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Gravity Probe B Relativity Mission

SRE/ECU/TRE ADP Review – Final Issue Close Out Summary

S0870, Rev. -

April 26, 2003

Close Out Certification

The SRE, TRE, and ECU data packages have been reviewed by Stanford University. MSFC and the IRT have been requested to identify any flight risks from any review to the Stanford University review chairman. The chairman, having assessed all inputs received as of the review date of 26 April 2003, finds the components reviewed acceptable for the GP-B flight mission contingent on the acceptable closure of the action items and acceptable system level testing.

ADP Review Chairman:

Bill Bencze — Date: 8 May 03.

GP-B Program Manager:

Gaylord Green — Date: 12 May 2003

Concurrence:

Rich Whelan — Systems Engineering — Date: 8 May 2003

Concurrence:

Dorrene Pons — Quality Assurance — Date: May 12, 2003

ITAR Assessment Performed — Tom Langenstein — 5/12/03

ITAR Control Req'd? ☐ Yes ☒ No

Line	Subsystem	MSFC Reviewer	Findings/issues	Finding resolution
			drawing not found	
211	TRE	Feltner	Weight and balance log not found	Repeat question, see above
212	TRE	Feltner	form DD 250 or equivalent not found	Repeat question, see above
213	TRE	Feltner	As-designed (Qual) versus as-built (Flight) with explanation of results: No comparison found in ADP between Qual and Flight Units	No Qual units were built; GP-B program used a proto-qual approach to hardware development. Proto-qual units are flyable.
214	TRE	Feltner	As Measured Mass Properties Report not found	Repeat question, see above

SRE/ECU/TRE ADP Data Review (telecon) and Issues Resolution Meeting Minutes:

Location: Lockheed Martin, Building 205 "War Room", 1200PT, 24 April 2003.

References:

Attendees:

SU: ..... William Bencze, Steve Young
LM: ..... Mike Sisley, Terry McGinnis, Bob Farley, Lim Mar, John Thatcher

Background:

Acceptance Data Packages for all Spacecraft and Space Vehicle components were sent to Marshall Space Flight Center for review. MSFC responded with questions and issues raised by the ADPs. A series of Issue Resolution Meetings were scheduled to address those questions and achieve issue closure based on appropriate discussions, clarifications, or actions. The issue closure process began when several ATC component issues were addressed in January 2003. Meetings scheduled for March and April (2003) will address other subsystems and their components.

The 24 April 2003 meeting focused on the SRE, TRE, and ECU components of the payload electronics package.

Due to coordination problems, MSFC was not able to participate in the meeting, however, the team assembled the set of responses noted herein and is submitted to MSFC to close these issues.

For reference only: line numbers in the table below are row numbers from C. Dischinger's findings spreadsheet, dated 17 Mar 2003.

