



GSFC Risk Assessment Process for Inherited Items



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Outline

- Inheritance Process Motivation
- What Can NASA/GSFC Do?
 - Inherited Item Risk Assessment Process
 - Typical Results to Date
- Benefits and Lessons Learned
- Summary

MOTIVATION

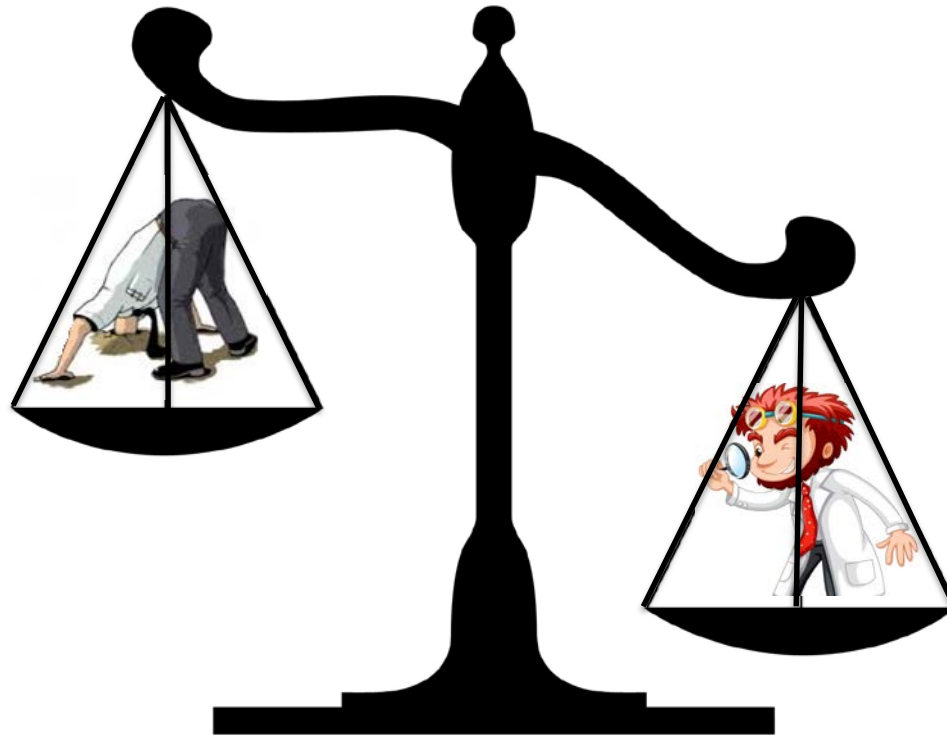
Supplier Standardization and
Common Buys

Supplier and GSFC Flight
Spares



Shrinking Budgets and
Compressed Schedules

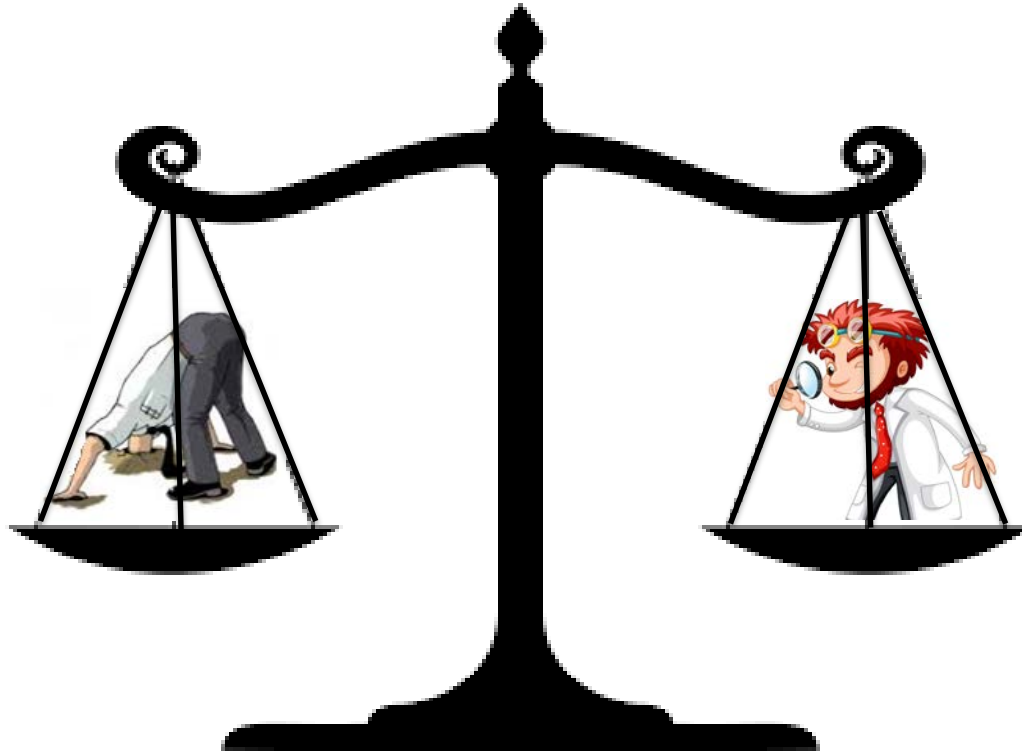
What Has NASA/GSFC Done in the Past?



