

USER REQUIREMENT DOCUMENT (URD) FOR SMK FLIGHT SIMULATOR

Aim

1. The aim of this document is to delineate the end user requirements for development of **Specific Configuration of** Super Mushshak (SMK) Flight Simulator for AMF, PAC Kamra.

User Requirement Statement

2. The SMK Flight Simulator is to be static (though the device does not move, the psychosomatic feedback of the wrap-around visuals is to provide a convincing sense of movement), to the aircraft scale, and should be able to impart the required realistic training (capabilities and procedures) to the pilots.

Flight Simulator Categorization

3. The required SMK FS is defined by FAA as Flight Training Device (FTD) with qualification levels from 1 (Lo-Fi) to 7 (Hi-Fi). An FTD is a replica of aircraft instruments, equipment, panels and controls in **an open flight deck area** or **an enclosed replica** of aircraft cockpit. It includes the equipment and computer programs necessary to represent aircraft (or set of aircraft) operations in ground and flight conditions having the full range of capabilities of the systems installed in the device as described in 14 CFR Part 60 and qualification performance standard (QPS) for **minimum FTD Level 5** (specific class of aircraft / meets a specific FTD design criteria) and **maximum Level 6** (High fidelity / aircraft specific / specific aerodynamic modelling) qualification.

4. **Level 5** represents a “class” of aircraft (meaning single-engine, multiengine, etc), and also requires a document called a qualification and approval guide that contains FTD design criteria. At this level, the device is starting to look more like the aircraft you are going to fly.

5. **Level 6** has to be accurate for the aircraft you fly, right down to spatial relations and actual functions. Like all flight training devices and simulators, it must also have a qualification and approval guide, but makes use of expensive aerodynamic data. It flies with more realism.

6. The SMK FS compliance matrix to FAA FTD Level 5 and Level 6 or any other equivalent standard is required to logically qualify and develop acceptance procedures.

Simulator Training Capabilities and Features

7. The SMK FS is required to exhibit following major pilot training capabilities :-

(a) **Cockpit Familiarization.** SMK FS is to provide a realistic cockpit environment so that trainee pilots can familiarize themselves with the cockpit and aircraft systems. Major features in this domain are listed below :-

- (i) Cockpit Seating including seatbelts & harnesses.
- (ii) Aircraft & Engine controls.
- (iii) Integration of Gauges, Indicators and Alarms (visual & aural).
- (iv) Layout of Switches, CBs, Knobs.

(b) **Aircraft Ground Operations.** These training objectives refer to all those operations which are to be carried out on the ground but limited to cockpit operations only. To practice all ground operations of aircraft, SMK FS should provide following necessary features :-

- (i) Aircraft controls for on ground taxi (use of rudder pedals and brakes).
- (ii) Functionality of Switches & Engine Controls as per aircraft for performing on ground checks and procedures as per aircrew checklist.
- (iii) Controls and Ops of **Specific Configurations** of PFDs / MFDs.

(c) **SMK FS Fidelity for Flying Operations.** FDM of FS should be able to replicate behavior & performance as of SMK aircraft in following domains :-

- (i) Take Off and landing (circuit flying as per given location).
- (ii) General Flying & effect of power at varying attitudes, altitudes & speeds. (Including slip stream effect and yaw behavior at varying speeds and power settings on Take Off and in Air).
- (iii) Engine sound/ behavior vis-a-vis aircraft performance including indications on engine instruments.
- (iv) Effects of flaps on aircraft behavior in different flap setting.
- (v) Basic Maneuvers (Medium/ Steep Turns, Loop, Aileron Roll etc). A high performance control loading may be utilized to provide near realistic feel of stick forces to the aircrew in different speed regimes.
- (vi) Stall and Unusual Attitude Recoveries along with stall warning audio horn.
- (vii) Instrument flying including VOR, ILS & GPS Approaches.
- (viii) Navigation Training
- (ix) All cueing systems of the flight simulator should be well integrated with realistic behavior.
- (x) Recording of Simulator Mission flown to replay the mission for debriefing purposes.

(d) **Emergency Simulations System.** SMK FS should be able to simulate all emergencies as per Check List & Dash-1 of SMK. The simulation of emergencies must replicate the cockpit indications and behavior of actual aircraft to impart realistic training.

(e) **Simulator Flying Record.** SMK FS should record flying sessions carried out by aircrew in past 01 year and the option should be available on IOS to download individual simulator flying record.

(f) **Instructor Operating System (IOS).** A user friendly IOS display on single scree should be available to provide Instructor Pilot liberty to simulate any kind of flight scenarios (IFR, VFR, Day, Night and Emergency simulations as per SMK checklist). Another screen should provide live video streaming of cockpit along with 2D map display of simulator flying. Provision of a **Wireless Tablet for IOS Operations** may also be available to further assist aircrew to accrue maximum training benefits from the simulator.

