Specification
for
Spaceflight Electronics Test Capability

The Naval Research Laboratory has a requirement for **two** Spaceflight Electronics test rack systems with integrated control computers. **Each** test system will consist of a control workstation hosting NRL's integration and test software coupled with a specialized compliment of COTS and Custom electronics housed in standard equipment test racks – see Figure 1. The system will test Flight Electronics hardware at both the subsystem chassis level and at the spacecraft system level. The racks are designed with equipment that supports current industry standard interfaces as well as newly emergent technologies that enable the system to support NRL programs for many years into the future.

1.0 Space Electronics Development Lab Technical Requirements

The Contractor shall provide **two** test racks to accomplish the following functionalities:

1. *Ground Application Software Control & Network Connectivity*: Provide control of equipment racks via a Sun Workstation communicating with the space environment simulator chassis via Ethernet per equipment list. Provide for connectivity to external hardware via GPIB. Provide network connectivity with firewall and Ethernet switch.
2. *Spacecraft Environment Simulator (SES):* VME chassis with capability to support or provide RS-422 interfaces, Spacewire interface (1 rack only), 1553 interface (1 rack only), analog & digital outputs, analog & digital inputs, time synchronization, thermistor simulation,& high and low level commands. All functions shall be provided by the specific equipment defined in Table 1. Note that Table 1 defines the equipment and quantities that shall be installed in **each** (both) rack.
3. *Electronics Diagnostics*: Provide for real time bus analysis for Spacewire and 1553 standard interfaces in one of each racks only (e.g. 1553 bus in 1 rack, Spacewire in the other rack) via bus analyzer cards and embedded controllers as necessary. Provide for test and debug of space flight electronics equipment via an arbitrary waveform generator per the equipment list. This waveform generator shall be installed into the rack that includes the spacewire but analyzer equipment. Note that the diagnostic equipment in Table 2 defines a single quantity capability in 1 of each racks, not both, unlike Table 1 which specifies equipment to be installed in each/both racks.
4. *Spacecraft Uplink/Downlink Simulation*: Provide an interface to simulate uplink and downlink interfaces to spacecraft subsystems via a custom Command Encoding unit (CEU). The unit must be compatible with existing NRL CEU's installed in system and subsystem test units. The CEU shall be compatible with the existing NRL Common Ground Architecture test and operations software.
5. *Bus protection unit* (BPU) Custom unit providing protection against under voltage, overvoltage, reverse input voltage, current (diode) direction, and (over)voltage crowbar meeting established NRL criteria for time to effect.
6. *Power Supply, Power distribution and backup power*: Provide a power supply capable of delivering 30A at 40V or equivalent. Provide power distribution for equipment in rack. Provide back up power in the event of power loss for workstation and rack equipment. Provide a rack power warning light to externally indicate the power status of the unit under test. Provide a bus power elapsed time indicator. See equipment list.

7. *Structural*: Provide mechanical support for rack equipment as appropriate via rails and other hardware. Provide a pull out drawer in rack for tool storage. Provide a front panel power strip for powering external equipment.

In order to insure compatibility with existing NRL infrastructure designs, the test systems shall conform to the following:

1. *IO panels, parts, labels*: The racks will use IO connector part numbers, labeling and grouping as shown in Figure 1 below. Wiring shall be done such that Internal SES chassis cables are pinned 1-to-1 from VME cards to the SES IO panel using circular connectors (except for LAN). All SES wiring shall be presented to the SES IO panel. No cables will run from the SES IO panel to the rack IO panel
2. *Software drivers*: The test bed equipment will be exercised and controlled via NRL CGA (Command Ground Architecture) ground software and therefore must be compatible with existing CGA drivers. CGA software will be installed after the test system is delivered to NRL. No software, other than for purposes of test and checkout, shall be installed at contractor site.
3. *AC Power*: The test bed shall be powered by a 120V single phase input via L5-30 connectors. Appropriate grounding and shielding, where necessary, will be maintained throughout the equipment structure.
4. *Encapsulation*: The equipment shall be contained in a standard 1-bay equipment rack with lift points, forklift sockets and lockable casters. The encapsulation must be capable of supplying the appropriate cooling capacity based on the installed equipment requirements. The equipment racks must be structurally capable of supporting the installed equipment and handling the shock and vibration environments associated with transporting the equipment from the contractor's location to the NRL.

2.0 Material Requirements:

A ***recommended*** equipment list is provided in Table 1 and 2. Note that Table 1 defines the equipment that shall be installed in **each** rack, while Table 2 defines the equipment that is installed in only one of the two racks. The equipment necessary to accomplish the required functionalities shall be developed and/or procured and installed in the racks as specified herein.

