GLAST Large Area Telescope:
MGSE, Flight Integration HDWR,
Design / Status Review

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AGENDA

• Introduction
  – Scope
  – Review Goals and Ground Rules
  – Requirements Hierarchy
• MGSE Required for Assembly / Disassembly of the LAT ( SLAC Ops )
  – List
  – Design Over View
    • Long Lead Items
      – Analyses Results
      – Single Failure Point Items
    • Readiness Verification
  – Schedule
    • Long Lead Items List
  – Summary
  – Additional Status
    • Two TWR ESA Beam Test Stand
    • Environmental Test Rotation Option
Introduction

• Scope
  – Provide detailed design / functionality of Long Lead I&T provided MGSE for LAT Integration (and De-Integration that is hopefully not needed!)

• Goals
  – Receive Constructive Comments regarding operations methodologies and MGSE capabilities
  – Obtain Authorization to Proceed (ATP) for Long Lead Procurements affecting Near Term Objectives (NTOs)
    • Obtain concurrence for MGSE sub-schedule milestones
  – Define Open Issues / Actions

• Ground Rules
  – Asking for Clarification is Good; Avoid Debates
  – Ask Specific Questions
    • If Questions aren’t addressed adequately, Request Action Item
    • Write Down Action and Present for Management Concurrence
      – One issue per Action (Avoid several actions in one para. / essay)
MGSE NASA Requirements

• Requirements Hierarchy
  – GSFC Program Agreements (Approved RFA Responses)
    • GLAST LAT Performance Specification, LAT-SS-00010
    • GLAST Mission System Specification, GLAST00074
    • Mission Assurance Requirements Document for the Gamma-Ray Large Area Telescope, GLAST00110
      – GLAST SC / Delta II LV Interface Requirements Document, 433-IRD-003
      – General Environmental Verification Specification for STS & ELV Payloads, Subsystems and Components, GEVS – SE
      – NASA-STD-8719.9 Lifting Devices and Equipment
        » Allows Project to Define Requirements Acceptable to NASA Program Office (Process can be labor intensive)
• Requirements Hierarchy, Cont.

• EWR – 127.1 East – West Range Safety Requirements
  – I&T Decision to avoid requirements development / Program Authorization cycle(s)
  – At CDR GSFC Directed that Lift Devices and Equipment have Factors of Safety (FoS) of 5 X Against Ultimate (More semantics than bite)
    » Sounds more conservative than EWR 127.1
    » Actual 127.1 Requirement is FoS of 3 X against Yield, if Yield Stress is < 85% of Ultimate Stress; If Yield Stress is > 85% of Ultimate, then FOS is 5 X against Ultimate
  – LAT will meet EWR 127.1!

• JSC - 22267 NASA / FLAGRO, or equiv
  – Invoked by EWR 127.1 for Single Failure Point Items
MGSE Requirements, Cont.

• Requirements Hierarchy, Continued
  – LAT - TD - 00676, Rev. Current
    • LAT Integration Sequence
      – Top Level (Realized to be an iterative working document)
        » Detailed plans and procedures will likely find new needs for small items
  – LAT - TD - 01462, Rev Current
    • SLAC MGSE Development Plan (Requires Minor Update)
  – Reference Docs
    • NASA - STD - 5005A GSE
    • ASME B30.1 SLAC Requirements for Jacks
      – Consistent with EWR 127.1
MGSE Overview

Total of 31 MGSE items to be produced for LAT integration

• Big Hardware Items
  – Rotation Stand
  – Personnel Access Platforms
  – Grid Perimeter Ring (GPR); Primary support for LAT
  – Support Shaft-Flange Assemblies
  – GPR to Grid Support Brackets

• Drawings
  – Critical Path Detail Drawings are 80% complete
  – Detailed drawings are 55% complete
    • Drawing will be processed through CCB after completion of Formal Stress Analyses Reports
      – Structures will be signatories to CCB approval process
MGSE Overview

