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Customer Success Is Our Mission

Requirements Based Analysis

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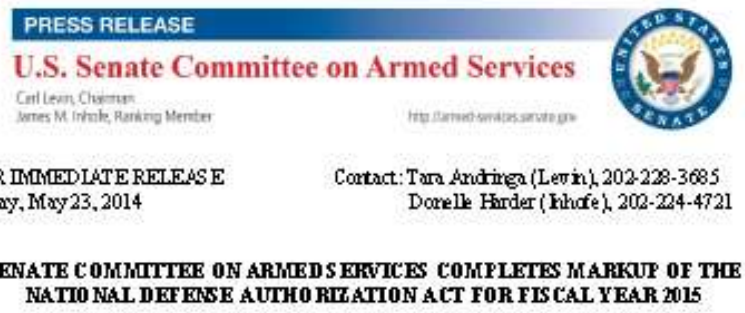
Defining The Business Rationale/Need

- Customer Expectations/Requirements are Changing:
  - Weapon Systems Acquisition Reform Act 2009
  - DoD Instruction 5000.02 (Acquisition)
- Competition is Increasing:
  - Domestic
  - Foreign
- Cost Structures are Changing:
  - More fixed price contracts
- Cuts are Increasing
  - Fiscal budgetary challenges



PRESS RELEASE

U.S. Senate Committee on Armed Services

Carl Levin, Chairman
James M. Inhofe, Ranking Member

FOR IMMEDIATE RELEASE
Friday, May 23, 2014

Contact: Tara Andringa (Levin), 202-228-3685
Dorelle Harder (Inhofe), 202-224-4721

SENATE COMMITTEE ON ARMED SERVICES COMPLETES MARKUP OF THE NATIONAL DEFENSE AUTHORIZATION ACT FOR FISCAL YEAR 2015

Senate Armed Services Committee Markup of the National Defense Authorization Act FY2015				
Program	**Agency**	**Category**	**Reason**	**Savings ($M)**
Warfighter Information Netweork-Tactical (WIN-T)	Army	Cuts	Delays	$125.0
Joint Tactical Radio System	Army	Cuts	Slow Execution	$88.0
Mid-tier Networking Vehicle Radio	Army	Cuts	Delays & Slow Execution	$8.0
Joint Battle Command-Platform	Army	Cuts	Delays & Slow Execution	$10.0
Counterfire Radars	Army	Cuts	Slow Execution	$80.4
Indirect Fire Protection Capability Increment-2	Army	Cuts	Delays	$30.0
Next Generation Joint STARS	Air Force	Cuts	Use Existing Tech.	$63.1
Global Hawk R&D	Strategic Systems	Cuts	Use Existing Tech.	$136

We Must Change with Our Customer!

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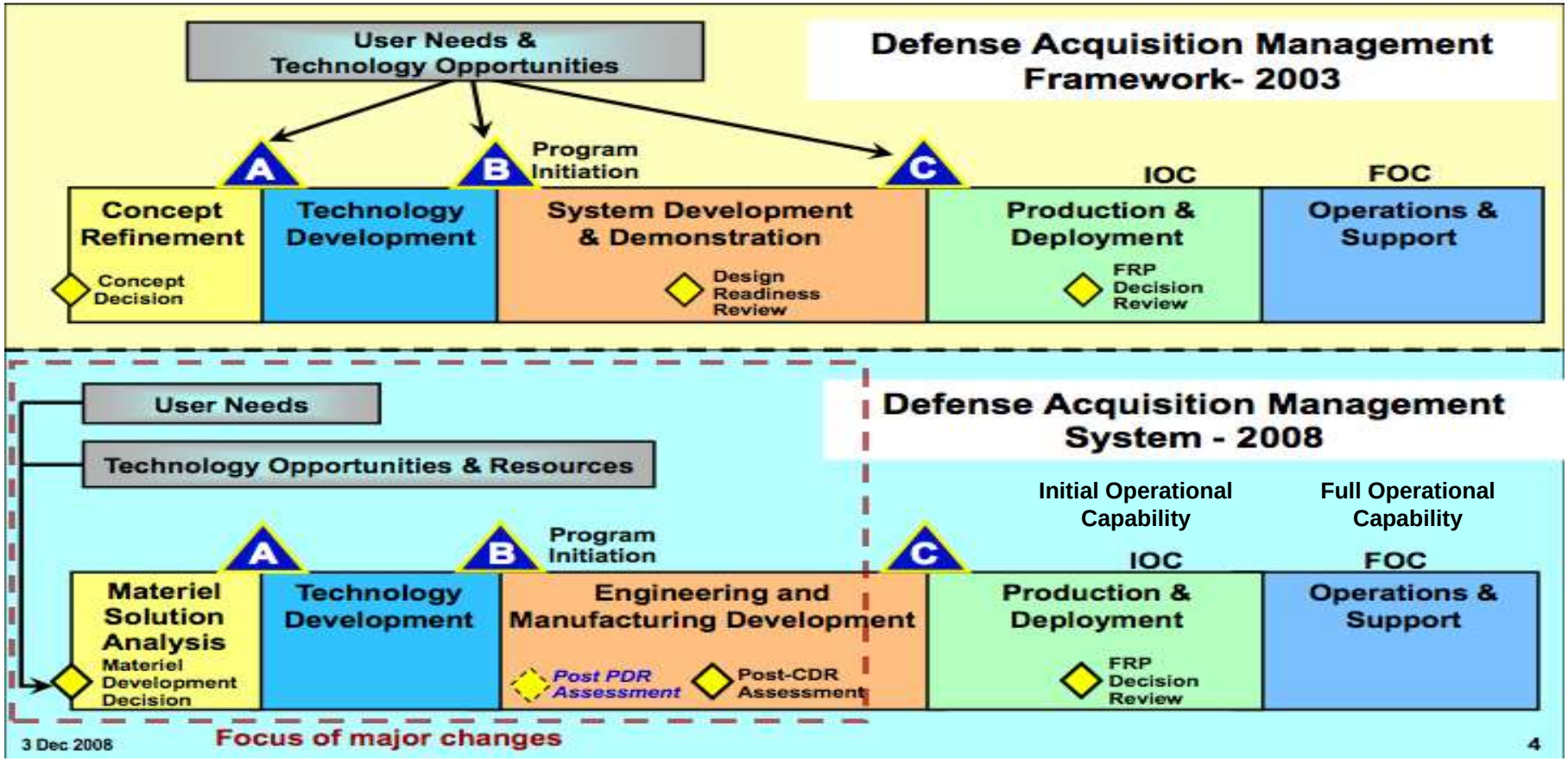
Acquisition Reform – Before and After



