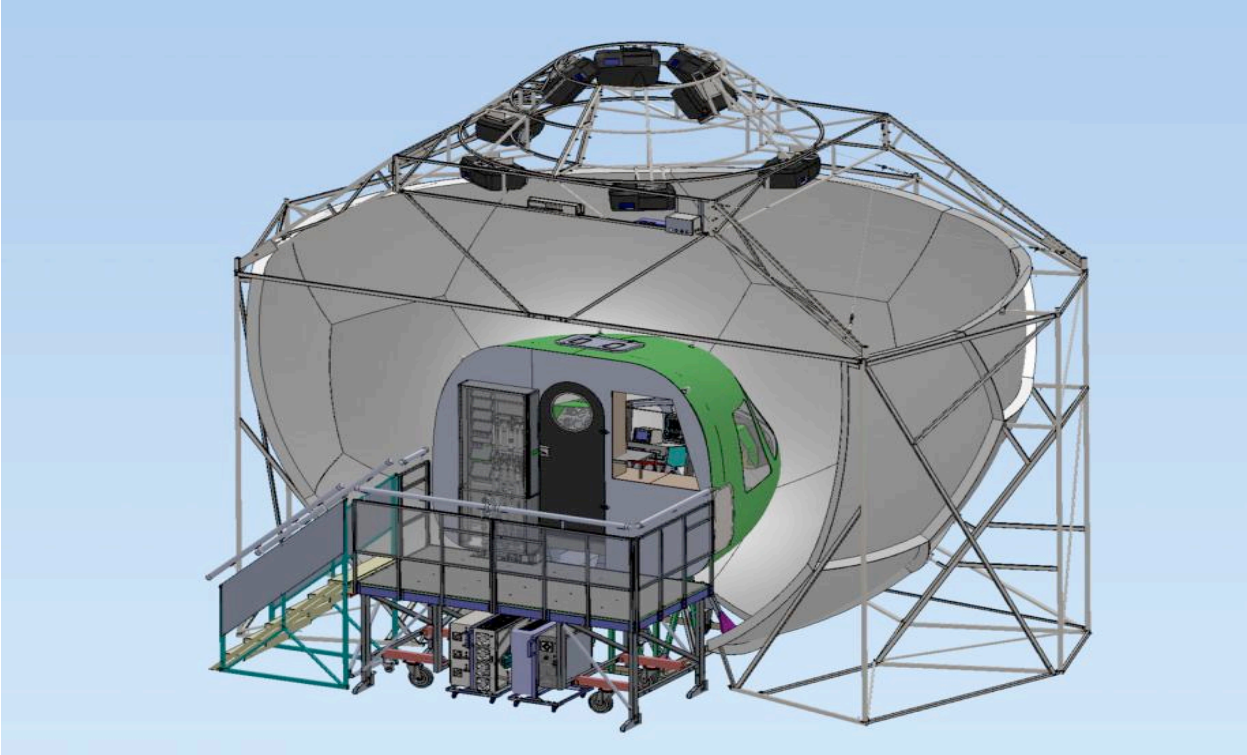
Local visibility areas
The visual system provides the display of local reduced visibility areas provoked by fog, clouds, or rain. Fog, clouds and rain characteristics can be set from the IOS/ RIOS and can be changed during the exercise.



Projection system

The visual projection system onto a dome screen provides the following characteristics:

- resolution not more than 1400 1050 per channel, at least 3 ang. min. per pixel
- number of colours - 16 mil.
- delay time not more than 150 milliseconds
- view angles:
  - horizontal - at least 180°
  - vertical - at least 60°



The lower side hemisphere should be viewed from each pilot's crew station.
At customer's option it can be represented the visual scenes of specific district.

4.4.8 VIDEO SURVEILLANCE SYSTEM

The video surveillance system along with the flight data recorder represents an optional means of control over the trainees' actions in the simulator cockpit. The fixed video surveillance cameras allow observing each pilot's crewstation separately. The received images are displayed on the RIOS display. For the purposes of further analysis and debriefing of the students' actions, signals can be recorded from each camera.
The video surveillance system comprises:

- video surveillance cameras;
- video server.

Cameras of the simulator video surveillance system shall be installed in the cockpit above the left and the right pilots' seats. The camera image is displayed on the IOS video surveillance monitor.

The video server is installed in a special box behind the left pilot.

The camera image is displayed on the RIOS video surveillance monitor.

4.4.9 DVI VIDEO SIGNAL TRANSMISSION SYSTEM

The DVI video signal transmission system is intended for transmitting the DVI image signals from the computers, which are parts of RIOS, DC and VS, to the visual system projectors, RIOS touch screen monitors and IOS touch screen monitor via the Ethernet cable.
The DVI video signal transmission system comprises:

- 16-channel transmitter;
- one-channel receiver;
- nine-channel receiving unit;
- six-channel receiving unit;
- cable network.