• Drawings, Continued
  – Interim Stress Analyses all Good to Go
  • Final Reports in Work –
    – Only need two more man weeks
• MGSE that may be used at Launch Site
  – All Safety related MGSE data must be delivered to Spectrum Astro-Space for their inclusion into their Missile System Pre-Launch Safety Data Package (MSPSP)
  – Cape Canaveral Operations (SLAC Safety validation req’d)
    » HDWR is not allowed on site until has been reviewed and Approved by the US Air Force / their designee
    » Formal Data Package required at site 45 to 60 days prior to hardware arrival

• Concepts to be Presented today May Work for Calibration Unit Beam Test and Environmental Test
  – Propose Review of details After Integration Hardware and Analyses Mature
LAT Rotation Stand – Personnel Access Platform

• Design Philosophy
  – Maximize parallel work area in the Integration Hall
  – Minimize mechanical preparation for Flight work Ops

• Status
  – Two Concepts for Personal Access Platform are completed
  – No major issues
  • Primary Concept minimizes impact to work area, but impacted Integration Stand (aka LAT Rotation / Support Stand)
    – Minor impact; delays final detail drawings by ~ 10 to 15 days if Stress Analyses complete in parallel
  • Second Concept impacts work area and time for mechanical preparation Ops
    – Not part of presentation; In back up charts

• Issue – Both Concepts take up more Rm 104 “Real Estate” than desired
  – See Concept Views after Hardware List (please be patient)
    – Views do NOT imply detail drawing maturity; much work to do
LAT MGSE Review – Hdwr List

- LAT 4 x 4 Rotation / Support Stand (including drive system and flex coupling)
- GPR and GPR to Grid attach bracketry
- Support Shaft-Flange Assemblies, GPR to Rotation / Support Stand
- LAT Z Axis Vertical Lift Fixture
- LAT Z Axis Horizontal Lift Spreader
- 1 x 4 Lift Spreader Design
- Personnel Access Platform (Interfaces to Rotation Stand Weldment)
- Proof test weights for LAT Lift Fixture, GPR, GPR to Grid brackets, Support Shaft Flange Assemblies and Rotation Stand
• CAL –Z Up Lift Fixture, Complete and Ready for Use

• CAL +Z Up Lift Fixture, Design Complete, $700.00 to build

• TKR Lift Fixture – Provided by TKR

• TKR Alignment System

• Crane Scale; Calibrated and ready to use

• CAL Alignment Tool

• CAL Alignment Rods
• TKR to TKR No Touch During Ascent Verification Tool

• TKR Cable Attachment to Bay Side Wall Tooling

• TKR Thermal Tie flex / positioning tool

• CAL Inversion Stand; Systems available for EM Series

• Metrology Bay for Shimming E-Box Height with respect to CAL Grid Interface – In Procurement

• Metrology Bridge – Goes away since Laser Trackers can do job

• LAT Z Axis Horizontal Support Braces
• Menning Plate Installation Equipment

• Interim Integration E-Box support brackets TBD

• Electrical Cable Connector Torque Tools

• Lift Fixture relocation dollies; Use Lead Stack dollies from EM Series

• ACD Low Profile Integration Stand

• Brackets to hold Lift Fixture Spreaders on top of Bonded Stores Containers
• Ambient Test Thermal Control System
  – Not part of this review

• 1 x 4 EM-Calibration Unit Rotation Stand
  – EM – Cal Rotation Stand to 1 x 4 Grid Interface Plates

• TWR (TKR, CAL, TEM, TEM PS) Mass Simulators

• Rotation Axis “Riser Block” Sub-Assys
DETAILS
LAT MGSE Review – Details

• LAT 4 x 4 Rotation / Support Stand (including drive system and flex coupling)
  – Design 90% complete; Detail Drawings about a 1.5 weeks away
  – Analysis shows compliance with EWR 127.1; More later
  – Primary Weldment Heavily Impacted by Personnel Access Platform
    • About 1.5 weeks to go for detailed drawings of Primary Support Structure (PSS)
      – PAP interface definition maturing nicely (detail drawings about two weeks after PSS)

• GPR and GPR to Grid attach bracketry
  – Analysis shows compliance with EWR 127.1
  – Design & Detail Drawings 99% complete (need final tolerance check and processing notes)
  – GPR increased along X Axis by 6” Total
    • Reduce risk while lifting GPR away from LAT
    • 92” x 96”GPR and GPR to Grid Fits within Existing MGSE Useable Envelope
      – No CCB Required!