Note the focus of our customer is toward the early program life-cycle phase.

Early Engagement is Mandated by the Customer by Recent Changes in Acquisition Reform, DoD 5000.02, 8 Dec 2008

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Key Features of Acquisition Reform

- Acquisition Reform – DoD 5000.02, 8 Dec 2008
  - Mandatory Acquisition Process Entry Point
  - Competitive Prototyping
  - More Frequency and Effective Program Reviews
  - Configuration Steering Boards
  - Technology Readiness Assessments
  - Engineering and Manufacturing Development
  - More Effective Integrated Test & Evaluation
- Acquisition Reform Policy Changes
  - Emphasis on Fixed Price (FP) Contracts
  - Detailed Systems Engineering Policy

"A key to defense acquisition programs' performing successfully is getting things right from the start – with sound systems engineering, cost-estimating, and developmental testing early in the program cycle."

John McCain
Arizona Senator

2008 Defense Acquisition Management System More Frequent and Effective Program Reviews

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- Change:
  - More rigorous technical reviews will be conducted to assess progress.
  - Two key engineering reviews, the PDR and the CDR become significant program decision points that allow acquisition authorities to assess progress and redirect as appropriate.
- Benefit:
  - Reviews should provide identification and action plans for design and integration problems earlier in System development.
  - Require us to keep our solutions sold through each review and convince the government to select our team for EMD.
  - Design maturity along with demonstrated manufacturing capability becomes instrumental to completing a successful CDR.
  - New Acquisition Decision Memorandum requirements for PDR and CDR could increase the required activity to support successful milestones.

More Rigorous Technical Reviews Will Provide Identification and Action Plans for Design and Integration Problems Earlier in the EMD Cycle

2008 Defense Acquisition Management System More Effective Integrated Test & Evaluation

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- Change
  - Test and Evaluation (T&E) will be integrated into every acquisition development phase to facilitate early identification and correction of technical and operational deficiencies.
- Benefit:
  - Early T&E should reduce failures in later, more costly integration stages.
  - It increases the importance of T&E in every phase of acquisition.
  - Change strategies to secure Government confidence without increasing the budget traditionally available for testing.

Early T&E Should Reduce Failures in Later, More Costly Integration Stages

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Requirements Based Analysis

- T&E tools and methodologies must be consolidated and better aligned with program requirements to improve analysis efficiency and productivity.
- Requirements Based Analysis (RBA) approach will aid in common tool development and provide a focus on developing requirement based scripts and utilities to support all test phases and test levels across multiple integrated product teams.

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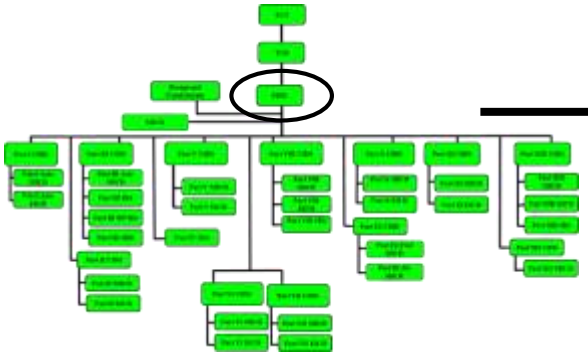
RBA Process Flow Diagram (Notional)

Specification Tree



Requirement Doc.