Avoid unknowns and establish hard barriers/checkpoints to mitigate the risk of failures; this leads to potentially de-focusing resources from “true” risks and increasing the risk of unknowns

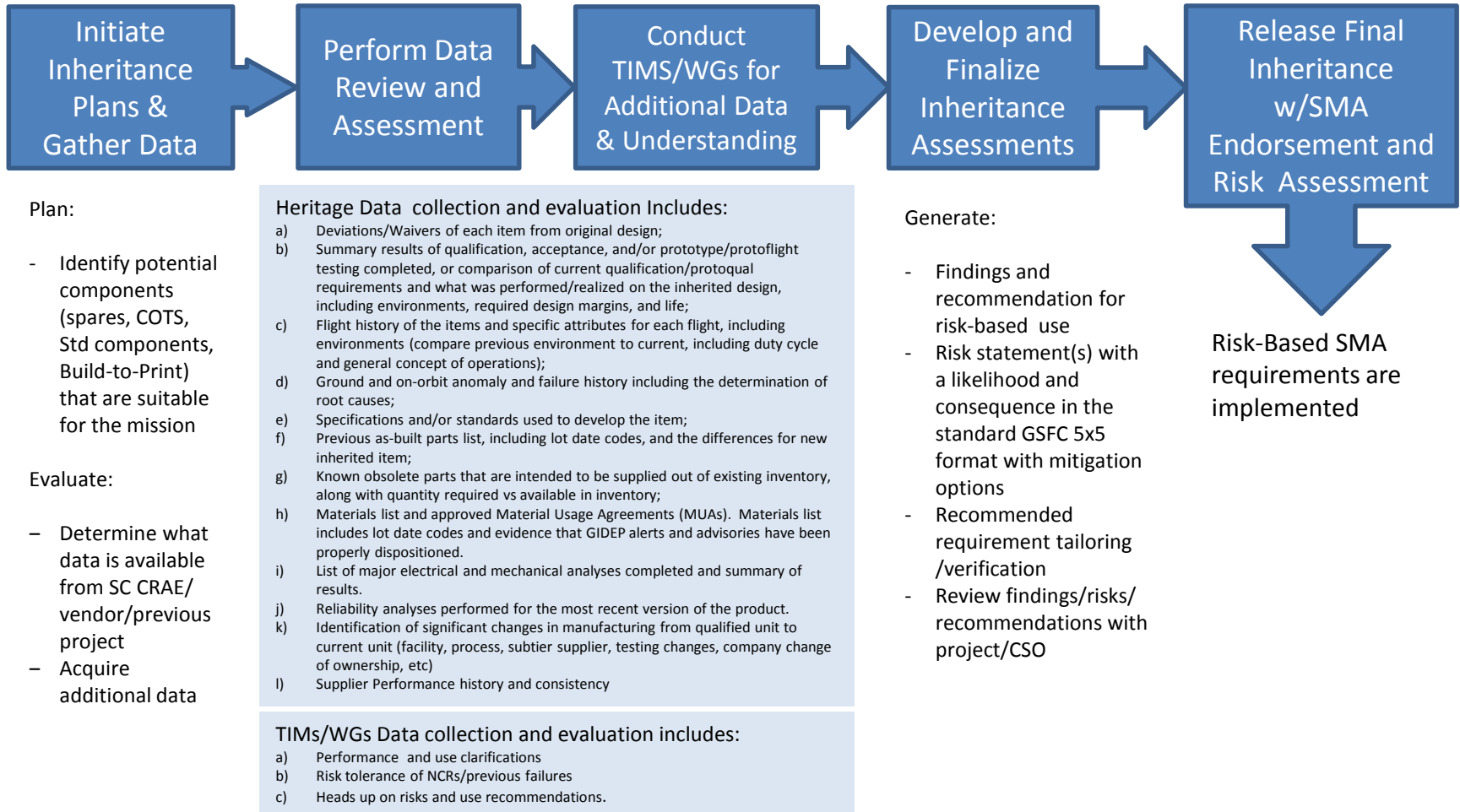


What Can NASA/GSFC Do?



Balance the need to know everything while avoiding blind trust through the use of risk analysis; this leads to focusing resources on “true” risk discovery and mitigations not just compliance.

GSFC Inheritance Risk Assessment Process



Typical Results to Date

<p>Flight Spare Heat Pipes</p>	<p>Recommended: 1) Additional thermal analysis on Radiator Ammonia Heat Pipes (B03, B04, B06); 2) Avoid using Radiator Ammonia Heat Pipe (B10) until leakage can be resolved; 3) Conduct mechanical/thermal analysis to determine if tolerance /thickness violations on Link Bars, Cryocooler Radiator Doubler and Mount Targets is not an issue, then either use with drawing update (and close risk) or discard. Re-machining may cause additional issues and unknown risks.</p> <p>MAR requirement verifications/changes recommended: 1) <u>EEE Parts</u> - Parts approved based on inheritance review. No Re-use MRB is required, or new ABPLs are needed for on-hand components; 2) <u>Materials</u> - N/A for products on hand. Previous approvals and testing on <i>Previous Mission</i> are applicable.</p>
<p>COTS Reaction Wheel Assembly (RWA)</p>	<p>Recommended: 1) Accept the RWAs as a black-box COTS items with full functional verification for acceptance of and contractual return/replacement for non-functional units. This implies the acceptance <i>Vendor</i> processes, parts, materials, and