Electrical Ground Support Equipment Overview

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EGSE Functions

• EGSE Mission

  – Provide common ground based operations infrastructure
  – Support subsystem I&T including realtime software development
  – Support T&DF development
  – Support requirements verification testing
  – Support LAT integration and test operations
  – Provide environment for prototyping IOC functions, procedures, and processes.
EGSE Functions

• Provide common infrastructure
  – Command and control, including test procedures
  – Telemetry acquisition, archive, and distribution
  – Health, status, and data quality monitoring
  – Support data visualization tools
  – Support subsystem engineering displays and EGSE

• Support subsystem development
  – Trigger & dataflow system
  – Flight software environment, FSW Testbed
  – ACD, CAL, and TKR subsystems I&T

• Support integration and test
  – Verification Testing
  – Qualification/Calibration Unit I&T
  – Subsystem receiving inspections
  – LAT I&T including environmental testing
  – Mission Systems Integration & Test
Evolutionary EGSE Development

Subsystems Development

T&DF Development

LAT Flight Software Testbed

LAT Integration & Test

Mission Systems Integration & Test

S. Williams

IOC/SAS Interface
LAT GSE Interfaces
GLAST GSE Interfaces
GLAST Flight Interfaces
EGSE Requirements Sources

EGSE requirements are traceable to several sources

- LAT Performance Specification LAT Trigger & Dataflow Specification
- LAT Power System Specification
- LAT Flight Software Performance Specification
- LAT IOC Performance Specification
- LAT Verification Plan
- LAT Integration & Test Plan
- Subsystem Integration & Test Plans
- LAT IOC Verification Plan
- SI-SC Interface Requirements Document, 433-IRD-0001
- GLAST Mission Assurance Requirements, 433-MAR-0001
EGSE WBS Organization

GLAST IPO
SU-SLAC

Electronics & Data Acquisition
WBS 4.1.7
G. Haller, SU-SLAC

EGSE Integrated Product Team
S. Williams, SU-HEPL
D. Nelson, TKR, SU-SLAC
B. Phlips, CAL, NRL
B. Schaeffer, ACD, GSFC
M. Lovellette, E&DA, NRL
D. Lauben, IOC, SU-HEPL
A. Waite, FSW, SU-SLAC
D. Wood, FSW, NRL
TBD, I&T, SU-SLAC

Electrical Ground Support Equipment & Operations
WBS 4.1.7.A
S. Williams, SU-HEPL

EGSE Requirements
WBS 4.1.7.A.1
S. Williams, SU-HEPL

1 Requirements
2 System Conceptual Design

EGSE Development
WBS 4.1.7.A.2
TBD2, SU-HEPL

1 S/W Development
2 H/W Development
3 EM2
4 Qualification Unit
5 Flight Unit

Spacecraft Interface Simulator
WBS 4.1.7.A.3
TBD3, SU-HEPL

1 SIS Development
2 Qualification Unit
3 Flight Unit

Instrument Power Supply
WBS 4.1.7.A.4
TBD3, SU-HEPL

1 IPS Development
2 Qualification Unit
3 Flight Unit
EGSE Products

- **4.1.7.A.2 EGSE**
  - Realtime System and RTOS, application S/W
  - Network
  - Workstation/Software
    - Realtime S/W development environment
    - Test executive software
    - Data acquisition, archive, and distribution
    - Data visualization

- **4.1.7.A.3 Spacecraft Interface Simulator**
  - Realtime System and RTOS, application S/W

- **4.1.7.A.4 Instrument Power Supply**
  - Power supplies
  - Configuration control and monitoring
## Work Breakdown Structure