PIDS

Requirement Paragraph

Paragraph 4.3.2.1.1
Part I / Part II Staging Pre-Separation:

Body Rate X	±xx deg/sec
Body Rate Y	±yy deg/sec
Body Rate Z	±zz deg/sec
Angle of Attack	< x deg
Dynamic Pressure	≤ y psf
Altitude	±aa m

Title Part I / Part II Pre-Separation Dynamics

Comment Measure the Part I / Part II Pre-Separation Body Rate, AOA, and Dynamic Pressure

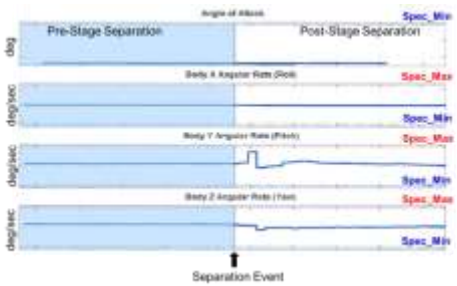
Configuration Control

Revision	Date	Initials	Change
Rev 0	9/3/2014	AAA	Initial

RBA Summary Sheet

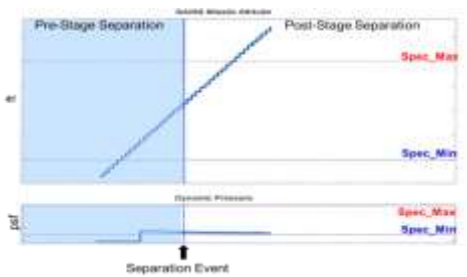
Name	Req.	Section	Comment	Parameter	Min	Max	Meas.	Results (Pass/Fail)	Units	Expected	Range Time	Plot
Pt1_Pt2_presep_brate x	PIDS	4.3.2.1.1	Body Rate Axial	BODY_RATE_X	+xx	-xx	v1	Pass	°/s	steady (avg) for 150 ms pre-event	pt1_pt2_separation ± 500 ms	pg_pt1_pt2_preseparation_1
Pt1_Pt2_presep_brate y	PIDS	4.3.2.1.1	Body Rate Radial	BODY_RATE_Y	+yy	-yy	v2	Pass	°/s	steady (avg) for 150 ms pre-event	pt1_pt2_separation ± 500 ms	pg_pt1_pt2_preseparation_1
Pt1_Pt2_presep_brate z	PIDS	4.3.2.1.1	Body Rate Radial	BODY_RATE_Z	+zz	-zz	v3	Pass	°/s	steady (avg) for 150 ms pre-event	pt1_pt2_separation ± 500 ms	pg_pt1_pt2_preseparation_1
Pt1_Pt2_presep_AOA	PIDS	4.3.2.1.1	Angle of Attack	AOA		<x	v4	Pass	°	steady (avg) for 150 ms pre-event	pt1_pt2_separation ± 500 ms	pg_pt1_pt2_preseparation_1
Pt1_Pt2_presep_Q	PIDS	4.3.2.1.1	Dynamic Pressure	DYN_PRESS		≤ y	v5	Pass	psf	steady (avg) for 150 ms pre-event	pt1_pt2_separation ± 500 ms	pg_pt1_pt2_preseparation_2
Pt1_Pt2_presep_alt	PIDS	4.3.2.1.1	Altitude	ALTITUDE	+aa	-aa	v6	Pass	m	steady (avg) for 150 ms pre-event	pt1_pt2_separation ± 500 ms	pg_pt1_pt2_preseparation_2

pg_pt1_pt2_preseparation_1



Pass

pg_pt1_pt2_preseparation_2



Pass

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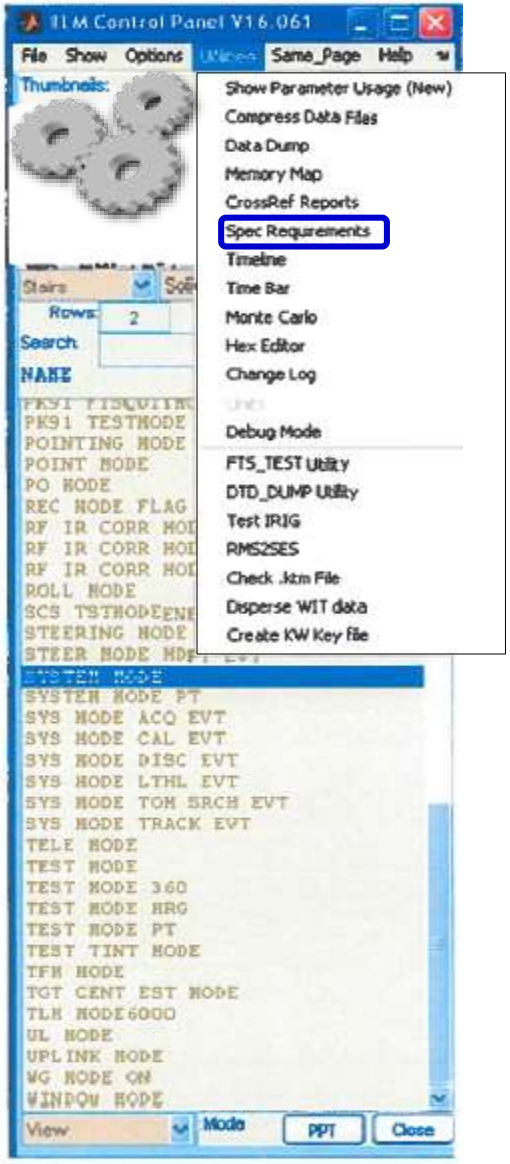
RBA – Tool Execution