the expectation of advertised performance; 2) Conduct inspections or similar action to verify fabrication form, fit, and function is per specification and return/replace non-conforming units; 3) Use this Risk Assessment as a replacement for any waivers/deviation on RWA fabrication, parts, materials, or processes and as a proviso to acceptance documentation.</p> <p>MAR requirement verifications/changes recommended: 1) <u>Quality Management System</u> - Item is a proven COTS from proven vendor therefore standard vendor processes and controls are acceptable; no process verification is required; 2) <u>Qualification</u> – N/A; COTS item has been previously proven on previous mission; 3) <u>ESD</u> - Item is a proven COTS from proven vendor therefore standard vendor processes and controls are acceptable; no verification is required; 4) <u>Board/Connection Building</u> – a proven COTS item from proven vendor with high heritage printed wiring board, thus coupons are not required; And vendor’s processes have been proven sufficient to manage repairs, board integrity as well as soldering and flux materials; 5) <u>EEE Parts</u> - Parts are approved based on this inheritance review. No new ABPLs are needed supplied standard parts list is sufficient, unless changes are made. Vendor responses to GIDEPs should be pursued and kept up-to-date; 6) <u>Materials</u> – Materials approved via this inheritance review and TESS waivers noted above on epoxy and marking ink; 7) <u>Contamination</u> - Item is COTS therefore standard vendor processes and controls are acceptable; no verification is required.</p>