<table>
<thead>
<tr>
<th>WBS</th>
<th>Task</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1.7.A</td>
<td>EGSE &amp; Operations</td>
<td>All labor and material required for the ground support for the LAT electronics. Provides interfaces to the LAT via the spacecraft interface unit. Simulates the spacecraft functions required to control and readout the LAT.</td>
</tr>
<tr>
<td>4.1.7.A.1</td>
<td>EGSE Requirements Definition</td>
<td>All labor required to define the requirements of the EGSE system.</td>
</tr>
<tr>
<td>4.1.7.A.2</td>
<td>EGSE Development</td>
<td>All labor and material required to develop the EGSE to support the control and readout of the LAT electronics, hardware and software.</td>
</tr>
<tr>
<td>4.1.7.A.2.1</td>
<td>EGSE S/W Development</td>
<td>Development of software for Engineering Model 1 EGSE</td>
</tr>
<tr>
<td>4.1.7.A.2.2</td>
<td>EGSE H/W Development</td>
<td>Development of hardware for Engineering Model 1 EGSE</td>
</tr>
<tr>
<td>4.1.7.A.2.3</td>
<td>EM2 Support</td>
<td>EGSE support for LAT Engineering Model 2</td>
</tr>
<tr>
<td>4.1.7.A.2.4</td>
<td>Qual Unit Support</td>
<td>GSE support for LAT Qual Unit</td>
</tr>
<tr>
<td>4.1.7.A.2.5</td>
<td>Flight Unit Support</td>
<td>GSE support for LAT Flight Unit</td>
</tr>
<tr>
<td>4.1.7.A.3</td>
<td>S/C Interface Simulator</td>
<td>All labor and material required to build and operate spacecraft interface simulator as seen from the LAT.</td>
</tr>
<tr>
<td>4.1.7.A.3.1</td>
<td>SIS Development</td>
<td>Design and develop EM2 SIS</td>
</tr>
<tr>
<td>4.1.7.A.3.2</td>
<td>Qual Unit Support</td>
<td>Production of LAT Qual Unit SIS</td>
</tr>
<tr>
<td>4.1.7.A.3.3</td>
<td>Flight Unit Support</td>
<td>Production of LAT Flight Unit SIS</td>
</tr>
<tr>
<td>4.1.7.A.4</td>
<td>Instrument Power System</td>
<td>All labor and material required to build the EGSE power supply system for the LAT.</td>
</tr>
<tr>
<td>4.1.7.A.4.1</td>
<td>IPS Development</td>
<td>EGSE power system development</td>
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<tr>
<td>4.1.7.A.4.2</td>
<td>Qual Unit Support</td>
<td>Power supplies for LAT Qual Unit</td>
</tr>
<tr>
<td>4.1.7.A.4.3</td>
<td>Flight Unit Support</td>
<td>Power supplies for LAT Flight Unit</td>
</tr>
</tbody>
</table>
Balloon Flight EGSE

Balloon, telemetry, disk read

Archive, dataHub

Gse clients, private net

Single command console for flight

Outbound internet access via firewall router
Electronics Development Cycles

- EGSE must support electronics development
- Engineering Model 1 (EM1)
  - Tower Electronics Module or ACD Electronics Module
- Engineering Model 2 (EM2)
  - Complete T&DF electronics using commercial parts
- Qualification
  - Thermal Vacuum
  - Vibration
  - EMI/EMC
  - Power
- Flight
  - Fully qualified
**EM1 EGSE**

**Functions**
- Support development of Tower Electronics Module (TEM)
- Support subsystem development, integration and test
- Support initial flight software development
- Support LAT integration and test of subsystems during LAT assembly

**Concept Description**
- Custom TEM interface board
- COTS cPCI chassis with PowerPC CPU and ethernet interface
- EGSE Workstation (Linux or Solaris) dual home ethernet with VxWorks environment
**EM2 EGSE**

**Functions**
- Support development of Trigger and Dataflow System
- Support Flight Software Testbed
- Support Qual/Cal Unit I&T
- Support Flight LAT I&T

**Concept Description**
- Spacecraft Interface Simulator with COTS cPCI chassis, PowerPC CPU, ethernet interface, MIL-STD-1553 interface, Serial data interface, Analog and Discrete I/O
- EGSE Workstation (Linux or Solaris) dual home ethernet with VxWorks environment
- Instrument Power Supply under computer control
- Ethernet Router/Firewall
Subsystem Support

• **EGSE Support - 4.1.7.A**
  – EGSE systems for integration and test
    • Common command/configuration environment - TBD
    • Common data visualization and analysis tools - e.g. ROOT
    • Realtime s/w development environment - e.g. Tornado

• **Other Hardware Support - 4.1.7.4/5/6**
  – Hardware simulators
    • Memory based front end detector simulators
  – Provide subsystems with firmware support.

• **Flight software group is committed to providing subsystem test support for the detector development - 4.1.7.7**
  – The emphasis is on RTOS support
    • Provide low-level utilities to access the hardware.
    • Provide a framework to construct a test environment.
    • FSG does not write acceptance test code.
## EGSE Deliverables

<table>
<thead>
<tr>
<th>Function</th>
<th>Version</th>
<th>Number</th>
<th>Need Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEM Development</td>
<td>EM1</td>
<td>2</td>
<td>Nov-01</td>
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<tr>
<td>Subsystem I&amp;T</td>
<td>EM1</td>
<td>6</td>
<td>Mar-02</td>
</tr>
<tr>
<td>LAT I&amp;T</td>
<td>EM1</td>
<td>2</td>
<td>Apr-03</td>
</tr>
<tr>
<td>T&amp;DF Development</td>
<td>EM2</td>
<td>1</td>
<td>Sep-02</td>
</tr>
<tr>
<td>FSW Tesbed</td>
<td>EM2</td>
<td>1</td>
<td>Dec-02</td>
</tr>
<tr>
<td>Qual/Cal Unit</td>
<td>QU</td>
<td>1</td>
<td>Apr-03</td>
</tr>
<tr>
<td>Flight Unit</td>
<td>FU</td>
<td>1</td>
<td>Aug-03</td>
</tr>
</tbody>
</table>

### Total Systems

- Engineering Model 1 - 10
- Engineering Model 2/Qual Unit/Flight Unit - 4