3.0 Documentation:

The Contractor shall deliver the following commercial documentation package for each rack containing:

- System interconnect drawing and wiring diagram(s) detailing all connections and cables used in rack including a wire list.
- Bill of Materials listing all parts used to assemble the racks, including model, manufacture and serial numbers.
- Mechanical drawings detailing all exterior dimensions, lift points, and IO panels.
- All received 3rd party equipment documentation.

4.0 Warranty:

The contractor shall provide a standard commercial warranty against all parts and labor.

5.0 Performance Verification:

The contractor shall verify and test the full functionality of all custom hardware they are supplying to the system. The contractor shall also verify the standalone equipment going into the racks such as the power supplies, oscilloscopes, deck warning light, etc to ensure they operate properly after installation into the rack. The contractor is only required to test the more complex items, such as the VME cards housed in the SES or the bus analyzers, by powering up the card in the VME chassis and ensuring the proper power lights are strobed and any indicator lights reflect the proper state.

Figure 1: Rack Configuration & Installation Drawing

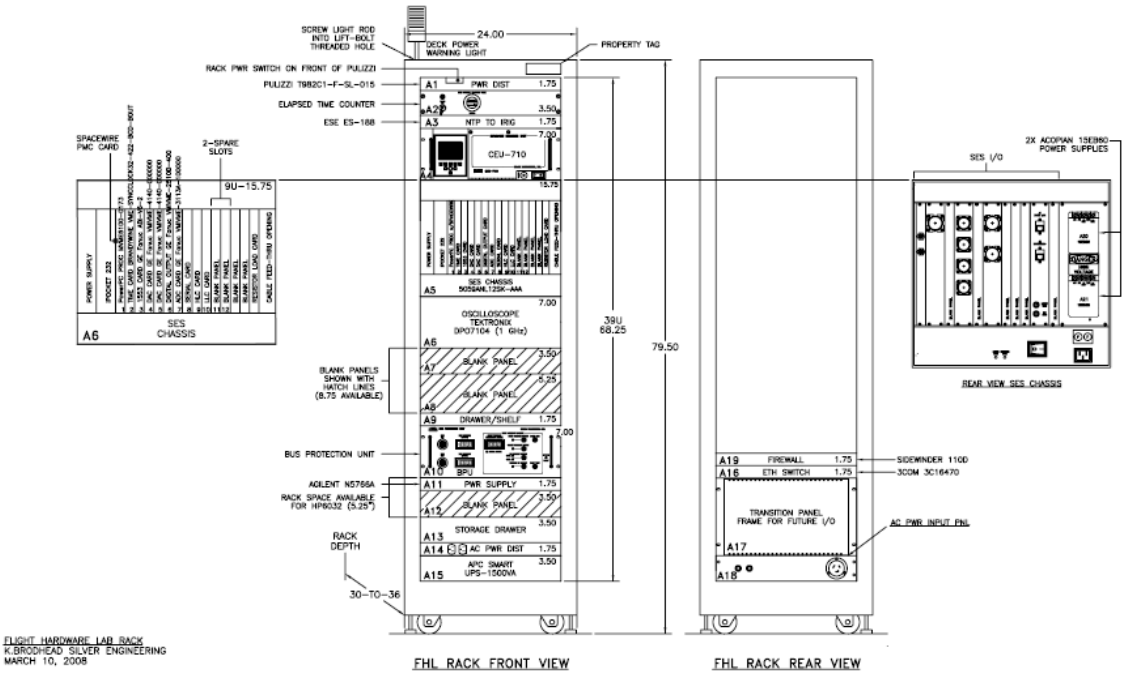

Table 1: Rack Equipment List

Item	Model #	Qty
Computers		
Sun Test & Control Workstation *		1
Support & Documentation PC **		1
Rack Equipment		
Rack Hardware		
Heavy Duty X-Bay Rack w/ Internal AC/Gnd		1
Bus Power Elapsed Time Panel		1
Transition Panel Frame		1
AC Power Input Panel		1
Deck Power Warning Light		1
Storage Drawer(s)		1
Pull-out Shelf/Drawer		1
Blank Panels		3
Spacecraft Environment Simulator (SES):		
VME64x 12-Slot Chassis	Carlo Gavazzi 5059ANL12SK-AAA	1
PowerPC Processor	Emerson MVME61006E-0173	1
Time Card	Brandywine Comm VME-SYNCCLOCK32 -422 -BCD- BOUT	1
DAC Board	GE Fanuc VMIVME-4140-000000	2
Digital Output	GE Fanuc VMIVME-2510B-400	1
ADC Board	GE Fanuc VMIVME-3113A-100000	1
Serial Board	GE Fanuc PMC-HS-SERIAL (11050-201)	1
Resistor Load Card	SEI	1
HLC	GE Fanuc VMIVME-1184-000000	1
LLC	GE Fanuc VMIVME-1184-000000	1
Ethernet to 232	Precidia iPocket 232	1
30V Power Supply	Ecopian 15EB60 wired in series	2
I/O Panel	SEI	1
Chassis Rack Adapter Ear	SEI	1
Electronics		
CEU	SEI	1
Power Supply - LAN	Agilent N5766A	1
GPIB to Ethernet Converter	National Instruments GPIB-ENET/100	1
Bus Protection Unit	SEI	1
Uninterruptible Power Supply	APC Smart UPS-1500VA	1
Ethernet Switch	3Com 3C16470	1