Typical Results to Date

<p>Fight Launch Lock spare</p>	<p>Recommended: 1) Process BTP items with routine certifications and inspections; 2) Complete planned Re-work and the needed Re-work on <i>Previous Mission</i> Telescope Shield; 3) Certify and full assess impacts of modified items as if new designs.; 3) Conduct modified item qualification applicability assessments to find out if changes do not invalidate previous qualifications and if so do not re-qualify if not re-qualify.</p> <p>MAR requirement verifications/changes: 1) Qualification – BTP and on-hand Inherited items are all already qualified; Compliance with qualification requirements can be established using this inheritance review. However, modified items should be qualified or have a qualification assessment to establish qualification based on similarity; 2) Materials - Previous approvals and testing on <i>Previous Mission</i> are applicable to products on hand and that are Build-to-Print and/or modified items. However, modified items needed material certification to ensure compliance and identify any new material not used on <i>Previous Mission</i>.</p>
<p>Flight Scene Select mirrors and Filter assemblies & components</p>	<p>Recommended: 1) Certify and full assess impacts of modified items as if new designs. For these optics this entails completing planned Re-figuring with routine certifications, inspections, and qualifications as well as updating impacted design analyses (e.g., thermal, optical, etc.); 2) Eliminate the filter set at temperature dimensional measurement requirement waived previously due to the inability to make the measurement at temperature;3) Sequester in-hand and un-mounted filter sticks for non-flight use only until such time as re-acceptance testing can be completed; 4) Conduct Optical Inspections on mirrors prior to any re-work as noted above, especially SN 001, and select best candidates for flight.</p> <p>MAR requirement verifications/changes recommended: 1) Qualification – BTP and on-hand Inherited items are all already qualified; Compliance with qualification requirements can be established using this inheritance review. However, modified items (Scene Select Mirrors) should be re-qualified; 2) Materials - Previous approvals and testing on <i>Previous Mission</i> are applicable to products on hand and that are Build-to-Print and/or modified items. However, modified items need material certification to ensure compliance and identification/approval of any new material not used on <i>Previous Mission</i>.</p>

Typical Results to Date

Instrument
Diode Board
Flight spares

Recommended: Complete full testing plan used on *Previous Mission* for these boards.

MAR requirement verifications/changes recommended: 1) Integrated Independent Review Requirements- N/A at the board level (inherited or BTP) since board designs have been previously reviewed on *Previous Mission*; 2) Design Verification Requirements- N/A at the board level (inherited or BTP) since board designs have been previously reviewed on *Previous Mission*; 3) Materials - Previous approvals and testing on *Previous Mission* are applicable to products on hand. No material approvals are needed for SN 003/004 unless modified; 4) EEE Parts – Previous approvals on *Previous Mission* are applicable to products on hand. No new parts approvals are needed for SN 003/004 unless modified; 5) Parts Analysis – Applicable to board component failures only for products on hand or BTP since all previous PCB and Material approvals on *Previous Mission*; 6) Parts Age Control – Satisfied since these Diode Boards were properly stored, there is no need for rescreening thus the SN 003/004 are compliant with this and *the current mission's* parts control plan and approved instrument's PCB; 7) Derating: is satisfied with assessment based on included Reliability Engineering assessment; 8) Prohibited Metals – Satisfied by previous PCB and Material approvals on *Previous Mission*; 9) Parts List - No submittal required from vendor. *Previous Mission* List, referenced above, are acceptable for *the current mission*. However, the vendor shall maintain knowledge of parts used in *the current mission's* build so GIDEP/alert responses can be kept up-to-date.; 10) Data Requirements - Satisfied by previous PCB and Supply Chain Management audits of the vendor; 11) ESD–The developer shall prepare and implement an ESD control program that conforms to the requirements of ANSI/ESD S20.20 for storing and handling these previously developed parts and for any required re-work; 12) GIDEP Alerts and Problem Advisories - No Change: vendor shall participate in GIDEP in regard to inherited as well as BTP Diode boards; 13) End Item Data Package (EIDP) – Board level details for on-hand and BTP boards is still required in the *current mission's* EIDP.