- Matlab based application (2013a)
- Telemetry Toolbox … GUI based.
- Utility Program … Spec Requirements

- Procedure
  - Load run_id
  - Run Requirements Spec Tool
  - Produces 3 output files
    - Summary HTML (Pass/Fail/No Data)
    - Hyperlink to Requirements File Summary
    - Hyperlink to Requirement Script

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RBA Summary Sheet Expansion (1 of 3)

Name	Req.	Section	Comment	Parameter
Pt1_Pt2_presep_brate x	PIDS	4.3.2.1.1	Body Rate Axial	BODY_RATE_X
Pt1_Pt2_presep_brate y	PIDS	4.3.2.1.1	Body Rate Radial	BODY_RATE_Y
Pt1_Pt2_presep_brate z	PIDS	4.3.2.1.1	Body Rate Radial	BODY_RATE_Z
Pt1_Pt2_presep_AOA	PIDS	4.3.2.1.1	Angle of Attack	AOA
Pt1_Pt2_presep_Q	PIDS	4.3.2.1.1	Dynamic Pressure	DYN_PRESS
Pt1_Pt2_presep_alt	PIDS	4.3.2.1.1	Altitude	ALTITUDE

Hyperlink to Part I / Part II Staging Pre-separation statistics/trends

Requirement Information

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RBA Summary Sheet Expansion (2 of 3)

Name	Min	Max	Meas.	Results (Pass/Fail)	Units
Pt1_Pt2_presep_brate x	+xx	-xx	v1	Pass	deg/sec
Pt1_Pt2_presep_brate y	+yy	-yy	v2	Pass	deg/sec
Pt1_Pt2_presep_brate z	+zz	-zz	v3	Pass	deg/sec
Pt1_Pt2_presep_AOA		<x	v4	Pass	deg
Pt1_Pt2_presep_Q		≤ y	v5	Pass	psf
Pt1_Pt2_presep_alt	+aa	-aa	v6	Pass	m

Hyperlink to Part I / Part II Staging Pre-separation statistics/trends

Requirement Information

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RBA Summary Sheet Expansion (3 of 3)

Name	Expected	Range Time	Plot
Pt1_Pt2_presep_brate x	steady (avg) for 150ms pre-event	pt1_pt2_separation ± 500 ms	*pg_ptl_pt2_preseparation_1*
Pt1_Pt2_presep_brate y	steady (avg) for 150ms pre-event	pt1_pt2_separation ± 500 ms	*pg_ptl_pt2_preseparation_1*
Pt1_Pt2_presep_brate z	steady (avg) for 150ms pre-event	pt1_pt2_separation ± 500 ms	*pg_ptl_pt2_preseparation_1*
Pt1_Pt2_presep_AOA	steady (avg) for 150 ms pre-event	pt1_pt2_separation ± 500 ms	*pg_ptl_pt2_preseparation_1*
Pt1_Pt2_presep_Q	steady (avg) for 150ms pre-event	pt1_pt2_separation ± 500 ms	*pg_ptl_pt2_preseparation_2*
Pt1_Pt2_presep_alt	steady (avg) for 150ms pre-event	pt1_pt2_separation ± 500 ms	*pg_ptl_pt2_preseparation_2*

Hyperlink to Part I / Part II Staging Pre-separation statistics/trends

Expected Result (not included in Pass/Fail)

