

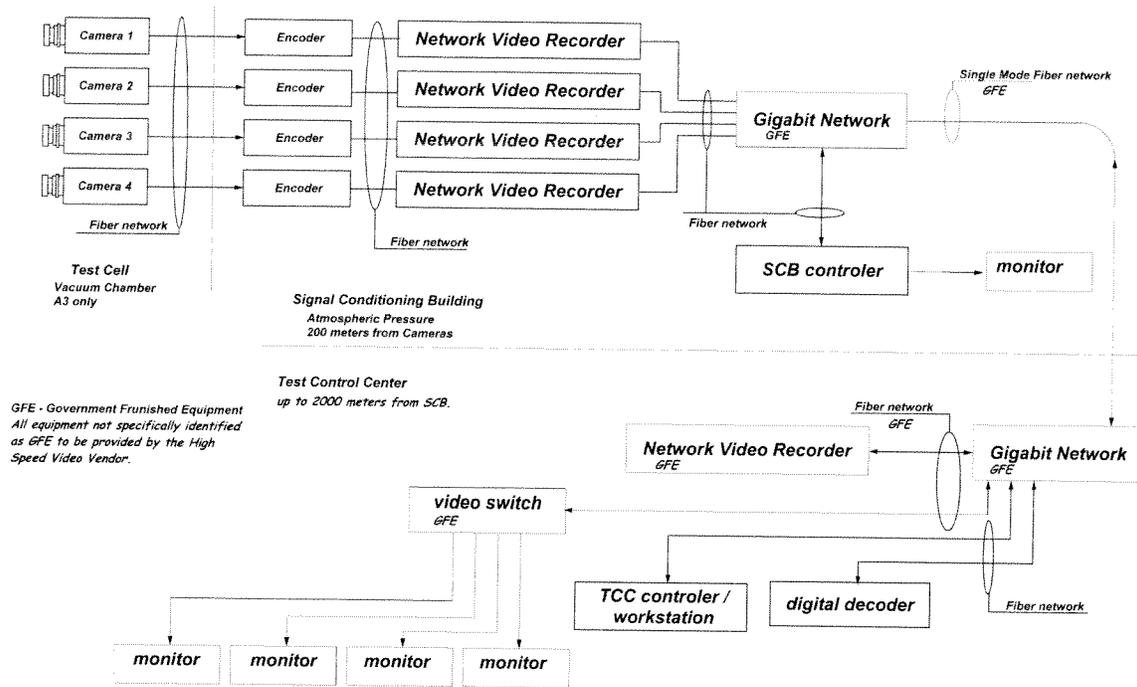
## **REQUIREMENTS FOR A HIGH-SPEED VIDEO SYSTEM**

### **1.0 INTRODUCTION AND DESCRIPTION**

This document contains requirements for a High-Speed Video System (HSVS) that includes cameras, and recording units for use on rocket engine propulsion test stands. These test complexes include the A1, A2, B1, B2, E1, E2, E3, E4, and A3 Test Stand. The goal of Stennis Space Center is to provide a common video system to each stand for use in recording rocket engine tests on each stand. The development of such a system will require several years and multiple orders. The initial purchase will be to equip the A3 test stand. The A3 test stand consists of an altitude start test chamber capable of producing near vacuum conditions that simulates the space environment for engine starts/restarts in upper stage engines. This chamber is approximately 40-feet in diameter. The total height is approximately 80 feet tall, including the upper end, which is hemispherical and the lower end, which is a truncated cone through which rocket engine exhaust is ported to a diffuser.

- 1.1 The High Speed Video System shall consist of the following major components:
  - 1.1.1 High Speed Color Video Cameras with a minimum record rate of 250 Frames per second.
  - 1.1.2 A control point where the video systems operator controls the camera view, focus, recording speed and data output.
  - 1.1.3 High-Speed Video recording.
- 1.2 The recording device will be separated from the camera by as much as 200 meters.

- 1.3 A sample pictorial representation of potential system architecture is depicted below in **Error! Reference source not found.** This is only a one of potentially several system architectures, actual implementation may vary with individual capabilities. The vendor will supply the actual architecture proposed with his offer.