• Support Shaft-Flange Assemblies, GPR to Rotation / Support Stand
  – Analysis shows compliance with EWR 127.1
  – Design & Detail Drawings Complete (need to design weld fixture)
  – Processing notes complete; Verified for EM & 1 x 4 Grid Shafts
  – 15-5 PH, Cond 1100
A Frame Stand with PAP, Small
A Frame Stand with PAP, Small

Personnel Platforms Up

Personnel Platforms Down
A Frame Stand with PAP, Small
A Frame Stand with PAP, Small
A Frame Stand with PAP, Small
A Frame Stand with PAP, VdG

Rough
Look More
Accurate
Layouts Are
Needed

2' of Clearance
From Stand to
Wall for Egress

~ 95"
4x4 Integration Stand Budget - Cost Summary

• PMCS Budget
  – Integration Stand Total $78K
  – GPR $9.5K
  – LAT Z Up Lift Fixture $8.7K
  – CU Beam Test Stand none

  Total Budgeted $96.2K

• Current Cost Estimates
  – GPR $16.2K
  – Support Shaft-Flange Assemblies $7.5K
  – 4x4 Integration Stand (See IDL for Breakdown) $57.9K
    • Includes Support Stand and PAP

  Total Mature Estimate $81.6K

Total Delta ( + = available to use for other MGSE ) + $14.6K
LAT Support Structure; GPR, Support Shafts & Brackets

- **Design Philosophy**
  - Bolt together frame
  - Precise bracketry with Respect to Grid Attach Interface

- **Status**
  - Detailed Drawings of all pieces 100% Complete
  - Stress Analysis completed and shows compliance to EWR 127.1
  ( > 5 x against Ultimate )

- **Issues**
  - Interference with heater control box connector is resolved
    - Need to review Clevice Pin Removal Access Envelope
      - Requires update to MGSE Allowable Envelope for SLAC Use Only?
      » Technically speaking, considered minor issue
GPR Complete

GPR Corners Held Together Using Four ea ½” 180 KSI Bolts into Keenserts

Each Corner Includes Two Capped Tapered Pins for Shear and Re-Assy Alignment

Support Shaft Flange Assys Held to GPR by Eight ea 180 KSI Bolts into Keenserts

Two Capped Tapered Pins for Shear and Re-Assy Alignment
• GPR Corner Attach Design
  – Same concept used for GPR to Grid Attach Brackets and for T-Vac Stand

![Diagram of GPR Corner Attach Design]

- GRID PERIMETER RING
- TAPERED PIN
- MAIN SUPPORT BRACKET
- DETAIL A 1:2
- DETAIL C
- SCREW, 1/2-20 UNF-2A T3.0
- WASHER, FLAT NAR 1/2 (4X PER BRACKET)
- SET SCREW 5/16-18, 1/2L
LAT Support Shaft / Flange Assys

- Fabricated of 15-5 Precipitation Hardened Corrosion Resisting Steel
  - Cond 1100 (ºC) Material Properties
    - Yield Strength of 115 KSI
    - Ultimate Strength of 140 KSI
  - Weld and Heat Treatment Process
    - Defined and verified for EM-1 Series; Shafts are beautiful!
    - SLAC Welders though not specifically certified know how to do it
    - Weld rod is expensive and in house (with certs)
    - SLAC Furnace is much lower cost that outside vendors
    - SLAC Furnace is large enough to do Rotation Stand Shaft-Flange Assys and Z Axis Horizontal Lift Spreader all at the same time
  - Only about 20% more expensive than steel if purchased from Fry Steel Co.
    - Material Composition Analysis and Proof Test Certifications are free if requested at time of purchase
    - Other vendors are much more expensive
LAT Support Shaft / Flange Assys

- Shaft and Flanges are 15-5 PH
  - Annealed condition at receipt of raw materials
  - Machined prior to welding operation
  - Post weld Heat Treatment: Anneal then Precipitation Harden to Cond 1100; About 2.5 days of processing
  - Post Heat Treatment final machining to ensure perpendicularity of shafts to flange