4.4.10 POWER SUPPLY SYSTEM

simulator power supply system (PSS) provides uninterruptible power supply of the simulator components with a one-phase alternating current of 50 Hz frequency and 220 V design voltage, including cases of AC voltage loss or deviation above the acceptable limits.
Technical characteristics:

- Input voltage - three-phase 380 V, 50 Hz AC.
- Output voltage - one-phase 220 V, 50 Hz AC.
- Maximum output power - 24 kW.
- Back-up time under full load - 4 min.
- Battery recharge time - 2.2 h.

4.4.11 SYSTEM AND CONTROL SOFTWARE

System and control software provides general control over the computing system operation, as well as coordination of operations of the applied specialized programs of certain systems.
The system and control software includes:

- operating system
- antivirus software;
- software for data backup and HDD data recovery
- Control software of the following simulator subsystems:
  - network administration and network resources management services
  - visual system
  - video surveillance system
  - acoustic noises simulator
  - instructor operating station / remote instructor operating station
  - power supply.

4.4.12 SPECIAL SOFTWARE

Special software (SSW) is intended for flight process simulation, as well as the simulator maintenance and setting.
The simulator SSW enables imitation of:

- aircraft aerodynamics and flight dynamics
- environmental exposures
- acoustic noises
- power plant operation
- operation of the instrument equipment
- operation of the flight and navigation equipment
- operation of the onboard systems

4.4.12.1. AERODYNAMICS AND FLIGHT DYNAMICS MODEL

The helicopter aerodynamics and flight dynamics model is based upon the initial data received from the designer, MIL Moscow helicopter plant, JSC.
The model provides an adequate imitation of the helicopter behaviour depending on:

- the flight mode within the helicopter flight limitations
- ground proximity, including the landing areas of limited dimensions (landing pads on the offshore drilling units and sea vessels)
- environment conditions (temperature and air pressure, wind disturbance parameters);
- mass and center-of-gravity characteristics (with regard to the fuel depletion).

4.4.12.2 POWER PLANT MODEL

Power plant operation is simulated with regard to the engine installation management algorithms, steady and transient characteristics under different operation conditions. Parameters of the transient processes and static characteristics are simulated on the basis of the flight tests.
The model provides adequate imitation of engines operation with regard to the helicopter and its rotor system aerodynamics peculiarities, in different flight modes in standard conditions, under faults and failures input from the IOS/ RIOS. The model takes into account peculiarities of oil system operation.

4.4.12.3 MODEL OF THE ENVIRONMENT

The model of the environment provides simulation of the atmospheric, wind disturbances and magnetic variation parameters in the current point of flight. This information is taken into account in the models of aircraft flight dynamics, power plant, onboard systems and navigation equipment.

The model of the environment comprises:

- standard atmosphere model with possibility to change temperature and pressure in the flight areas from the IOS / RIOS;
- wind disturbance model including the vertical wind shear with possibility to change its parameters in the flight areas from the IOS / RIOS;
- landscape model and objects of the visual system database with visual and touch screen presentation (radar presentation, collision geometry, etc.).

Temperature, barometric pressure and air humidity are the main characteristics of the model of the environment. Temperature and pressure changes with regard to the altitude are simulated in accordance with the Standard Atmosphere GOST 4401-81.

Pressure and temperature fields and the airport heights are simulated within the aircraft operational constraints. The barometric pressure is simulated within the range from 605 to 800 mm. Hg.
Wind is simulated under the following parameters:

- horizontal speed - from 0 to 30 m/sec;
- direction - from 0 to 360 .

The model enables imitation of weak, strong and moderate horizontal and vertical wind shears, as well as atmospheric turbulence of different intensity.
The landing gear response is simulated under different runway conditions:

- dry concrete
- wet concrete
- unpaved soil coating
- ice coating

The environment parameters in the airport area and enroute are entered from the IOS/ RIOS. They comprise:

- temperature and pressure
- wind speed and direction
- speed, direction and amount of the vertical wind shear
- visibility parameters
- type and quantity of the clouds
- presence of hazardous weather conditions and their parameters (icing, thunderstorms, dust storms, snow whirls, etc.).

4.4.12.4 MODEL OF THE FLIGHT NAVIGATION

The model of the flight navigation system allows imitating the aircraft's spatial and geographic position and the onboard navigation equipment operation.
The model consists of the following components:

- geographic coordinates of the waypoints, airports, radio beacons and reference points;
- magnetic variations in the areas of airports and radio beacons location, and flight areas.
- airports heights above the sea level (absolute heights) and the terrain features in the airports neighbourhood;
- magnetic headings of the airport runways;
- location of the locator radio stations in the airport coordinate systems;
- coverage areas and directional patterns of the radio beacons and locator radio stations.

4.4.12.5 MODELS OF THE ONBOARD SYSTEMS

The models of the onboard systems enable imitating operation of each system in normal conditions, as well as under faults and failures input in accordance with the Flight Manual (entered from the IOS/ RIOS).
The models are based on the analysis of the construction and the principle of the aircraft systems interaction with regard to the materials investigating flight incidents and their inceptives.