**Figure 1 : High-Speed Video System (HSVS) Conceptual Block Diagram**

**2.0 Definitions and Acronyms:**

- 2.1 LS: Low Speed
- 2.2 HS: High Speed
- 2.3 CS: Control System
- 2.4 NIST: National Institute of Standards and Technology
- 2.5 SCB: Signal Conditioning Building
- 2.6 TCC: Test Control Center

**3.0 Standards and Specs**

- 3.1 FRD-A3TF-1901; Section 8.5, “Video”, of the A3 Facility Requirements Document
- 3.2 NPR 7150-2 NASA Procedural Requirements Document
- 3.3 MIL-STD-810F: Department Of Defense Test Method Standard For Environmental Engineering Considerations And Laboratory Tests

**4.0 HARDWARE**

4.1 Modularity and Expandability

- 4.1.1 The system shall be modular with 1 camera per recorder.

#### 4.2 Video Storage

The system shall record at least 250 frames per second to an external recorder with latency less than 200 milliseconds for a minimum of 30 minutes.

#### 4.3 Video Playback

Playback of the recorded Video shall be accessible through the 1 GB network.

#### 4.4 IRIG Timing

4.4.1 The system shall provide an IRIG B time code stamp on each image recorded.

4.4.2 All recorded video shall be time-tagged to 1 millisecond resolution within  $\pm 4$  milliseconds of image acquisition.

#### 4.5 Interfaces

4.5.1 The system shall initiate recording start/stop based on a remote 24-32 volt signal from an external source.

4.5.2 The system shall have controllers located in the Signal Conditioning Building and the Test Control Center.

4.5.2.1 Each Controller shall have a display panel capable of displaying the video from the selected camera.

4.5.3 Replay capability shall be provided at each controller (i.e., the TCC and SCB).

#### 4.6 Camera housing

4.6.1 Each camera shall be housed in a sealed and purged, housing suitable for use in Class I, Div II, Group B environment.

4.6.2 Each camera shall be housed in a classified area use certified explosion proof housing.

#### 4.7 Resolution

4.7.1 Video resolution of the camera shall be a minimum of 640 X 480 at 250 frames per second.

4.7.2 Video Resolution shall be maintained at frame rates greater than 250 frames per second.

#### 4.8 Lens

Each camera shall be provided with a zoom lens with equivalent focal length of approximately 5 mm to 90 mm or greater, with an approximate zoom value of 22X optical. The successful offeror will provide the actual parameters of the lens to be furnished.

#### 4.9 Power

The camera shall operate at 24 to 32 VDC power. The remainder of the system shall utilize as its primary source of power 120  $\pm 10\%$  VAC power.

## 5.0 **PHYSICAL**

### 5.1 Environmental (general)

- 5.1.1 System shall operate at humidity levels of 30% to 100% RH non-condensing.
- 5.1.2 System shall operate at temperatures ranging from +5 deg. C to +40 deg. C.
- 5.1.3 System shall be capable of being stored at temperatures ranging from -20 deg. C to +60 deg. C without damage.
- 5.1.4 The Manufacturer shall provide data for their proposed camera that details its current performance in an environment subject to vibration. Details of the testing of the camera shall be provided that include the frequency and load levels placed on the camera to test the system. This information shall also include the direction or axis; Axial (X), Radial (Z), and Tangential (Y); on which these loads were placed and the duration of the loads.

### 5.2 Environmental (Test Cell)

- 5.2.1 In addition to the general conditions specified above, the system shall operate at pressures of <0.08 psia.
- 5.2.2 Camera housing shall be rated for operation in Class I, Div II, Group B environment.

### 5.3 Size

- 5.3.1 System components, excluding cameras and their housing, shall mount in a standard EIA 19 inch rack.

### 5.4 Weight

- 5.4.1 Individual component weight shall not exceed 50 lbs.
- 5.4.2 Assembled camera and housing shall not exceed 75 lbs.