- J-Groove & Chamfer Weld Preps Proven for EM Shafts
- Taper Pin Receptacles Machined after Perpendicularity Face Cut is Complete
- Attach holes initially drilled as \( \frac{1}{4} \)" dia for attachment of Weld Jig
- Attach holes Increased to 0.530”, for \( \frac{1}{2} \)” Bolts, After \( \perp \) Face Cut
LAT Support Shaft / Flange Assys

- Pre weld machine, weldment, post heat treat machining drawings are ready for CCB release cycle
  - Stress Analysis result Good to Go; More detail later in presentation

- Cost
  - Shafts
    - Two pieces 3” OD by 30” long each ~ 120 lbs
    - $3.43 / lb + $8.00 cut charge; Total ~ $420.00
  
  - Flanges
    - Two pieces 30” long by 6” wide by 1.3 thick ~ 140 lbs
    - $4.30 / lb + $8.00 cut charge; Total ~ $600.00

  - Shipping $30.00 / 70 lbs
    - 120 lbs + 140 lbs = 260 lbs; 260 / 70 = 3.7; 4 x $30.00 = $120.00

  - Total Raw Material, Shaft-Flange Assy, Cost $1,140.00
LAT Support Shaft / Flange Assys

- Pre-weld machine preps (Diamond Tool & Die) ~ $1,000.00
- Welding & Cleaning ~ $1,400.00
- Anneal & Heat Treat ~ $1,400.00
- Post Heat Treat Machining ~ $2,200.00
- Dye Penetrant inspections (pre & post proof test total) ~ $200.00
- Post Dye Penetrant Test Passivation ~ $150.00

- Total Processing Cost ~ $6,350.00

- Total cost of Shaft-Flange Assemblies:
  ~ $1,140.00 + $6,350.00 = $7,490.00
Grid Perimeter Ring & Attach to Grid Brackets

Prior design for 86” by 96” GPR, GPR to Grid Attach Bracket

New design for 92” by 96” GPR, GPR to Grid Attach Bracket

Same Raw Material Al, 6061 – T6

New design is 3” longer along X Direction

Stress: Good to Go

Radiator Corner Mount Bracket
Grid Perimeter Ring & Attach to Grid Brackets
Grid Perimeter Ring & Attach to Grid Brackets
Top Looking Down View

Grid attached to GPR - Brackets

We Now Have Similar Working Clearances on X and Y sides of LAT

Working Clearance Will Greatly Reduce Risk to ACD for GPR Bracket Removal and GPR Lift Away Ops

92” x 96” GPR
Grid Perimeter Ring & Attach to Grid Brackets

Side View, 92” x 96” GPR

GPR-Brackets with Grid, RCMBs and EMI Skirt Sections
Grid Perimeter Ring & Attach to Grid Brackets

92” x 96” GPR in LAT Integration Stand

Wheel used only when Moving Support Ends After Stand Disassembly
92” x 96” GPR in LAT Integration Stand

LAT Z Axis Horizontal

Wheel used only when Moving Support Ends After Stand Disassembly
Grid Perimeter Ring & Attach to Grid Brackets, Cont.

- Allied Engineering and Production Co estimates:
  - Total machining time GPR and GPR to Grid attach brackets ~ 96 hr at $107.00 / hr = $10,272.00
  - Final machining of Clevince tabs can be done as an assembly
    - Virtually ensures fit to Grid, especially if Grid ‘As Built’ Dims are known and can be fed to Allied prior to final machining
    - Is this level of precision required?
  - Raw Material Cost (GPR & Brackets) ~ $4,200.00
  - Anodize GPR beams $670.00
  - Anodize brackets at SLAC $250.00
  - Transport box, foam, packaging and freight ~ $750.00

Total ~ $16,150.00

- Cost is ~ $6K higher than originally planned
  - Biggest cost driver is difficulty moving heavy articles around machine and surface coating shops
  - Didn’t consider transport box and freight
  - Raw materials informal estimate a year ago was $2,800.00
Grid Perimeter Ring & Attach to Grid Brackets