Typical Results to Date

<p>COTS Reaction Wheel Assembly</p>	<p>Recommended: 1) Confirm if the same lot/date code of 5962-9800101KEC and JANSF2N7268 parts experiencing non-conformances on the current mission have also been used in the Previous Mission's RWAs. If so the project should develop a corrective action plan with Prime, Supplier, GSFC SC-CRAE/PRAE, and Current Mission's Parts Engineer; 2) Accept the RWAs as a black-box COTS items with full functional verification for acceptance and contractual return/replacement for non-functional units. This implies the acceptance Vendor processes, parts, materials, and the expectation of advertised performance (See specification in backup data).</p> <p>MAR requirement verifications/changes recommended: 1) <i>Surveillance</i> – Prime contractor surveillance is sufficient based on proven flight performance and GMIPs as called out in the Current Mission's Spacecraft & Observatory Surveillance Plan can be eliminated or curtailed to: pre-closure inspection of flight components; 2) <i>Quality Management System</i> - Applicable in-project at GSFC; Satisfied for out-of-house RWA proven vendor processes based on item's demonstrated COTS performance, therefore standard vendor processes and controls are acceptable. No process verification is required. 3) Reporting of Material Review Board (MRB) Actions, is still required; Government is not required to verify or participate in the Vendor MRB process; 4) Reporting of Anomalies, is still required; Government is not required to verify or participate in the Vendor Anomaly process; 5) <i>Parts</i> – Satisfied, based on RWA being flight proven COTS assembly from a vendor with proven processes Any failures/issues/ alerts that Vendor becomes aware of with their COTS hardware shall require the vendor to recall/repair/ adjudicate the impacted assemblies; 6) <i>Workmanship</i> – Satisfied, since item is flight proven COTS routinely produced with well-established and proven vendor practices; 7) <i>Qualification</i> – Satisfied, since COTS item has been previously proven on the Previous Mission; 8) <i>Board/Connection Building</i> – This is a COTS item with high heritage with well-established vendor printed wiring board assurance testing therefore coupons are not required to be sent to GSFC; Jumpers/White wires and splices inherent in this RWA design as of this assessment are accepted as part of the proven design per this assessment and don't require any additional waiver or MRB; 10) <i>EEE Parts</i> - Parts approved based on this inheritance review. No new ABPLs need to be supplied, parts list on file with GSFC is sufficient, unless changes are made; 11) <i>Materials</i> – All materials are approved via this inheritance review including epoxy and marking ink based on Previous Mission waivers; 12) <i>Contamination</i> – Satisfied, since item is flight proven COTS manufactured using well-established and proven vendor contamination control manufacturing practices. Standard vendor processes and controls are acceptable; no verification is required.</p>
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Typical Results to Date

Instrument
Scene Select
Mechanism
(SSM)
assemblies
flight spares

Recommended: 1) Consider the motor stator silver plated copper wire as a limited life item and ensure that it is never exposed to more than 70% RH. Reference the JSC 64647 Red Plague Control Plan for handling and storage instructions to properly mitigate the risk associated with this failure mechanism; 2) For added confidence that red plague is not a high risk, it is recommended that two samples of wire from the spare stator assembly not being used in the Instrument's SSM, be cut and evaluated; 3) Ensure that all motor assemblies are cleaned prior to next level of assembly and that any particles magnetically bound to the magnetic rotors are removed; 4) Re-work any magnets with exposed magnet material to prevent corrosion. Verify successful coating with QA inspection; 5) Motor S/N 007: If selected for flight perform non-destructive inspections and analysis to confirm the magnet on the stator does not have a crack.

MAR requirement verifications/changes recommended: 1) Qualification – BTP and on-hand Inherited items are all already qualified; Compliance with qualification requirements can be established using this inheritance review; 2) EEE Parts – Should be considered approved under this assessment; 3) Materials - Previous approvals and testing on the *Previous Mission* are applicable to products on hand;

Typical Results to Date

COTS & Spare
Pressure
Transducer

Recommended: 1) Accept the spare *Previous Mission* pressure transducers S/N 36697 and S/N 36699) as is for flight spare purposes; 2) Include a requirement in the 30005 purchase order that JANS2N2222A transistors from lot date code 1011 are prohibited from use in the flight product; 3) Accept the *Vendor* pressure transducers as a black-box COTS item with full functional verification for acceptance and contractual return/replacement for non-functional units. This implies the acceptance of *Vendor* processes, parts, materials, and the expectation of advertised performance; 4) Use Risk Assessment as a replacement for any waivers/deviation on pressure transducer;