Measurement Time Criteria

Hyperlink to Part I / Part II Staging Pre-separation plot

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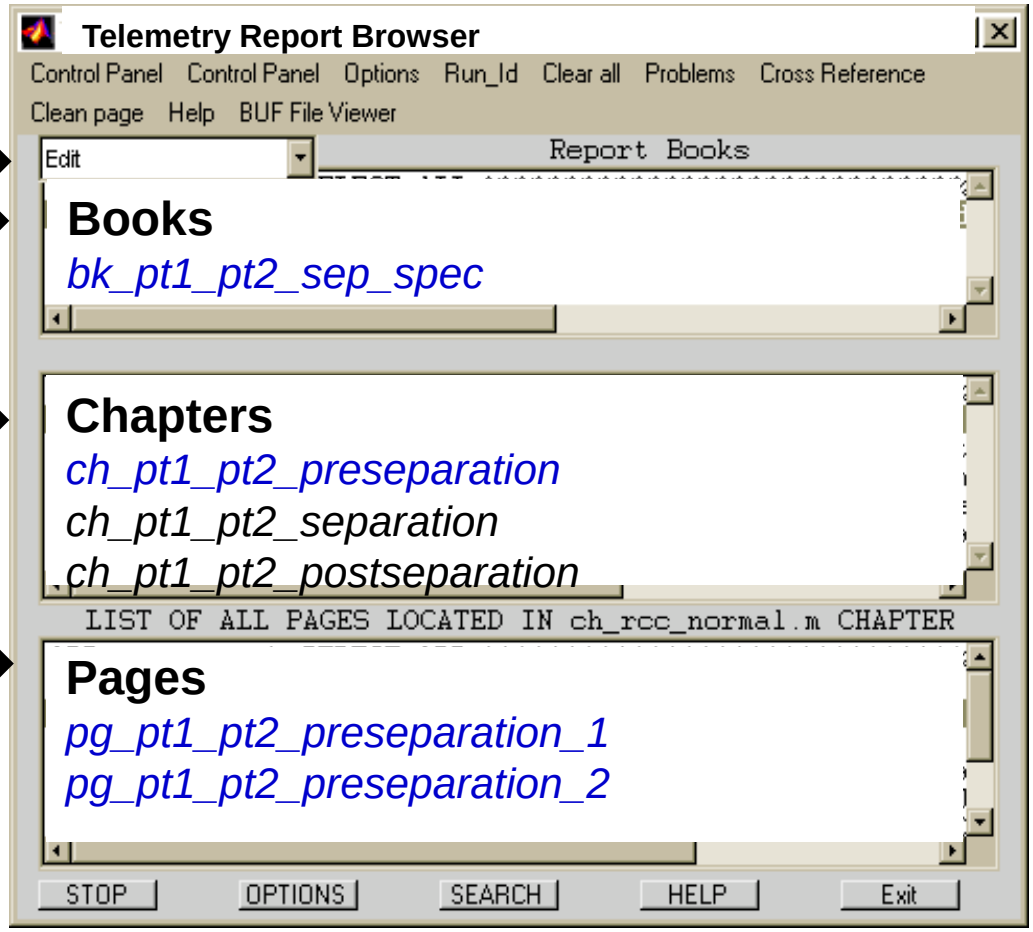
RBA Report Browser

Edit, view, list, .ppt selected script files

List all report books

Lists chapters within a report

Lists pages within a chapter



Report Browser Organizes Scripts

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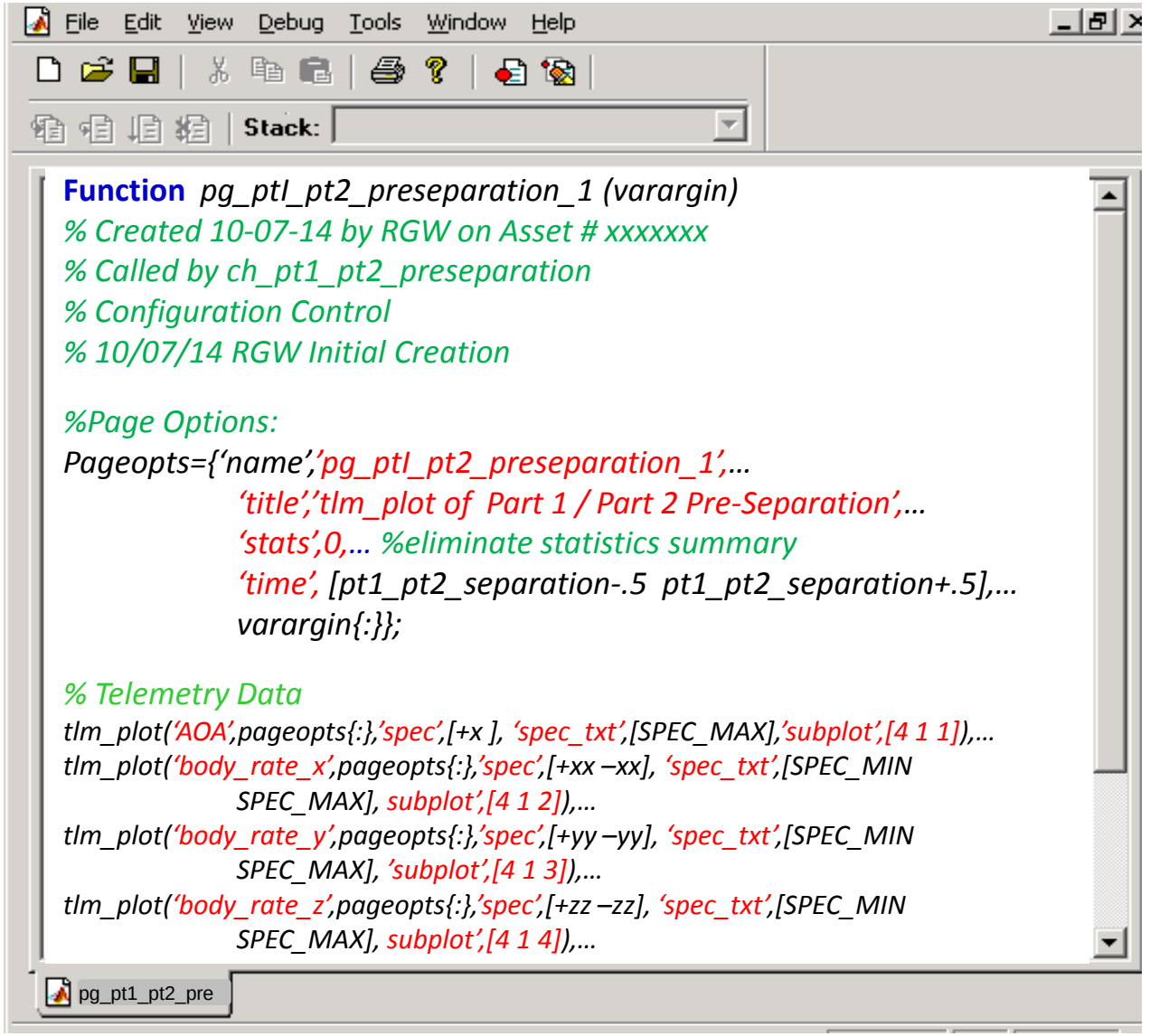
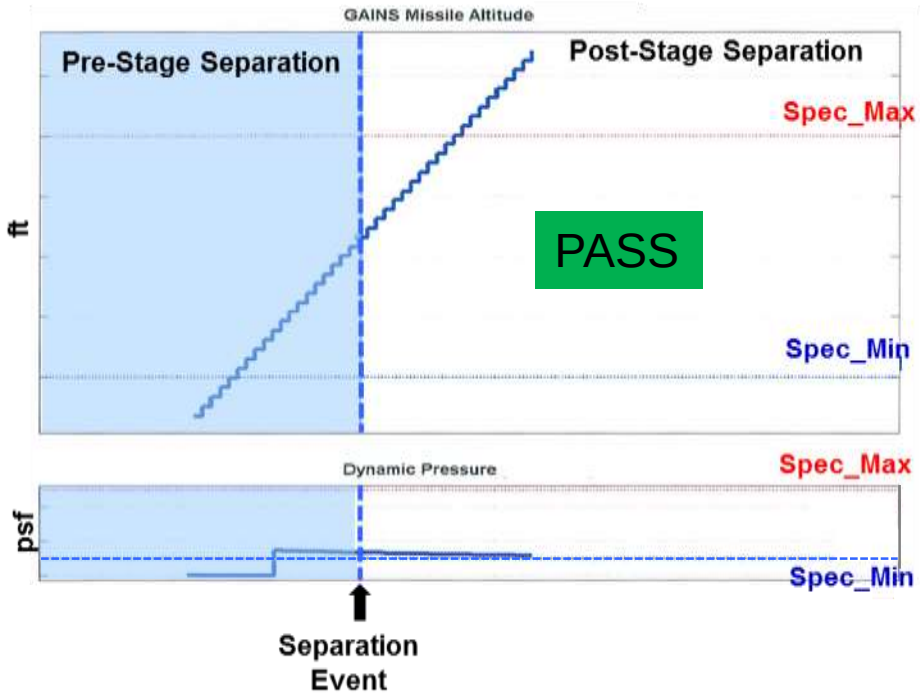
RBA Report Scripting