### 5.5 Interfaces and Mounting

- 5.5.1 Input and output connectors shall be non-solder type connectors, keyed with positive locking mechanisms.
- 5.5.2 Input and output connectors electrical contacts shall be made of non-oxidizing metal.

## 6.1 Control and Displays

### 6.1.1 Operator Control

- 6.1.1.1 A systems controller shall be provided, 1 each in the Signal conditioning Building, and Test Control Center, that will allow for the following:
  - 6.1.1.1.1 Control of the Pan, Tilt, and Zoom functions.
  - 6.1.1.1.2 Control of the Iris.
  - 6.1.1.1.3 Control of the Lens.

- 6.1.1.2 A control and setup window and/or pull-down menu shall be included to allow for the following:
  - 6.1.1.2.1 Setup of the camera record rate.
  - 6.1.1.2.2 Selection of monitor to display camera views.
  - 6.1.1.2.3 Starting and stopping recording of video from all cameras individually or simultaneously.

6.2 Remote displays

- 6.2.1 Software shall stream real-time video at 30 frames per second for immediate viewing.

7 **DOCUMENTATION REQUIREMENTS**

7.1 **GENERAL DOCUMENTATION REQUIREMENTS**

- 7.1.1 A printed user's manual with instructions for all aspects of operation, including setup, recording, interfaces, connections, software, and video retrieval shall be provided with each camera.
- 7.1.2 A printed maintenance manual shall be provided that contains diagrams of system architecture, lists of spare parts, instructions for replacing parts and troubleshooting procedures shall be provided with each camera.

7.2 **SOFTWARE DOCUMENTATION, VALIDATION, AND VERIFICATION REQUIREMENTS**

- 7.2.1 The vendor shall provide documentation describing the following specific aspects of the software:
  - 7.2.1.2 Video Formats
  - 7.2.1.3 Video interface formats and requirements
  - 7.2.1.4 Formats of remote video transmission streams.
  - 7.2.1.5 For software provided that is not "Off the Shelf" for this application, instructions for user customization of software, for example, DLLs, etc., shall be provided. Off the shelf software setup for specific applications does not customize the software package.
- 7.2.2 The following are documentation requirements with which the vendor shall comply per NASA Procedural Requirements document NPR 7150-2:
  - 7.2.2.2 Requirements that are to be met by the off-the-shelf software are identified within the software documentation provided.
  - 7.2.2.3 The off-the-shelf software includes documentation to fulfill its intended purpose, such as usage instructions.
  - 7.2.2.4 Proprietary, usage, ownership, warranty, licensing rights, and transfer are addressed within the software documentation.

- 7.2.2.5 The following documentation requirements shall apply only to software necessary to be developed to meet the specifications within this document that is in addition to existing software supplied by the commercial product:
- 7.2.2.5.1 The software supplier(s) shall provide insight into software development and test activities, including monitoring integration and verification adequacy, trade study data, auditing the software development process, and participation in all software reviews and technical interchange meetings.
  - 7.2.2.5.2 The software supplier(s) shall provide NASA all software products and software process tracking information, in electronic format, including all software development and management metrics.
  - 7.2.2.5.3 The software supplier(s) shall notify NASA, in the response to the Request for Proposals, as to whether open source software will be included in code developed for the project.
  - 7.2.2.5.4 The software supplier(s) shall provide NASA with electronic access to the source code developed for the project, including modified off-the-shelf software and non-flight software (ground test software, simulations, ground analysis software, ground control software, science data processing software, hardware manufacturing software, or other).
  - 7.2.2.5.5 The software supplier shall track all software changes and provide the data for the project's review.
  - 7.2.2.5.6 The software supplier(s) shall provide software metric data as defined in the project's Software Metrics Report.
  - 7.2.2.5.7 NASA shall participate in any joint NASA/contractor audits of the software development process and software configuration management process.
  - 7.2.2.5.8 The software supplier(s) shall provide a software schedule for the project's review and updates as requested.
  - 7.2.2.5.9 The software supplier(s) shall make available, electronically, the software traceability data for the project's review.
  - 7.2.2.5.10 The software supplier shall document in the solicitation the software processes, activities, and tasks to be performed by the supplier.