4.4.12.6 ACOUSTIC NOISES SIMULATOR

Acoustic noises simulator enables imitating the whole range of noises heard by the crew (engine, aerodynamic noise, movement along the runway, audible warnings, voice messages, noises from the onboard systems operation, etc.) in accordance with the simulated flight conditions and failure situations.

List of operation papers:

- Mi-171 FTD Operating Manual Book 1. Simulator components and operation
- Mi-171 FTD Operating Manual Book 2. Instructor operating station Operating Manual

The model has been created on the basis of noises recording when performing helicopter flight tests. Some part of noises has been synthesized on the basis of empirical data.
Acoustic pressure levels and sounds amplitude and frequency characteristics correspond to the simulated helicopter.
The model enables imitating the aerial noises during operation of the radio stations and execution of the radio communications.

4.4.13 DOCUMENTATION PACKAGE

As part of the simulator, a documentation package in hard copy and electronic form shall be provided:

- procedure and results of simulator acceptance tests;
- approved acts and reports of preliminary tests;

Mi-171 FTD Operating Manual Book 3. Maintenance practices and faults management

- Mi-171 FTD Maintenance Program
- Mi-171 Flight Training Device. Consolidated technical certificate.
- List of maintenance single set of spare tools and accessories

- Album of electric circuit diagrams

Documentation for the item components, including the purchased ones:

- Acoustic noises simulator Technical certificate
- Video surveillance system Technical certificate
- DVI video signal transmission system Technical certificate
- 8-channel visual situation simulator Technical certificate
- Mi-171 simulator cockpit Technical certificate
- Instructor operating station. Technical certificate
- Remoter instructor operating station. Technical certificate
- 3x10000 power supply system. Technical certificate
- Digital Computer Complex Technical certificate.
- Digital Computer Complex for the 8-channel visual system Technical certificate.

4.4.14 SPTA SET

The SPTA set is a set of spare parts, tools and accessories, which provides an operative resolution of faults occurring in the simulator operation throughout its service life.
The SPTA set contents is determined when the simulator technical configuration is approved.
Operational experience relating to the similar simulators is taken into account when SPTA set is determined.

4.4.15 PACKAGE SET

Package provides simulator (and its components) protection from the external mechanical and environmental factors exposure during its transportation and storage.
The manufacturer shall pack the equipment in accordance with the packaging instruction. On the customer's site, packaging shall be done in accordance with GOST 9.014-78 as for the inner packaging VU-1 for a long-term storage for 2 (S) conditions, and in accordance with GOST 15150-69 for 3(ZhZ) conditions.
In case total or partial preservation is required, the manufacturer shall apply a temporary anti-corrosive protection (preservation) to the equipment in accordance with the correspondent instructions.

5. OPTIONAL EQUIPMENT FOR THE HELICOPTER SIMULATOR

5.1 SIMULATOR OF TERRAIN AWARENESS AND WARNING SYSTEM

Terrain awareness and warning system (TAWS) for helicopters provides the crew with the visual and audible warning on dangerous closure to the terrain or obstacles with regard to the flight stage, speed and crew response time, and allows taking efficient actions to avoid the collision.
TAWS simulator enables the crew members to gain and reinforce skills of system operation while practicing day and night flights in normal and adverse weather conditions.

5.2 WEATHER RADAR SIMULATOR

The weather radar simulator enables the crew to practice skills and actions in thunderstorm conditions and navigation management relating to the hazardous areas avoidance route generation.

5.3 VIBRATION SIMULATION SYSTEM

Vibro-acoustic platform is intended for reproduction of vibration from the helicopter primary systems in order to give the trainee additional information on the aircraft piloting process and definition of failure situations.
The system is based on the vibration parameters data received from the MIL Moscow helicopter plant, JSC.
The system consists of a mechanical part, an electronic control unit and special software.
The system enables simulating the following effects:

- vibration caused by engines and transmission operation
- vibration caused by main and tail rotor operation
- vibration during helicopter flight in the transient modes.

The mechanical part of the system is installed under the simulator cockpit. The vibration effect is achieved by changes of the drive shaft rotation frequency and location of amplitude setting unit.
The amplitude versus frequency characteristics of the generated vibrations are controlled by the electronic control unit using special software, which takes into account parameters of the applied aerodynamics and flight dynamics models, the power plant and the environment.
The system enables reproducing the whole range of background harmonics of the power plant, the transmission, the tail and the main rotors.

5.4 NVG VISUAL SYSTEM

Night vision goggles visual system represented by GEO-ONV goggles is implemented in a set of technological software, which provides generation of real time and dimensionally correct images in the range from visible-light spectrum to IR wavelengths, and models the reflected sunlight (sky light), moonlight and reflected shadows taking into account physical properties of surfaces, time of the day and weather conditions.