



TURKISH AIRLINES
Visual System
Technical Specification
for
Full Flight Simulator

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SUMMARY

Definitions:

- Full Flight Simulator or FFS shall mean the Simulator **with the Visual System** and the integration of the DPE.
- The Seller shall mean the Visual System Manufacturer.

This document describes the Turkish Airlines Visual System minimum requirements which shall be installed and integrated on A320 and A330/A340 Full Flight Simulator .

The Seller will specify in its detailed proposal how these requirements are fulfilled, and particularly provide ;

- The Visual System Manufacturer Technical Specification
- The Library of existing models
- The specific Maintenance procedures and Seller's product support

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1 DESIGN AND PERFORMANCE REQUIREMENTS

- The Visual System as the entire simulator shall be qualified to **Level D** in compliance with :
JAA JAR-STD 1A Amendment 3
 FAA AC 120-40B for the US FAA
 In case the FAA or JAA Advisory Circular changes, the contract shall define the valid reference.
- **ARINC Report 434 Requirements**
 The requirements of Arinc Report 434 shall be considered as a reference addition to THY Technical Specification. Seller to meet this requirement as well.
- It shall provide high resolution image capability and full colour, day/dusk/night/dawn.
- The Seller shall take special care in avoiding undesirable cockpit light reflection effects or aliasing .
- The choice of the Visual System will rely not only on the quality and the realism of the image and scenarios but also on the specific models availability and the maintainability features .
- An acceptable field of view in respect of distortion must be available to the instructors.
- **Projectors shall be HD LCoS.**
- Seller shall also inform Turkish Airlines about the newly developed latest technology products and quote them if available.

1.1 MANOEUVRES TO BE SIMULATED

Any flight Phase (Docking , Taxiing, taxi turn, Accelerate-stop, Take-off, Climb, Cruise, Circling and Landing and Roll out.
 Low Visibility Conditions (such as CAT1, CAT2, CAT3A/B, 0/0),

1.2 FIELD OF VIEW (FOV)

The minimum uninterrupted available FOV shall be of 180 degrees horizontally by 40 degrees vertically , with a vertical distribution of +20°/-20° in respect of the pilot eye point position. Wider FOV will be preferable.

1.3 RVR , CLOUD AND FOG SETTINGS

Performances:

RVR	0 to 50 Nm	Cloud Base	0 to 10,000 Ft
Fog RVR	0 to 5 Nm	Cloud Top	0 to 40,000 Ft
Fog layer	0 to 1000 Ft		

There shall be two separate controllable cloud and fog layers.

1.4 IMAGE FEATURES

- Day / Dusk / Night scenes
- Global Terrain Data and Texture shall be available all over the world and shall correlate with the EGPWS.
- Raster scan with calligraphic light points
- High resolution
- Full-colour photo texture
- Visibility / Haze effect

- Time of Day effect
- Falling snow effect
- Full weather effects
- Snow
- Fully correlation with EGPWS ,
- Moving models
- Real fog
- Global texture
- Cloud clipping and multiple cloud layers
- Landing light lobes
- Transparency
- Occulting level
- Textured surfaces
- Photo texture
- Clouds with variable density,
- Scattered to broken cloud deck,
- Scud clouds,
- Fog,
- Patchy fog,
- Rain,
- Lightning,
- Storm,
- Aircraft lighting (land, nose, runway turn off and beacon, strobe),
- A/C lights or environment reflection effects.
- Cloud scenarios Database and effects in correlation with Weather Radar simulation,
- TCAS intruders in correlation with TCAS simulation,
- TACS display correlation,

The Visual system shall include the capability to reproduce an effect of uninterrupted and smooth transition from daylight through night (and vice versa) according to an adjustable delay set by the instructor through IOS.

1.5 AIRFIELD AND GENERAL LIGHTING

On top of the basic standard provisioning, the Seller shall provide the following:

- Airfield Lights
- Approach, , Strobe, Centreline, Taxi , Runway edge, Touchdown zone, VASIs, PAPIs, Category III lighting and guidance, REILS .
- General lights:
Environment , Obstruction , Airfield Beacon

These lights shall comply with the necessary precision, directionality, elevation, colour, beam angle and intensity.

The Variable intensity function shall have 5 levels, 3 being the normal intensity in relation with the threshold pattern default calibration in CAVOK.

1.6 AMBIENT LIGHTING

The Seller shall provide a realistic system that will comply with the following objectives:

- Meet FAA / JAA JAR STD 1A Amendment 3 level D requirements
- No interference with the A/C cockpit environment.
- The light intensity shall be equally spread through out the cockpit .
- The light intensity shall be automatically adapted and adjustable to the Visual Scene brightness.



2 PERFORMANCE TESTS

The visual system will be tested in accordance with Authorities requirements refer to Chapter 1.and shall fully meet these requirements.