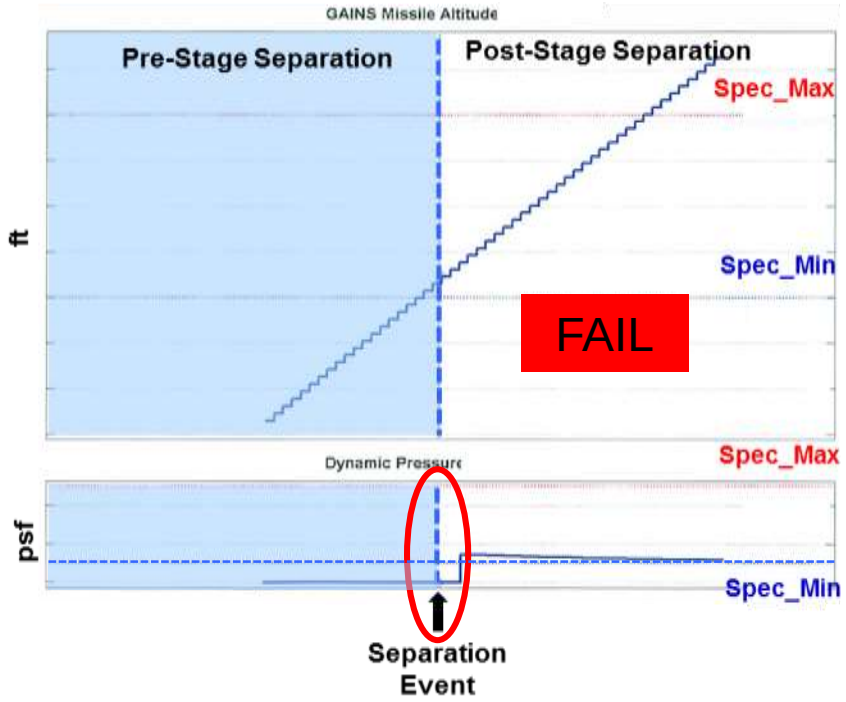
- **Common Scripting Format**
  - **Creation**
  - **Called by**
  - **Configuration Control**
    - **Date, Initials, Description**
  - **Page Options**
    - **Arguments passed to the TLM Plot structure**
  - **TLM Plot structure**
  - **Algorithms/Logic Structures**