Line	Subsystem	MSFC Reviewer	Findings/issues	Finding resolution
			not found	No parts were procured to a specification control drawing
			3. Parts procured to a specification control drawing a. List of parts procured to specification control drawing not found.	Final mass of boxes provided in VRCM section 3.2.4.2
			g. Weight and balance Log Weight and balance log not found in ADP.	There are no waivers or deviations on the TRE system.
			h. List of authorized deviations and waivers Slide in ADP presentation package indicates NONE.	i. DD250 is for a transfer to the government. No such transfers occurred. The TRE was provided to SU for some PL Ver II testing, however it was returned to LM and is at LM now. Transfers are documented on an DD-1149 form (or equivalent) on file in Stanford and LM receiving and are not part of the ADP
			i. DD Form 250 or equivalent – Not found	There are not Qual units in the GP-B program As built = As designed, and the as-built config is listed As-built (you mean as-tested?) section of the ADP.
			j. As designed (Qual) versus as-built (Flight) with explanation of resolution No comparison found in ADP package between Qual and Flight Unit.	LM DRs are available on the VRC.
			l. Class 1 Discrepancy Reports (found only for rebuild effort) a. DRs were found in the ADP with the following exceptions. i. R14495 ii. R14496 iii. R14497 iv. R14499 v. R52138 vi. R52143	This is presented at the program level at each monthly; none bearing on the TRE
			m. Comparison with NASA Alert a. None listed.	There are no limited life items on the TRE
			n. Limited Life Items List a. List not found in ADP.	Final mass of boxes provided in VRCM section 3.2.4.2
			o. As-Measured Mass Properties Report a. Report not found in ADP.	As noted in the VRCM, these were deferred to the SRE/TRE joint EMC test and are documented in the SRE ADP, p. 35. All four requirements verified.
			p. Verification Requirements Compliance Document a. Document was included in ADP but document not complete. The verification of the following requirements (parag numbers) was not verified. i. 3.2.2.1 ii. 3.2.2.1.1 iii. 3.2.2.1.2 iv. 3.2.2.1.3	
206	TRE	Feltner	Certificate of Acceptance Sign off page by SU not found in Data Package	Repeat question, see above
207	TRE	Feltner	Transfer records not found in ADP to record transfer of TRE from LM to SU	Not part of Stanford ADP; records on file in Stanford Receiving/QA bonded stores
208	TRE	Feltner	Subsystem, assembly, and subassembly hardware (to lowest p/n): Drawing list found in ADP; does not include PCB piece parts	PCB (GP-B nomenclature PWA) BOM is part of the PWA drawing for the TRE boards (8A00842, 8A00843). The as-built parts list is not available at the ADP; EEE parts are listed in PLPA-06 Rev B; procurement details are stored in the LMMS procurement system.
209	TRE	Feltner	Parts procured to a source control drawing :List of parts procured to source control drawing not found	Repeat question, see above
210	TRE	Feltner	Parts procured to a specification control drawing: List of parts procured to specification control	Repeat question, see above

ECU Questions / Issues from MSFC:

line	Subsystem	MSFC Reviewer	Findings/issues	Finding resolution
175	ECU	Feltner	1. EMI noise spikes exceeded limits by as much as 30 dB for CE06 & RE02-NB. Additional data were requested but not received to demonstrate that this is not an impact to the spacecraft.	Addressed in DR 33805. Stanford and LMCO review of the excedences were found to be narrow band and not in the operational band of sensitive electronics systems. The determination at the time was to use as is. Subsequent testing in Payload Verification II and on the vehicle show that the space vehicle is functioning properly and not in violation of any specification; this fact help to further justify the UAI determination.
176	ECU		2. Data not presented for isolation test. Isolation test data requested.	Data have been provided to satisfy request

TRE Questions / Issues from MSFC:

Line	Subsystem	MSFC Reviewer	Findings/issues	Finding resolution
197	TRE	Feltner	The SRE/TRE EMI test report (QTP SRE-176) did not identify tests conducted to the levels required by parag 3.2.2.1.2 of the TRE specification.	Test not performed because of shielding provided by FEE structure. Levels were adjusted due to presence of Forward Equipment Enclosure
198	TRE	Feltner	The analysis (EM PLE-202)referenced in the VRCM for parag 3.2.3.2.1 and 3.2.3.2.2 was not found in the ADP or on the VRC.	Forward TRE Amplifier Analysis, EM NO. PLE 202, was not released until 28 June 1999, and was not included in the ADP data package of 25 June 1999. It is available separately.
199	TRE	Feltner	The verification method identified in the VRCM for parag 3.2.3.2.5 and parag 3.2.3.3 is listed as Test when in actuality the SRE is not used in either test. Method should be Similarity.	Differential signals at the TRE were supplied and measured during box testing.
200	TRE	Feltner	The TRE Full Functional Test Procedure (TRE-005) was not documented in a manner that clearly identifies the verification of parag 3.2.3.4 requirements; Engineering Data Channel Signals.	Measurements were made on all of the signals except Signal common, and the Plus and Minus TIA voltages during execution of TRE-005
201	TRE	Feltner	The analysis called out in the VRCM for parag 3.2.3.5.3 Gain Stability was not called out or identified.	Chart 25 of TRE ADP Charts shows a stability measurement of ±12 ppm/K which clearly meets the requirement of 1 part in 5000/K
202	TRE	Feltner	The tolerances for measurements made to support VRCM for parag 3.2.4.1 were not provided.	Measurements were performed by qualified personnel using standard practices.
203	TRE	Feltner	The analysis called out to support VRCM for parag 3.2.4.3.1 Load Shedding was not identified or provided.	TREs have no low temperature sensitive components. Other units operating in FEE should keep temperature above -55C. A ten watt heater between the SRE and TRE can be cycled to maintain temperature if required.
204	TRE	Feltner	Anomalies related to TRE performance during SV TVAC were not addressed in this ADP package: a. B side Cold 1 – RfR – 25 Nov 2002, b. B side Hot 1 – Full Run – 1 Dec 2002	These events occurred after box delivery and thus would not be part of the ADP. They are part of the program documentation surrounding the SV thermal vacuum test program.
205	TRE	Feltner	The following requirements of Appendix A from DRD No. 802PA-05 – Revision No. 1 – March 12, 1997 were either not found or incomplete. b. Certificate of Acceptance – Although page 3 of ADP presentation package identified names for which signatures were required no page with signatures from SU found in package. c. CEI Logbook – EMI test report not included in ADP; reference was made to SRE/TRE EMI test report. Records not found in ADP to record transfer of TRE from LM to SU. d. Drawing Tree 1. Subsystem, assembly, and subassembly hardware (to lowest p/n) The following drawings called out in the TRE Specification (P480135) were not found in the ADP or on the VRC. These drawing numbers also conflicted with numbers found in the As Built and Top Assembly Drawings list found in the ADP a. 8A00614 TRE Analog Board b. 8A00615 TRE Digital Board c. 8A00851 TRE schematic-Analog d. 8A00852 TRE schematic-Digital e. 5856128 TRE Mechanical Drawing 2. Parts procured to a source control drawing a. List of parts procured to source control drawing	 COC is provided in the TRE ADP; The ADP is a contractor generated document and the COC (or COA) indicates their certification of the quality of the product. At the time of the ADR, the EMI test was not yet performed (part of a joint SRE/TRE test, included in SRE package; this is noted in the open issues section of the ADP) Not part of Stanford ADP; records on file in Stanford Receiving/QA bonded stores The top level parts list is included and calls out subordinate assemblies (PWAs). BOM for sub-assemblies are found in those drawings. Drawings (a) thru (d) are available in the drawing package provided at the SC ADR No parts were procured to a source control drawing

SRE Questions / Issues from MSFC:

Line	Subsystem	MSFC Reviewer	Findings/issues	Finding resolution
179	SRE	Feltner	An SRE Acceptance Data Review was conducted by SU and LM on 18 July 2002; it included review of the verification data provided to support verification of parag 3.3.5 requirements. This review could not be completed due to incomplete analysis. Reference RL 603 and email dated 3/7/03 requesting missing attachment.	RL603 Items 1 and 2 answered via e-mail on 2/20/03. Item 1 (REF05) okay to use for application, Item 2 (REF08) okay per EM SYS 263. Item 3 (OCXO) still pending.
180	SRE	Feltner	The DR listed on page ADP-17 of the SRE Acceptance Data Review, P480600, is in error. The correct DR for the replacement of the DC/DC converters resulting from the GIDEP alert was not DR R74557 as listed. The correct DR numbers were provided by Mr. Gurr of ONR on 3/6/03. They are R74582, R74583, and R74585. Discrepancy should be corrected.	R74557 is for the ECU. R74582 and R74583 are for SRE. R74585 are for remaining spares in stores. This error will be corrected in revision of the SRE ADR package (P480600)
181	SRE	Feltner	The SRE box connector mate/demate information was provided in the ADP contrary to the response to RL 563 from Mr. Dougherty. Explain discrepancy.	The SRE Mate/Demate History in the SRE ADP was included as standard practice. This does not infer that the SRE connectors should be added to the Limited Life List. There is no discrepancy. Mr. Dougherty's statement withstanding, the data for the SRE was readily available and was provided
182	SRE	Feltner	The VCM for paragraph 3.2.3.2.1; Temperature Control, utilizes data taken from Flight Equivalent Unit. Rationale is needed.	For the SRE Spec Verification, para. 3.2.3.2.1, only data from Flight SRE testing per O/O SRE-062 was used in the S0653 analysis. The VCM states the results as, "O/O SRE-062 data combined with S0653". An FEU unit was not used for this verification.
183	SRE	Feltner	The PLPA-06 Approved EEE Parts List and PLPA-07 Non-Standard Parts List called out in the SRE Requirements Verification Compliance Matrix (VCM) for paragraphs 3.3.1 and 3.3.2 did not include table 1 that may have included SRE parts. RL 442 stated the NSPARs were submitted to SU;	PLPA-06 Rev B and PLPA-07 Rev A are complete and list the specified parts. Note, PLPA-06 is a two part document, the second piece of the document is a spreadsheet of parts (to facilitate computer searches)
184	SRE	Feltner	The VCM states Box dimensions are verified by inspection but the documents referenced in the Compliance Matrix; 8A00914 and 8A00919 could not be found. Provide docs.	Copies have been submitted previously and again in the SC ADR package sent prior to the April 1 SC ADR.
185	SRE	Feltner	A review of the SRE specification LMMS/P480136D identified incomplete flow down of T003 parag 16.8.1 requirements for operating normally during clock switching. Flow needs to be provided.	The SRE is the clock source, thus there is NO flowdown to the SRE. When a clock switch occurs, the SRE is probably not operating normally. See VLOA for T003 16.8.1 and the supporting analysis in S0843
186	SRE	Feltner	DR R74695 needs to be completed and disposition to allow SRE Operational Temperature requirements to be evaluated. Acceptance Data Review cannot be completed while DRs are open.	R74695 is a system-level was written against the Space Vehicle during TVAC #1 for not reaching the correct environment at the FEE area; not an issue for a box level ADP
187	SRE	Feltner	VCM Parag. 3.2.1.2.3; SRE to Spacecraft Telemetry Interfaces cannot be evaluated until TAR 307 is completed.	The fact that SQUID 3 is showing erratic behavior has nothing to do with the SRE Box Level VCM, which was completed long before TAR-307 was created. The Box Level requirement was verified per the VCM and there is no issue.
188	SRE	Feltner	[The following requirements of Appendix A from DRD No. 802PA-05 – Revision No. 1 – March 12, 1997 were either not found or incomplete.] d. Drawing Tree 1. Subsystem, assembly, and subassembly hardware (to lowest p/n);	 d. Drawing tree exists (8A03342) that points to the lowest assembly level drawings. Those drawings have to be consulted for the lowest p/n. 1. The Drawing Tree provides adequate information. All but one drawing starts wiith the LM "8A" drawing number. All parts were specified by LM; all boards (PWBs) were outsourced. All PWA assembling was also outsourced.

Line	Subsystem	MSFC Reviewer	Findings/issues	Finding resolution
			2. Parts procured to a source control drawing; a. List of parts procured to source control drawing not found; 3. Parts procured to a specification control drawing; a. List of parts procured to specification control drawing not found. g. Weight and balance Log (not found in ADP); i. DD Form 250 or equivalent – A DD Form 250 was not found; j. As designed (Qual) versus as-built (Flight) with explanation of resolution:No comparison found in ADP package between Qual and Flight Unit. A comparison was found on page SRE ADP-7 between the As-built vs As-tested unit. l. Limited Life Items List: a. List not found in ADP as promised via RL 563. m. As-Measured Mass Properties Report:	2. The SRE does not have parts procured to a source control drawing. 3. The SRE does not have parts procured to a specification control drawing. g. The final unit was weighed at the end and the weight included in the system level database and in the SRE VRCM. (SRE ADP pg 32 and 33) i. DD250 is for a transfer to the government. No such transfers occurred. The SRE was provided to SU for some PL Ver II testing, however it was returned to LM and is at LM now. Transfers are documented on an DD-1149 form (or equivalent) on file in Stanford and LM receiving and are not part of the ADP j. The As Built vs As Tested is the standard for GP-B hardware. The SRE had no Qual unit. l. RL-563 did not promise a limited life list in the ADP. There are no limited life items in the SRE. m. Documented in SCSE-11 per LM contract SCPA-05
189	SRE	Feltner	It is recommended that the developer complete the necessary verification activities and document the results in an update to the SRE ADP	All necessary Box Level verification activities were complete and documented in the SRE ADP that was signed off and released in February 2003. No update is warranted.