Signals needed for latency tests shall be wired on a specific panel of the FFS.



3 SCENE MODELS

1. Customized Models :

The Seller shall provide all models as per Appendix 1 together with a supplement of twelve (12) newly designed models to be defined by THY.

2. General requirements :

All customised models as listed in Appendix 1 together the new ones shall be designed and updated to meet level D (FAA & JAA) Authorities requirements (refer to Chapter 1) at contract signature.

All these models shall be specifically designed for the Visual System image generator.

3. Library Models access:

The Seller shall allow Turkish Airlines with free access to the Visual System Model library during the entire Visual System life.

4. Design capability :

The Seller shall be capable of designing and providing if so required , up to 10 new specific scenes to meet the training requirements at Ready For Training date .

5. Data Collection:

The Seller shall be responsible for all the necessary data collection regarding the scenes modelling.

6. Generic Airports :

All airports which are in the FFS Navigation Data Base and not customised shall be generic and aligned.

7. Schedule :

The Seller shall provide, integrate and align all above Customised and generic models at the beginning of the on site acceptance

8. Data storage:

ALL scene models shall be installed on only one mass memory.

4 OPERATION AND MAINTENANCE FEATURES

4.1 OPERATION

4.1.1 System starting and shutting down

Total time to start off the system (cold start) shall not exceed 5 minutes with the simulation loading in parallel.

During program and model data base loading, messages describing current status of the process shall be displayed on computer console and (or) printer.

-Shutting down shall be possible from the keyboard of the computer console .

4.1.2 Operator on line system facilities

A software module shall enable the user to:

- Dump memory locations.
- Look at host buffer contents.
- Disconnect host transfers.
- Simulate some commands (x,y,z,...)
- Modify scene models.

4.2 MAINTENANCE FEATURES

All the systems, particularly IGE and electronics on-board shall present a compact aspect.

Suitable screen compartment lighting shall be provided together with an auto-switch-off triggered by the access door when closed.

4.2.1 Computer and peripherals

The Seller shall supply customised computer diagnostics and special tools (if any) capable of testing the installed configuration and calibrating all peripheral devices (Discs, Tape, Console, Line printer...).

The hard disk system used for the IG (Texture and data base disks) shall be backed-up with a mirroring configuration.

4.2.2 Power supplies:

Adjustment and calibration shall be possible easily without dismounting.

All power supplies shall be modular line replacement devices.

A monitoring for displaying power supplies voltage and load shall be provided.

An auto-shutdown system shall be provided where necessary (hardware protection).

4.2.3 Image Generator and Projectors controller and screen trouble shooting:

Specific diagnostic tools shall allow to trace easily and rapidly a defective board, power supply and/or screen malfunction.

4.2.4 Image calibration and tuning

- Automatic Alignment system and program and procedures shall be provided in order to help adjustment of the system.
- Alignment shall be easy to operate by the use of efficient and normal tools.
- The remote control device (hand held unit) shall be a lap top PC using Windows like icons.
- Auto alignment system allowing complete geometry, convergence, video balance, black level..., calibration shall be provided.

- Four sets of calibration shall be provided and automatically elected in real time by the Visual System according to day, dusk, night, dawn image brightness.
- For final tuning it shall be allowed to display, using the hand held unit, a real time environment model (selected in the FFS library) and to choose one out of 10 pre-memorised pilot eye position (x,y,z,p,r,y), and ambient conditions.

4.2.5 Projectors assembly:

LCoS Projector exchange and subsequent alignment time shall not exceed 1 hours.

All parts shall be easily accessible for replacement or maintenance operation.

Lamps shall be removable easily and lamp replacement shall not call for any mechanical adjustment.

Air conditioning shall be ducted from the FFS for the cooling of each projector.

Seller shall also inform Turkish Airlines about the newly developed latest technology products and quote them if available.



5 ACCEPTANCE

Visual System acceptance shall be conducted in the following two phases.

- **In-Plant Acceptance**

In plant acceptance shall be conducted in simulator manufacturers facility . Visual System shall be installed on the simulator and all the features shall be available.

First an initial Fly out by THY pilots shall be performed before In-plant acceptance to ensure that simulator is enough mature to begin in-plant acceptance. Without this green light, in-plant acceptance can't be performed.

- **On Site Acceptance**

Before the On-Site Acceptance:

- The Seller should guarantee that the simulator status shall be at least at the level of In Plant Acceptance and DR status generated during In Plant Acceptance shall be on offer.
- All the software programs shall be compiled from the on-site available current source, in order to generate the code that will be used for the final acceptance and for the starting of training. This task shall be jointly performed between the Seller and THY.