RBA Report Scripting
Example 1 – Stage Separation Event

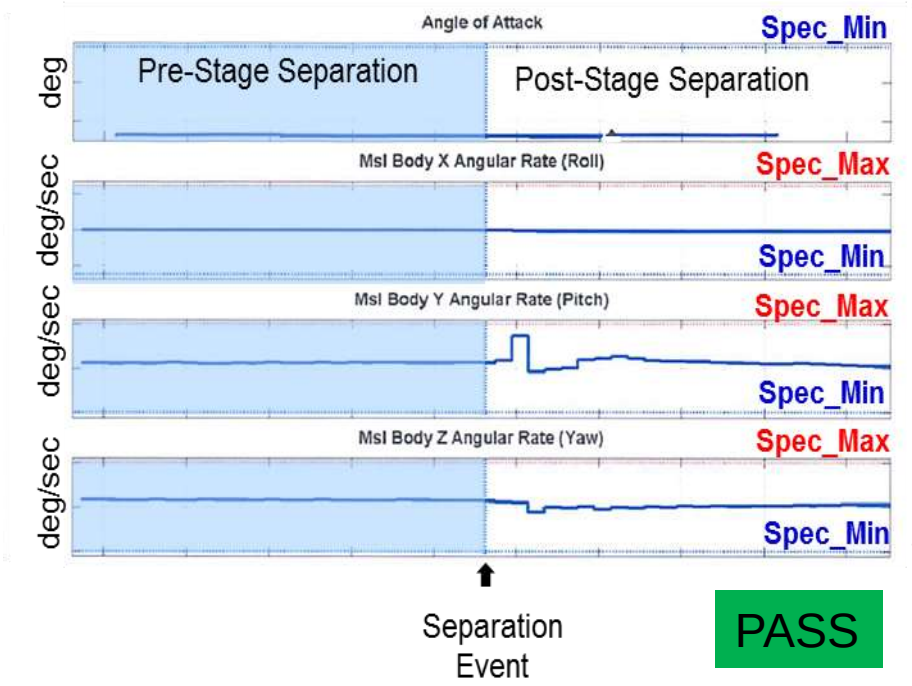
- PASS
  - Part 1 / Part 2 Pre-Stage Separation Altitude and Dynamic Pressure are within min/max specification at the Separation Event.
- FAIL
  - Part 1 / Part 2 Pre-Stage Separation Altitude is within min/max specification at the Separation Event, but the Dynamic Pressure is below the min specification.

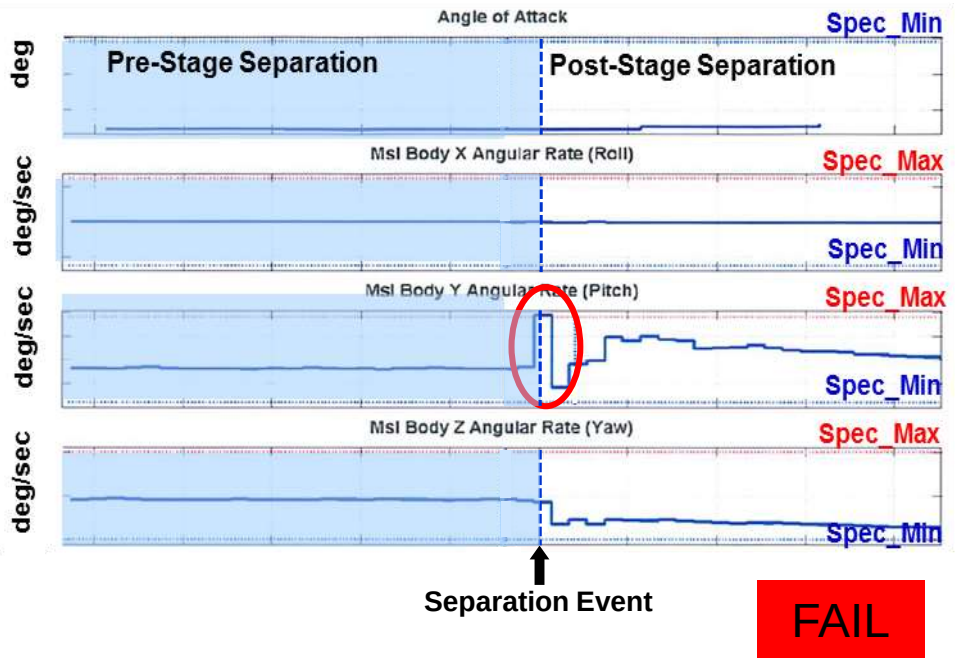




RBA Report Scripting
Example 2 – Stage Separation Event

- PASS
  - Part 1 / Part 2 Pre-Stage Separation AOA and Body Rates are within min/max specification at the Separation Event.
- FAIL
  - Part 1 / Part 2 Pre-Stage Separation AOA, Body Rate X and Z are within min/max specification at the Separation Event, but Body Rate Y is above the max specification.





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RBA Trend Tool

- Accurate Statistics
  - Time continuous vs. Parametric (P-Codes)
  - Min, Max, Mean, ±1σ
  - Overall data statistics (last data sample)
- Visual representation
  - vs. requirement
    - run_id(s) highlighted in "red" if data exceeds specification
  - vs. family of data (trend)
- Hyperlinks to individual files for further examination.