MAR requirement verifications/changes recommended: 1) Quality Management System - Satisfied for out-of-house pressure transducer trusted vendor based on item being proven COTS; therefore, standard vendor processes and controls are acceptable; no process verification is required; 2) Reporting of Material Review Board (MRB) Actions, is still required; Government is not required to verify or participate in the *Vendor* MRB process; 3) Reporting of Anomalies, is still required; Government is not required to verify or participate in the *Vendor* Anomaly process; 4) Workmanship – Satisfied, since item is proven COTS from trusted vendor. Standard vendor processes and controls are acceptable; no verification is required; 5) ESD – Satisfied, since item is proven COTS from a trusted vendor. Standard vendor processes and controls are acceptable, no verification is required; 6) Board/Connection Building – COTS item with high heritage from a trusted vendor, thus printed wiring board coupons are not required; Jumpers/White wires and splices inherent in this pressure transducer design as of this assessment are accepted as part of the proven design per this assessment and don't require any additional waiver or MRB; 7) Board/Connection Building – COTS item with high heritage from a trusted vendor printed wiring board coupons are not required; Jumpers/White wires and splices inherent in this pressure transducer design as of this assessment are accepted as part of the proven design per this assessment and don't require any additional waiver or MRB; 8) EEE Parts - Parts approved based on this inheritance review. Submittal of ABPLs is recommended for record keeping. Vendor responses to GIDEPs shall be pursued and kept up-to-date; 9) Materials – All materials are approved via this inheritance review; 9) Contamination – Satisfied, since item is COTS from a trusted vendor. Standard vendor processes and controls are acceptable; no verification is required.

Typical Results to Date

COTS Solar Array Drive

Recommended: 1) Have Vendor update the Current Mission's FMEA to include slip ring short consequences to properly reflect worst case sub-system and system effects in case of signal and power shorting; 2) That slip ring material samples of E.S. 193, E.S. 222, E.S. 307, E.S. 308, & E.S. 436 be provided by vendor for outgassing testing; 3) Accept the Vendor SADA as a black-box Commercial Item with full functional verification for acceptance and contractual return/replacement for non-functional units. This implies the acceptance of Vendor processes, parts, materials, and the expectation of advertised performance; 4) Use this Risk Assessment as a replacement for any waivers/deviation on Vendor SADA;

MAR requirement verifications/changes recommended: 1) Surveillance – GMIPs as called out in the the current mission's Spacecraft & Observatory Surveillance Plan can be eliminated or curtailed to pre-closure inspection of flight components, except for pre-closure inspection of slip rings. Pre-closure inspection of slip rings including photographic documentation is highly recommended; 2) Quality Management System - Applicable in-project at GSFC; Satisfied for out-of-house SADA proven vendor processes based on item's demonstrated COTS performance, therefore standard vendor processes and controls are acceptable. No process verification is required. 3) Reporting of Material Review Board (MRB) Actions, is still required; Government is not required to verify or participate in the Vendor MRB process; 4) Reporting of Anomalies, is still required; Government is not required to verify or participate in the Vendor Anomaly process; 5) Workmanship – Satisfied, since item is flight proven Commercial Item routinely produced with well-established and proven vendor practices. Standard vendor processes and controls are acceptable; no verification via audit or GMIP is required; 6) Qualification – Satisfied, since Commercial Item has been previously proven on the Previous Mission and other missions; 7) ESD – Satisfied, since item is a flight proven Commercial Item using well-established and proven vendor ESD manufacturing practices. Standard vendor processes and controls are acceptable; no verification is required; 8) EEE Parts - Parts approved based on this inheritance review. No new ABPLs need to be supplied, parts list on file with GSFC is sufficient, unless changes are made. Vendor responses to GIDEPs shall be pursued and kept up-to-date with vendor as built data; 9) Materials – All materials are approved via this inheritance review; 10) Contamination – Satisfied, since item is flight proven Commercial Item manufactured using well-established and proven vendor contamination control manufacturing practices.