- Detail design is 100% Complete; drawings are in Check Cycle
  - Plan to remove raw material acceptable void inspection
    - Saves about $1,200.00
  - Plan was to purchase 6.25” by 4.25” plate and cut lengths
    - 4.25” thick plate was available last year
    - 4.0” and / or 4.5” thick plate is available now
    - If we use 4.0” plate, width of GPR beams may reduce to 3.8”
      - Stress Analysis indicates final width of 3.8” will meet strength requirements with required Factors of Safety; More detail later in presentation
• Double Worm Gear Drive; Winsmith 951 Series
  – Selected Part Number 951 MDBD2000 RDL 56C
• 2000 : 1 Ratio
  – Output RPM with 1760 RPM Input Motor : 0.88 RPM
    » Time for 180º Rotation ~ 34 Seconds [ ( 1 ÷ 0.88 ) ÷ ( 2 ) x 60 = ]
    » Tip Speed of Outermost Corner of GPR :
      » ( 0.88 ÷ 60 ) 2 π = 0.092 rads/sec;
      » V = rω → ( 0.092 rads/sec ) ( 46 in ) = 4.2 in/sec
  – Output RPM with 1160 RPM Input Motor : 0.58 RPM
    » Time for 180º Rotation ~ 52 seconds
    » Tip Speed of Outermost Corner of GPR :
      » ( 0.58 ÷ 60 ) 2 π = 0.061 rads/sec;
      » V = rω → ( 0.061 rads/sec ) ( 46 in ) = 2.8 in/sec

• Max Continuous Torque : 23,200 in lbs
  – High Torque can Reduce QTY of TKR-CAL Mass Simulators
• Double Worm Gear Drive; Winsmith 951 Series, Continued
  – Max Output Shaft Thrust : 6,800 lbs
  – Max Output Shaft Overhung Load : 7,035 lbs
    • Unnecessary Risk with Respect to Earthquake
      – Not worth Analysis time
      – Go with Moment managing Pillow Block Bearings
  – Gear Lash
    • Standard OTS : 11 to 17 Arc – Minutes
      – 17 minutes ÷ 60 minutes/° ( π radians / 180° ) = 0.005 radians
        » S = rθ radians ; 0.005 radians ( 46 in radius ) = 0.227” Lash at GPR’s Outermost edge
  – Lead Time : 2 Months
    • Cost : $6,600.00 with Improved Paint Over Coat
Rotation Drive Detail, Cont.

• Bearings
  – Reaction Force bearing housing must accommodate
    • Max (from Earthquake) is 20,500 LBS Vertically Up
    – Split Bearing Part No. SP4B517-SAFS-300TT can react 39.9 K lbs
    – Lead Time 5 to 8 weeks
    – Cost: $770.00 ea x 4 = $3,080.00

Each Housing Attached to Stand with Four 5/8” by TBD Long Bolts

Split Top Attached to Housing with Two 5/8-11 UNC-2A X 3-1/4” Long GRADE 8.3 Bolts
Rotation Drive Detail, Cont.

- **Bearing Attach Fasteners**
  - Grade 8 by TBD – UNF TBD Threads/in
  - Material Composition Analysis and Proof Test Certifications Required
    - Will add about $250.00 to cost of bolts

- **Flanged Flex - Flex Gear Coupling (for min lash; Mfr LoveJoy Corp)**
  - Torque capability, Type F Gear Coupling, Flex – Flex 94,500 in lbs
  - Max Mis-Alignment: 0.115” @ 4,000 RPM
  - Lead Time: 6 Weeks
  - Cost: $750.00
• Z Axis Vertical Lift Fixture

Structural Box Beam
8” High by 6” Wide by 0.38” Thick
• Z Axis Vertical Lift Fixture

8” High by 6” Wide Spreader Cross Section

6” Clearance Between ACD and Lift Fixture’s Lowest Feature

CDR Rotation Stand Concept; Same Rotation Axis Height as PAP Stand
LAT Z Axis Vertical Lift Fixture; Design TBD% complete
  – Need to define Turnbuckles (3/4” CRES 316) and attach rod lengths
    • 3/4” OTS Turnbuckles Rated for 5,200 lbs each
  – Analysis status: Solution for 8” High by 6” Wide Spreader
    • Model is 95% Complete
    • Detail Drawings ~ 15% Complete
    • Estimated cost ~ $15K
      – $8.7K in current budget
LAT Z Axis Horizontal Lift Spreader

