

STATEMENT OF WORK FOR FFC REPLACEMENT PROJECTOR PROJECT

1.0 Introduction/ Background

The National Aeronautics and Space Administration (NASA) is seeking to select and procure 13 projectors to replace the current projectors in its Future Flight Central (FFC) simulation facility. NASA's Future Flight Central (FFC) is an airport Air Traffic Control (ATC) Tower simulation facility supporting research into problems at the nation's airports, Unmanned Aircraft Systems integration into the national airspace, and other research requiring visually immersive environments. The facility provides a detailed, realistic 3-D database modeling capability, projected on twelve screens, to provide a 360-degree out-the-window view. The facility also has an extensive video streaming capability for observation and control of distributed simulations and remote operations. The facility is used to develop new automation concepts and evaluate new ATC systems and related technologies.

2.0 Scope of Work:

NASA requires the new projectors to replace the existing 12 projectors that will provide the out-the-window scene in the tower simulator in the FFC. At least one spare projector will also be purchased. The contractor shall provide the projectors, lenses, documentation, and support for initial set up and optimization of the projectors after installation. NASA will design, construct, and install the mounting hardware for the new projection system, physically mount the projectors in FFC, and install necessary cabling and power.

3.0 Applicable Documents

The following picture of the control tower cab in the FFC shows the central workspace surrounded by the projection screens, mirrors, and projectors. The drawing contains dated renderings of the projectors, but accurately reflects the current layout of the facility. The new projector procurement will remove the mirrors from the light path.



The projection surface consists of 12 flat screens placed around the internal workspace. The screens are 150” diagonal [90.75” vertical by 121” horizontal] Stewart “Optawave” Fresnel/Lenticular rear projection screens [ref: Attachment 1 “Stewart Optascreen.pdf”] with a 4:3 aspect ratio.

Note - A site visit will be scheduled for prospective contractors during the solicitation phase.

4.0 Description of Technical Requirements:

- 4.1 The contractor shall provide the customer with projectors and lenses meeting the minimum specifications listed in Attachment 1.
- 4.2 The contractor shall also provide:
 - 4.2.1 The initial cost for each projector including lens.
 - 4.2.2 Cost of operation and scheduled maintenance over 5 years if the projector is operated 8 hours per day, 5 days per week, 52 weeks per year at full brightness.
 - 4.2.3 Mean time between failure for the projector.

- 4.2.4 Information on the network connectivity of the projector, including descriptions of all functions that can be accessed remotely for operations, set up and maintenance of the projector.
- 4.2.5 Information regarding extended capabilities that would allow automated color balancing or black level management for an individual projector or across multiple projectors.
- 4.2.6 Information regarding extended capabilities that would allow storage and retrieval of calibration parameters for multiple projectors from a single preset.
- 4.2.7 Information about the stability of brightness, color and geometric calibration across hours of operation between required maintenance.
- 4.2.8 The FFC visual presentation consists of 12 flat rear projection screens, which are 150" on the diagonal [90.75" vertical by 121" horizontal] and have a 4:3 aspect ratio. Replacement projects shall support the 4:3 aspect ratio either natively, or by other means. The projectors shall have the ability to fill the screen at the 4:3 aspect ratio with a throw distance of 90 inches or less. The contractor shall provide information about the method of projecting a 4:3 aspect ratio image within the throw distance required to fill an FFC screen.
- 4.2.9 Information regarding projector features that minimize horizontal motion artifacts such as temporal aliasing, smearing or ghosting.
- 4.2.10 A list of all OEM and third party vendor software and licensing required to operate and maintain the projectors
- 4.2.11 Information about off-site maintenance and repair options, to include spare parts and consultation (phone and one site) for at least 5 years.

4.3 Projector demonstration

All projectors that have passed initial evaluation shall be required to demonstrate at least one projector in the FFC facility to ensure that the direct projection solution does not create image problems with the existing screens. Contractors are encouraged, but not required, to provide two projectors if possible. Projectors will be evaluated for both observable and measureable anomalies using internal test patterns and images produced by the FFC image generation systems. A Subject Matter Expert (SME) Air Traffic Controller will also conduct an evaluation of projector performance under simulation conditions.