Typical Results to Date

COTS SADE
Electronic
Control Unit
(ECU)

Recommended: 1) Ensure that the ferrite beads are from the same lot/date code (LDC) as other mission builds; 2) Ensure that EEE parts used in the current mission's build are from the same LDC as other mission parts; 3) Confirm, if CB18766-001 hybrid is from the same LDC another mission. If not, it shall be submitted to the PCB for radiation approval; 4) **Positronic connectors are impacted by CHM-P-16-01A GIDEP. This GIDEP details an issue where contacts may have missing spring clips. If assembly is not yet completed all contacts shall be 100% visually inspected or force tested to confirm presence of spring clip;** 5) Accept the Vendor SADE/ECU as a black-box Commercial Item with full functional verification for acceptance and contractual return/replacement for non-functional units. This implies the acceptance of Vendor processes, parts (see exceptions above), materials, and the expectation of advertised performance; 6) Use Risk Assessment as a replacement for any waivers/deviation on Vendor ECU/SADE.

MAR requirement verifications/changes recommended: 1) Surveillance –GMIPs as called out in the *current mission's* Spacecraft & Observatory Surveillance Plan can be eliminated or curtailed to pre-closure inspection of flight components; 2) Quality Management System - Applicable in-project at GSFC; Satisfied for out-of-house SADE/ECU proven vendor processes based on item's demonstrated Commercial Item performance, therefore standard vendor processes and controls are acceptable. No process verification is required; 3) Reporting of Material Review Board (MRB) Actions, is still required; Government is not required to participate in or verify the Vendor MRB process. MRB reports are requested for information; 4) Reporting of Anomalies, is still required; Government is not required to participate in or verify the Vendor Anomaly process. Anomaly Review Board reports are requested for information; 5) Workmanship – Satisfied, since item is flight proven Commercial Item routinely produced with well-established and proven vendor practices. Standard vendor processes and controls are acceptable; no verification via audit or GMIP is required; 6) Qualification – Satisfied, since **Commercial Item has been previously proven on Previous Mission and other missions;** 7) ESD – Satisfied, since item is a flight proven Commercial Item using well-established and proven vendor ESD manufacturing practices. Standard vendor processes and controls are acceptable; no verification is required; 8) Board/Connection Building – This is a Commercial Item with high heritage therefore PCB coupons are not required to be sent to GSFC, in lieu of review of PCB manufacturer's and developer's PCB coupon testing results, or if PCB from same Lot/Date Code as for a *Previous Mission* are used; 9) EEE Parts - Parts approved based on this inheritance review. No new ABPLs need to be supplied, parts list on file with GSFC is sufficient, unless changes are made; 10) Materials – All materials are approved via this inheritance review; 11) Contamination – Satisfied, since item is flight proven Commercial Item manufactured using well-established and proven vendor contamination control manufacturing practices.

Typical Results to Date

COTS Inertial Reference Unit (COTS-IRU)

Recommended: 1) *Confirm if there are any EEE parts differences between the Previous Mission COTS-IRU when compared to the current mission COTS-IRU;* 2) Confirm if there are any software changes between *Previous Mission COTS-IRU* when compared to the current mission COTS-IRU; 3) *Avoid Ferrite Beads manufactured in China, unless DPA is performed to rule out cracking and chipping;* 4) Confirm if start up time is met with starting three or four gyros. If four gyros need to be started, adjust the procedures for the use of the COTS-IRU, e.g. start all four gyros and then shut one off; 5) Accept the *Vendor COTS-IRU* as a black-box COTS items with full functional verification for acceptance and contractual return/replacement for non-functional units. This implies the acceptance *Vendor* processes, parts, materials, and the expectation of advertised performance; 6) Use Risk Assessment as a replacement for any waivers/deviation on COTS-IRU.