- Analysis shows compliance with EWR 127.1
- Design & Detail Drawings 75% complete (need final tolerance check and material processing notes)
- Beefy Cross-Section 11” High by 3” thick
- A36 Steel Solution, Drawings in work

A36 Solution
3” Thick by 11” High

Handles to Assist Shackle Attach Ops

Attach Plates made of 15-5 PH
May Not be able to keep Existing Scale in the Loop for Lift Ops

Rotation Axis 53” from floor surface at first lift
LAT MGSE Review – Details

• Personnel Access Platform (Interfaces to Rotation Stand Weldment)
  – Model Design 55% complete
  – Stress Analysis waiting for detailed design to mature (about 1-2 weeks from now)

• Proof test weights for LAT Lift Fixture, GPR, GPR to Grid brackets, Support Shaft Flange Assys and Rotation Stand
  – Concept stage; No detailed design as yet
  – Not viewed as a schedule impact problem if started soon
• Metrology Bay for Shimming E-Box Height with respect to CAL Grid Interface
  – Released and In Procurement
LAT MGSE Review – Details

• **Z Axis Vertical Lift Fixture**
  - Assembly of ACD onto LAT when LAT is in Rotation Stand
    • Not Possible with LAT +Z Up Lift Fixture
  - A-36 Solution provides enough hook height to remove LAT from Rotation Stand
    • Layout in work to determine if existing Crane Scale fits in loop
    • Layout in work to determine if LAT can be placed into LAT Transport Container
      - LAT Transport Container Vibration Isolation Analyses are nearing point of recommendation (Good Work Youssef!)
## NEAR TERM MGSE Review - Fabrication Schedule

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<th>Early Finish</th>
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<td>Formal Stress Analyses Reports</td>
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<td>02/06/04*</td>
<td>03/09/04</td>
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*Note: Durations and dates are approximate and subject to change.*
• Need Authorization to Proceed for:
  – Purchase of long lead items
    • GPR frame pieces
    • GPR to Grid attach bracketry
    • Support Shaft Materials and Machining
    • Bearings
    • Rotation Drive, Flex Coupling & Drive Motor

  – Rotation System Weldment
  – LAT Lift Spreaders
    • Z Axis Vertical (Analysis Report in work)
    • Z Axis Horizontal (Analysis Report in work)
  – Proof Test Hardware
    • Design to begin after GPR ATP
Optional Use for 4x4 Integration Stand Sub-Assemblies

- One end of Support Stand with Personnel Access Platform can be modified to Support Two Tower ESA Beam Test
  - Drive System would need position indication encoders and possibly stepper motors – driver electronics
  - ROM Cost estimate is ~ $25K Engineering and $30K for materials and Test Check-Out
Additional Status – Two TWR Test

Lowest Position

- ESA Beam Line
- 80.4”
- 81.5”
- 73.1”
Additional Status – Two TWR Test

Highest Position

- ESA Beam Line
  - 89.2”
  - 81.5”
  - 81.8”
• Rotation Axis “Riser Block” Sub-Assys
  – Raises Rotation Axis by 27.25” to accommodate Rotating LAT with Radiators Installed after Acoustic Test (Used Only at NRL)
  – Needed if GSFC Provided Acoustic Test Stand Supports LAT with Z Axis Vertical
    • Prefer Z Axis Horizontal for Acoustic Test
    • Risky Op, “Do able, but Risky !!!”
  – Radiator Supports not started yet; not viewed as schedule impact
A Frame Stand with PAP, Small

10'-4.1"

6'-9.1"

4.00

14'-9.5"
ACD Lift Operations Status

- ACD to LAT ICD, Doc No. LAT-SS-0363.3, Rev. Dated April 04, 2002
  - Indicates there shall be TBD inches clearance between ACD and TKR during integration
  - Indicates that the ACD Multi-Purpose Lift Sling (MPLS) provides >300 mm [12"] clearance between load spreader apparatus and surfaces of ACD
  - Invokes ACD-Req-7002 against ACD MPLS