5.1 ACCEPTANCE CONTENT

Both the In Plant and On Site acceptance shall include Hardware and Software acceptance topics as mentioned in chapter 5.1.1 and 5.1.2

5.1.1 Hardware acceptance

The Seller shall demonstrate the performance of the system in the following areas:

- Installation and general wiring quality.
- Computer and peripheral performance.
- Mechanical positioning precision.
- Auto Tuning system : its performance shall be demonstrated by starting the operational acceptance with a complete display set up using the Auto-Tuning system
- Compliance with Authorities (JAR STD 1A Amendment 3)
- The diagnostics and the patterns used shall be the same as those used in maintenance.
- All the tubes shall be new for visual on-site acceptance.

5.1.2 Software Acceptance

The Seller shall demonstrate the following points for each scene:

- Model features and content.
- Model Alignment
- Modelling modification capability.
- CAT1, CAT2, CAT3 performance.
- Visual feed back signal to the host computer for terrain profile.
- Visual feed back signal to the host computer for moving vehicles position.
- Dialogue between visual system and IOS.
- Scene/simulator instrument correlation and response.
- Background computer capacity and performance.
- Identification of the model's version and updating.

5.2 AUTHORITIRS QTG

Upon requirement of THY, Seller shall provide technical assistance during the initial approval of each version of the FS by the JAA.

Seller shall present at Preliminary and Detailed Review an example of the QTG documentation to THY for agreement.

The QTG documentation will be available at the authorities and THY's facility before In-Plant Acceptance, including:

- The complete general part,
- The complete tests description part,
- The Statement of Compliancy document shall also be provided.

The final QTG documentation shall be available at the Authorities and THY's facilities within the time schedule mentioned in JAA requirements.

This final QTG documentation will provide all QTG tests required for a level D Visual System.

6 TECHNICAL SUPPORT

6.1 TECHNICAL PUBLICATION

All the documents shall be delivered as 2 sets of hardcopy and softcopy.
Associated editing tools for all kind of documents (including drawings, wiring manuals, schematics etc.) shall also be provided.

6.1.1 Publication Content

At least the following documentation shall be provided:

- (a) Documentation Inventory
- (b) Hardware Manuals:
 - (1) Operation Manuals for all simulator systems.
 - (2) Maintenance Manuals:
 - Preventive and Corrective Maintenance Manual
 - Fault Isolation Manual
 - (3) Test Equipment Documentation.
 - (4) PCB Documentation
 - (5) Engineering Drawings (such as wiring, all schematics, mechanical assemblies, etc.)
 - (6) All OEM Documentation.
- (c) Software Manuals
 - (1) Simulator Software Manuals.
 - Software Maintenance Manuals,
 - Software Design Documents,
 - (2) All OEM Software Documentation (User manuals, CDs and licences of all operating and application programs)
 - (3) User Guides of all Software Utilities,

6.2 FIELD SERVICE ENGINEER

The Seller shall provide during the entire Demonstration period (Refer to paragraph 7.2), the assistance of a qualified and experienced Field Service Engineer (FSE).

The Seller shall assign the FSE to:

- Assist to THY's maintenance teams in their daily operations.
- Provide the complementary on the job training.
- Assist THY's maintenance teams in troubleshooting and repairing the defects that could arise during the above period.
- Liase with the in house Seller's engineers to ease operational problems solving.
- Update the Seller provided Technical Publications on the critical maintenance procedures.

For example: (New set of world file integration, generating new disks)

Seller shall provide a field service engineer available at the Buyer's Site for as long as 1 month.

6.3 SPARE PARTS MAINTENANCE TOOLS AND TEST EQUIPMENT

The Seller shall be responsible for defining and describing his Policy in this proposal how Seller shall meet the Reliability objectives set up in paragraph 7.

This shall include:

- The itemised list of Spare Parts based on the quantities installed on the Visual System.
- All Recommended spare parts list shall be provided.
- Recommended spares package shall be quoted separately and the list price of each item will be clearly discernible.
- The Recommended Spares Listing , (RSL), should include the impact of component failures on STD operations:

Level A= Unsuitable for Training

Level B= May Impact Training

Level C= No Impact on Training

- **Guarantee of the Seller, to keep the prices of the spare parts unchanged as long as 5 years after the contract signature, will effect THY's preference positively.**
- The Special Tools and Equipment needed for operating and maintaining the Visual System(Refer to paragraphs , 6.5)
- Electronic Parts Catalogue (EPC) shall be provided.
- Warranty for the whole Visual system complex shall be **minimum 3 years**.
- The Repair Turn around time:3 weeks in total for normal repair excluding transportation.
- The AOG procedure for critical parts: the delivery time to THY site shall not exceed 36 hours..