MAR requirement verifications/changes recommended: 1) *Surveillance* –GMIPs as called out in the *current mission’s* Spacecraft & Observatory Surveillance Plan can be eliminated or curtailed to pre-closure inspection of flight components; 2) *Quality Management System* - Applicable in-project at GSFC; Satisfied for out-of-house COTS-IRU proven vendor processes based on item’s demonstrated COTS performance, therefore standard vendor processes and controls are acceptable. No process verification is required. 3) *Reporting of Material Review Board (MRB) Actions is still required; Government is not required to verify or participate in the Vendor MRB process;* 4) *Reporting of Anomalies is still required; Government is not required to verify or participate in the Vendor Anomaly process;* 5) *Parts* – Satisfied, based on COTS-IRU being flight proven COTS assembly from a vendor with proven processes Any failures/issues/ alerts that *Vendor* becomes aware of with their COTS hardware shall require the vendor to recall/repair/adjudicate the impacted assemblies; 6) *Workmanship* – Satisfied, since item is flight proven COTS routinely produced with well-established and proven vendor practices; 7) *Qualification* – Satisfied, since COTS item has been previously proven on *the Previous Mission*; 8) *Board/Connection Building* – This is a COTS item with high heritage with well-established vendor printed wiring board assurance testing therefore coupons are not required to be sent to GSFC; Jumpers/White wires and splices inherent in this design as of this assessment are accepted as part of the proven design per this assessment and don’t require any additional waiver or MRB; 10) *EEE Parts* - Parts approved based on this inheritance review. No new ABPLs need to be supplied, parts list on file with GSFC is sufficient, unless changes are made; 11) *Materials* – All materials are approved via this inheritance review; 12) *Contamination* – Satisfied, since item is flight proven COTS manufactured using well-established and proven vendor contamination control manufacturing practices. Standard vendor processes and controls are acceptable; no verification is required.

Lessons Learned

- ❖ Process is viewed as value-added and requests are overwhelming current staff.
- ❖ Consistency between Risk Assessments, Recommendations, and SMA Requirement Tailoring needs to be maintained
- ❖ Some recommendations are not always fully implemented by projects while others are.
- ❖ Heritage is not a guarantee of no risk.
- ❖ Data gathering and processing time are significantly reduced on recurring submittals
- ❖ Continual education and expectation leveling is needed to institutionalize the process and its outcomes

1.6: *Surveillance* –GMIPs as called out in the *current mission's* Spacecraft & Observatory Surveillance Plan can be eliminated or curtailed to pre-closure inspection of flight components; Project specific process audits are not warranted but can occur as part of general GSFC supply chain verification activities; Witnessing of screening and testing is highly recommended.

Project Disposition: The *current mission's* Project will tailor its GMIPs and will not perform any periodic process audits on the COTS-IRU supplier. For the COTS-IRU, the government will perform the following GMIPs:

- 1- Circuit Card Assembly Inspection
- 2- Start of Acceptance Test
- 3- Complete Acceptance Test |

2.1 – 2.2: *Quality Management System* - Applicable in-project at GSFC; Satisfied for out-of-house COTS-IRU proven vendor processes based on item's demonstrated commercial item performance, therefore standard vendor processes and controls are acceptable. No process verification is required.

- MA 2-1, Reporting of Material Review Board (MRB) Actions, is still required; Government is not required to verify or participate in the *Vendor* MRB process.
- MA 2-2, Reporting of Anomalies, is still required; Government is not required to verify or participate in the *Vendor* Anomaly process.

Project Disposition: *Current Mission's* Project does not accept the recommendation. *Prime/Vendor* shall comply with the MRB/FRB requirements as stated in the Spacecraft MAR.

Benefits

- ✓ Improved risk reduction
- ✓ Focus project resources on higher risk items, e.g. new developments
- ✓ Knowledge sharing from previous missions across GSFC
- ✓ More consistent non-conformance acceptance approach across projects / missions commensurate with payload risk classification
- ✓ Acceptance of SMA non-conformances and nonstandard practices that pose little or no increased risk to the mission
- ✓ Reducing the introduction of risk by having the manufacturer change the manufacturing process and/or introduce new materials
- ✓ Less SMA waiver processing
- ✓ Cost and schedule savings
- ✓ More time available for critical system-level testing

Summary

- GSFC has established an alternate path to accept and use heritage and spare products that were built using well-established successful processes and requirements for systems developed under a comparable risk posture.
- This process gives projects and vendors the ability to take credit for Inherited or Build-to-Print Items having successful histories.
- Projects are able to focus on technical risks versus process compliance risks by the use of this process.
- This process gives Projects recommendations and pre-verifications of SMA/MAR requirements that they can choose to implement in their Risk-Based SMA Implementation.