- ACD to LAT ICD, Doc No. LAT-SS-0363-04, Rev. Dated Sept. 04, 2002
  - Indicates there shall be 1 inches clearance between ACD and TKR during integration

- ACD to LAT ICD, Doc No. LAT-SS-0363-04, Rev. Dated Sept. 04, 2002
  - Indicates there shall be TBD inches clearance between ACD and TKR during integration
ACD Lift Fixture to ACD Interface Clarification

ACD Low Profile Lift Spreader Concept

3” Wide by 2” Solid with ¼” Top & Bottom Caps

6” Min Clearance

Half cone angle can be > 5º, Outbound of ACD Useable Envelope

2.5”

This part of the Attach interface needs clarification

Confirm clearance for attaching Tie Rod Ends is ~ 3” [75 mm]?
LAT With ACD To / From Rotation Stand

- SLAC needs clarification of Attach Interface to the ACD
- How does the ACD Provided Lift Interface attach to the ACD?
- How does it come off? Does it have a split seem to be able take it away from each side of the ACD, rather than a single lift over the top of the ACD?
FYI Chart: ACD Lift Spreader Over TKR

- Hook Height Remains a Problem, even with the Low Profile ACD Lift Spreader Concept

LAT Integration Stand Rotation Axis Remains 53" from Floor Surface
ACD Installation, Low Profile Integration Stand

Crane Lift Block at high point

Assuming 8” [203 mm] high lift fixture spreader, 6” [152 mm] clearance above and below spreader yields 16” [406 mm] of remaining room to increase clearances.
LAT With ACD To / From Rotation Stand

- Crane lift block maximum height is 134 inches [3,403 mm] (Hook removed)
  - No problem moving LAT to / from integration stand
  - 15" [381 mm] available room for clearance management
- Can existing Crane Scale fit?

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\begin{align*}
\frac{3}{4}" & \text{ CRES Lift Rods} \\
& \text{with Turn Buckles (Turn Buckles Not Shown)} \\
\frac{3}{4}" & \text{OTS 316 CRES} \\
& \text{Turnbuckles Rated for 5,200 lbs each}
\end{align*}
\]

Crane Lift Block attaches directly to LAT lift fixture with 1.25" high strength bolt

- ACD Installed
- 7.0" [178 mm]
- 119.0" [3,023 mm]
- 53.0" [1,346 mm]
LAT Transport Container

• Design Philosophy
  – Attempting to fit in 88” Truck
    • Taller and more narrow version adds $20-30K for engineering and mass plate
    – Have a concept that works but requires additional ~ $20K for non-std truck width for cross-country ride to NRL
    • Isolation system appears satisfactory
      – Would like to reduce 1st harmonic to < 1 Hz for Cross-Country ride
      – Currently 1st harmonic is ~ 3.1 Hz (TBC)

• Work in progress
  – Layout is in work; may not be available this week
  – Vibration Report in review
    • First Iteration, expect another iteration for final design to follow (1 wk)

• Issues
  – Limited Modal Survey should be done
    • Limited Accels, use Proof Test Weight 1 (same as max LAT) and Air Ride Truck
    • Not a current budget line
    • Estimated cost: ~ $20K (TBC)
Environmental Test

• Vibration Test Fixture for Lumped Mass Test
  – Have SC to LAT Bracket Modeled; Looks Preliminary
    • We’ll refer to them as the “Spider Leg SC Flexures”
  – Stress indicates 8 small interface brackets to NRL shaker will work
    • No need for $20K large interface plate
    • Interface Brackets are for Bounding Purposes Only!
      – Need Vibe Shaker interface bolt size and pattern from NRL
Environmental Test

- Vibration Test Fixture Interface Plates for Lumped Mass Test, Cont.
• Vibration Test Fixture Interface Plates for Lumped Mass Test, Cont.
ACD Lift Operations Status

- LAT CDR: CDR RFA 13 requests
  - 6” clearance between ACD bottom surface and TKR top surface
  - 6” clearance between ACD top surface and SLAC provided load spreader