Simulator Components

8. The SMK FS is to constitute following major components:-

(a) **Cockpit.** The cockpit of the SMK FS is to be an exact replica of specific Glass Cockpit Configuration of SMK including all cockpit interior items, seats, knobs, switches, instruments, avionics, communications equipment and displays. The arrangements / layout of these items are to be ergonomically and operationally similar to those of actual aircraft and perform as per technical and operational manual of the aircraft in normal and emergency conditions. The system should offer seat and rudder pedals adjustment as per actual aircraft.

(b) **Display System.** The Wrap-around display system is to provide complete horizontal and vertical view outside the simulated aircraft, and smoothly move / scroll scenery comprising landscape, structures and sky, creating the illusion and feeling of actual aircraft. The major features to include :-

(i) Mix Reality Flight Simulator (MRFS) / 220° screen with 05 projectors / 180°Dome Display system / 360°Dome Display system / Dome Display System with Motion Platform.

(ii) HD Laser-Hybrid projectors that provide high quality image with significantly lower maintenance cost

(iii) Live view with 5000+ ANSI lumens

(iv) Automatic Edge Building and Warping operations on screen.

(v) Training areas / Airfield requirements for Simulator.

(c) **Image Generation.** Installed in front of the device is either a large single channel projection screen or alternatively a three-channel curved projection

screen which displays the synthetic world. Additional visual portrayal options are required to ensure a highly accurate Flight Deck and visual system which provides an immersive training environment and puts pilots in an incredibly realistic simulated environment where they can learn aircraft flying skills that are, in some cases, impossible to train using actual aircraft.

(i) **Flight Deck.** Accurate representation of the aircraft with operational knobs and switches in their correct positions, and a fiberglass shell that is similar in size and shape as the actual aircraft for a realistic learning environment.

(ii) **Visual Display.** **Dome (220 x 90) screen** or **Wrap-around, 220° horizontal and vertical view** outside the simulated aircraft of smoothly moving landscape, structures and sky creates the illusion and feeling of actual flying.

(d) **Instructor Operating System (IOS).** IOS comprising 02 screens and **01 wireless Tablet.** IOS controls available in parallel on one screen and **Tablet** to simulate any kind of flight scenarios (IFR, VFR, Day, Night, Dawn, Dusk, and Emergency simulations as per SMK checklist). Another screen should provide live video streaming of cockpit along with 2D map display of simulator flying.

(e) **Avionic Configuration Suite.** Hardware and software operates and functions exactly like the aircraft to accrue maximum training before flying the actual aircraft.

(f) **Flight / Aerodynamic Model (FDM).** Based on actual aircraft flight test data, the simulator is to precisely comply with the flight, enabling students to accrue a great amount of learning from the training device.

(g) **Control System.** The control system should provide aircraft's primary controls movements, i.e. pitch, roll and yaw with varied forces throughout the flight profile. The trim mechanism should also be incorporated as per aircraft functionality.

(h) **Active Control Loading.** Pressures on all flight controls change with airspeed, altitude and configuration to provide the pilot with realistic feedback on the controls just like when flying the actual aircraft. Force-feedback on the dual control stick ensures accurate feel to the control surfaces with changes in airspeed altitude and weight configurations, resulting in a realistic control feel, which adds to the development of muscle memory and rapid emersion into the simulation scenario.

(i) **Electrical Power Systems.** UPS (for 20 Minutes backup time) and Automatic Voltage Regulator (AVR) should be arranged by end user at the installation facility. UPS and AVR is to cater for all the systems supplied by the supplier with flight simulator.

(j) **Audio System.** Flight Simulator audio system should offer following features :-

(A) Produce aircraft sound, warning tones and the sounds produced by the operation of any switch etc.

(B) Generate proper aural cues during all stages of a mission both on ground and in the flight as well during emergency simulations.

System Documentation

9. Developer agency should supply following documents :-

(a) Detailed Operations and Maintenance manuals along with circuit diagrams.

(b) Troubleshooting Guide and system crash restoration software including backup images of all PCs.

(c) Illustrated parts Breakdown & Catalogue.

(d) Systems individual & Inter-operations block, wiring and schematic diagrams.

(e) All original 3rd party hardware documents and restoration software.

System Maintenance & Ops Training

10. OEM should impart training in following fields:-

(a) Overall system familiarization.

(b) Maintenance oriented training on all sub-systems of Training Flight Simulator.

(c) Instructor orientated training on all features offered by IOS listed above.

(d) Troubleshooting and System crash recovery.