NASA will provide appropriate mounting such that the projector(s) will be aligned with the center of the projection screen at the required throw distance. The vendor shall calibrate the test projector(s) to provide a full screen, 4:3 aspect ratio image supporting 1600 x 1200 at 60Hz image as presented by the FFC image generation system.

NASA will provide a single link DVI-D connection between the FFC image generation system and the test projector.

4.3.1 Interaction between the projector and the existing screen(s) will be evaluated for compliance with specifications in Table 1 and for visual artifacts with internal projector test patterns, an FFC Image Generation System database, and 1080P HD video inputs. Visual artifacts may include, but are not limited to:

4.3.1.1 Variations in linearity, brightness, contrast, color, focus, and dark field performance

4.3.1.2 Observable patterning anomalies such as rainbow effects, color fringing, color banding, dithering, screen door effect, moire pattern, hot spots etc.

4.3.1.3 Aliasing, blurring or smearing of objects in motion

4.3.2 The projected image will also be evaluated by an SME Air Traffic Controller to ensure that the projectors meet NASA's research requirements. The SME evaluation will include, but is not limited to:

4.3.2.1 Out-the-window scenes representing light levels for various times of day including; dawn, dusk, high noon and midnight

4.3.2.2 Ability to recognize an aircraft at an appropriate distance from the runway

4.3.2.3 Ability to recognize airline liveries at an appropriate distance from the tower

4.3.2.4 Adequate representation of aircraft and ground lighting

4.3.2.5 Absence of distracting visual artifacts

5.0 Deliverables:

- 5.1 The contractor shall provide 13 projectors and lens and all additional required software, licenses, and hardware to operate the projectors.
- 5.2 The vender shall provide, as a separately priced item, a plan to support the initial set up and optimization of the projectors.
- 5.3 Documentation
 - 5.3.1 The contractor shall provide all maintenance and operational documentation with the projectors.
 - 5.3.2 The contractor shall provide a recommended spares list and pricing for the spares.
 - 5.3.3 The requested information listed in Section 4.2.

6.0 Period of Performance/Delivery

- 6.1 The period of performance (PoP) will be 60 days after receipt of order (ARO).
- 6.2 Performance will be conducted at the following location:
 - NASA Ames Research Center
 - Bldg. N239
 - Moffett Field, CA 94035-0001

Attachment 1

Table 1: Projector Requirements

<u>Element</u>	<u>Criteria</u>
Projection	Rear projection capabilities
Brightness	≥ 1000 lumens
Contrast Ratio	≥ 5,000:1 dynamic contrast
Uniformity	≥ 95% brightness and color uniformity
Resolution	≥ 1600 x 1200 @ 60 Hz up to 2048 x 1536 @ 120 Hz refresh
Video Signal Format	Analog: RGBHV, RGSB, RGsB, 0.7 VPP video - 0.3 composite sync Digital: Single Link DVI up to 165 Mhz pixel clock
Video Signal Connection	Analog: VGA [HD 15] or BNC [5 connector] Digital: DVI-D
Color Gamut	Full Spectrum sRGB/CIE 1976 with internal color calibration capability
Geometric Correction	Internal geometry correction within ≤ ½ line width variation full screen
Projector Presets	Ability to store and retrieve preset color and geometry calibration parameters
White Point	D6500
Motion Artifacts	Features to reduce horizontal temporal aliasing etc.
Aspect Ratio	4:3 full screen projection
Network Connectivity	Network connectivity for projectors is required
Lens type	Short Throw, Fixed Focus without discernable chromatic aberration
Lens Throw Distance	≤ 90 inches for full screen projection of 4:3 aspect ratio image
Lens Shift	± 10° H & V lens shift capability
Power	100-120 VAC 60 Hz
Reliability	≥ 20,000 hrs. MTBF
Warranty	≥ 2 years
Noise	≤ 90 dB at normal operating temperature
Thermal Load	≤ 2000 BTU/hr.
Refresh rate	≥ 60 HZ

Internal Test Patterns	White Field, Black Field, Checkerboard, Cross Hatch, Focus, Color Scale, Gray Scale, Contrast test patterns
Warranty	≥ 2 years
Projector Presets	Ability to store and retrieve preset color and geometry calibration parameters, and projector configurations