6.4 SIMULATOR LIFE CYCLE SUPPORT PARAMETERS

6.4.1 Preventative Maintenance

Seller shall provide a list of preventative maintenance items with their frequency and the man hour to accomplish each task in a predicted time period.

6.4.2 Consumable Spare Cost

Seller shall provide a list and the quantity of consumable spare parts which shall be used for preventative maintenance of the simulator during the longest maintenance cycle. Longest maintenance cycle refers to the longest frequency of the maintenance items.

6.5 OPERATION AND MAINTENANCE TRAINING

THY shall define its own requirements in the contract.

An initial syllabus will be submitted to THY in the early stages of the contract.

The syllabus will contain details of each module's training objective, outline and practical access requirements.

Details of the syllabus and the training schedule will be discussed between THY and Seller after the contract signing.

Following completion of the course, purchaser maintenance personnel shall be capable of operating, maintaining and troubleshooting the simulator to the board replacement level.

The training course shall be completed before the Ready for Training for all except for the on the job training.

The training course content shall cover at least the following subjects:



6.5.1 Hardware Training (8 people)

Power-up procedures
Visual System general architecture and daily operation,
Trouble Shooting Procedures,
Maintenance Procedures (Preventative & Corrective)
On the Job Training for Trouble shooting and tuning.

6.5.2 Software Training (6 people)

Operating System,
Software update and modification procedures,
New database integration and adding IG features,
Back-up Procedures,
Real time loop: s/w architecture, software design,
IG/peripherals dialogs/interface,
Monitoring, debugging tools,
ICD Software .
QTG tools

7 RELIABILITY

The Seller in his design and during the manufacturing phases shall consider as major criterion the general Reliability of the Visual System.

The Seller shall build the Visual System from components of known reliability and in such a manner as to reduce the time required for trouble shooting, repair and maintenance.

The Seller shall particularly provide the Spare Parts in adequate quantity and design efficient Special Tools and or Diagnostic means to allow for swift interventions of THY maintenance personnel.

The Seller shall ensure conformity of the Visual system to the following reliability criteria.

7.1 RELIABILITY REQUIREMENTS

The reliability requirement is based on two criteria: the Availability rate and the mean time between failures (MTBF).

The Visual System shall be capable of performing all functions in accordance with this Specification with an Availability rate not less than 99 % and a MTBF of at least 100 hours during its entire lifetime.

The Visual system shall be used on an average of 20h per day / 7 days per week during its entire lifetime.

The formula for the Availability rate is the ratio:

$$\frac{\text{Accomplished Training Time}}{\text{Accomplished Training Time} + \text{Failure time}} \times 100 \quad \%$$

Definitions:

1.Accomplished Training Time means the amount of time that Training has been performed without failure.

2.Failure Time, starts whenever a specific part or the entire Visual System does not meet the training requirements. Failure time stops when the failure is cured and the Visual system is ready for training again.

Should the Visual system be found to be inoperative more than 3 times during the same training session for the same reason, the failure time will then be equal to the entire training session time.

3.Visual System means IG and Projection system.

4.Erratic failures:

The Visual System shall be considered not meeting the requirements if "glitches" occur repeatedly during the training periods. Such "glitches" are defined as transient interruption in normal Visual system performances not traceable to malfunctions.

If at any time the reliability is below this standard, the Seller shall correct design deficiencies on an expected basis.

7.2 RELIABILITY DEMONSTRATION

For a period of 90 consecutive days the Visual system shall perform in accordance with the reliability objectives of chapter 7.

Computation procedure:

At the end of the first 90 days the reliability rate will be computed,

- In case the requirement is met , the demonstration period will be deemed complete
- In case it is not met, the period will be extended by the necessary amount of days to reach the requirement on 90 consecutive days.

The demonstration period shall begin on Seller completion of the following:

- Final acceptance complete
- FS Approval given by Authorities at the JAR STD 1A Level D.
- FS Hardware and Software configuration stabilised.

8 OPTIONS

8.1 MODELLING FACILITIES

The Seller shall provide a graphical modelling system which must offer high efficiency in model creation and editing in a "friendly" and intuitive full colour, high resolution graphic environment.

The Seller shall provide the software and the hardware of this modelling system. The system shall allow Airbus to produce a (new) modified model acceptable for Authorities in less than 2 weeks. It shall have a sufficient mass storage size to manage all the models with two releases.

A training course shall familiarize the buyer's personnel with software tools and methods to maintain and update visual system software and model generation. The duration , number of participants, and contents of the courses shall be mutually agreed between the buyer and the Seller, before the contract signature.



9 APPENDIX 1: SPECIFIC MODELS LIST (TBD).

1. Seller shall provide 50 Customised models with the system from Sellers Library. The TBD models shall be define at the contract signature. They shall be selected among the manufacturer model data base.
2. The Seller shall also build 12 new models which will be determined during contract sign.