NTP to IRIG	ESE ES-188	1
Oscilloscope	Tektronix DPO7104 (1 GHz)	1
Oscilloscope Probes - Differential	Probe Master 4233	4
Oscilloscope Probes - Single Ended	Probe Master 5905-1RA	4
Firewall	Linksys RV082	1
Power Distribution	Pulizzi T982C1-F-SL-015	1

* Sun Test and Control Workstation

Purchase a system comparable to the capabilities listed below, in today's technology. One workstation per rack, quantity 2 total.

- A89-XHZB1-9AT-1GDU SUN ULTRA WORKSTATION
  1.34 GH ULTRASPARC IIIi PROCESSOR WITH 1MB ON-DIE L2 CACHE
  SUN XVR-300 GRAPHICS ACCELERATOR
  1 GB DDR1 MEMORY (2 x 512 MB DIMMs)
  1 x160 GB 7200 rmp SATA DISK

DVD-DUAL
2 x 10/100/1000 BASE T ETHERNET PORTS
2 SERIAL PORTS
6 UBS 2.0 PORTS
2 FULL-LENTH PCI-X SLOTS
3 PCLE SLOTS
SOLARIS 10 PREINSTALLED
RoHS-6 COMPLIANT

- X311L POWER CORD KIT NORTH AMERICAN/ASIAN, RoHS COMPLAINT
- X3738A TYPE 7 UNIX COUNTRY KIT, RoHS-6 COMPLIANT
- X311L POWER CORD KIT NORTH AMERICAN/ASIAN, RoHS COMPLIANT
- X7205A 19-INCH TFT LCD COLOR MONITOR, 19-INCH VIEWABLE AREA, 0.294mm PIXEL PITCH, BRIGHTNESS 300cd/m2 (typ),500:1 CONTRAST RATIO (typ), REASPONSE TIME 5ms (typ), 1280x1024 @ 60Hz, 170 DEGREE VIEWING ANGLE, INTERNAL POWER SUPPLY, TILT, ANALOG(HD15) AND DIGITAL INPUT(DVI), 410mm(W)x406mm(H)x213.7mm(D), WEIGHT:3.9kg/ 8.59lbs, POWER CONSUMPTION 37 WATTS MAX, HD15 TO HD15 VIDEO CABLE AND DVI-D TO DVI-D VIDEO CABLE INCLUDED, WW AGENCY COMP, ENERGY STAR, TCO '99, EU, CHINA, RoHS COMPLIANT

**** Support & Documentation PC**

Purchase a system comparable to the capabilities listed here, in today's technology. One PC per rack, quantity 2 total. One PC per rack, quantity 2 total

- Intel Pentium D Processor 820 Genuine Window XP Professional
- PS2 NTFS File System for Operating Systems
- 2.0GB DDR2 Non-ECC SDRAM
- 533MHz
- Monitor - Dell 20" UltraSharp 2007FP PCIe 256MB ATI Radeon X600, Dual Monitor DVI or VGA
- 250GB SATA 3.0Gb/s & 8MB DataBurst
- 1.44MB 3.5" Slimline Floppy Drive
- Dell USB Enhanced Multimedia Keyboard
- Dell USA 2-Button Optical Mouse, Mouse Pad
- Integrated AC97 Audio Stereo Speakers
- 8X DVD+/-RW, w/Sonic Software and Cylerlink Power D
- RoHS Compliant lead Free Chassis and Motherboard

Table 2: Diagnostic Equipment List

Diagnostic Equipment		
Spacewire Bus Analyzer	4Links ESL-RG401/8 with the following options: Error reporting, Error Waveforms, Time Code Generator and Time tags	1
1553 Bus Analyzer	GE Fanuc BT3-QPCI1MW	1
Arbitrary Waveform Generator	Tektronix AWG 7052	1
1553 Board	GE Fanuc ABI-V6-2	1
Spacewire PMC Card		1