Facilitates Reviewing/Analyzing Large Quantities of Data Quickly

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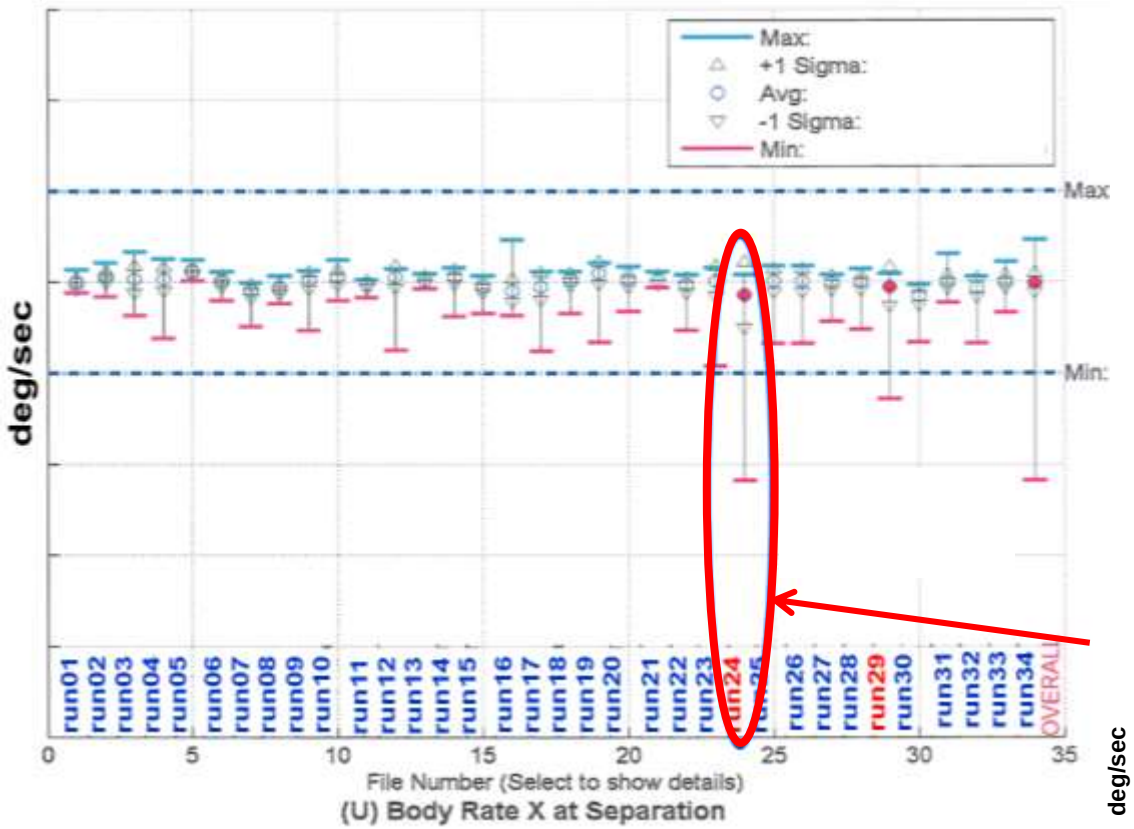
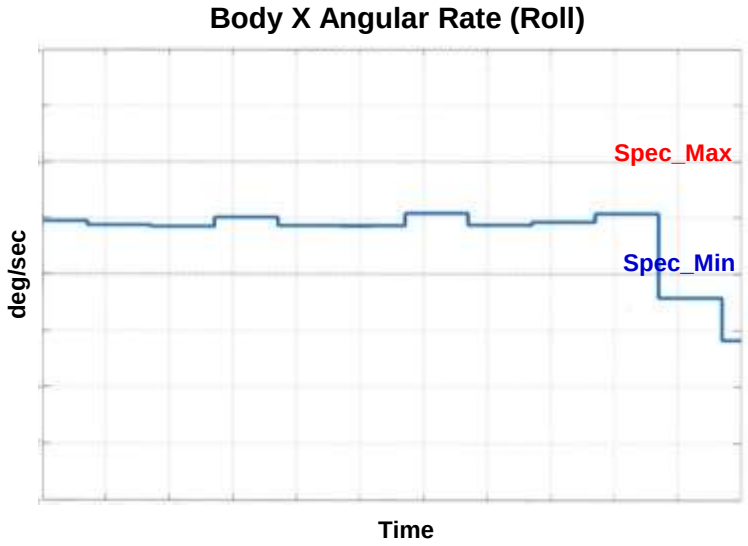
RBA Trend Tool - Body X Angular Rate (Roll)





Easy Access to Trended Data Via Hyperlinks

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Underlying Assumptions of RBA

- When using RBA with derived parameters, the appropriate engineering rigor should be exercised to avoid missing an issue with parameters that make up the derived parameter. In this case, RBA can be used to also analyze the parameters which are used to calculate the derived parameter, or RBA can be supplemented with analysis of time history data.
- Analysis using sampled parametric data only may mask certain issues. Engineering judgment is required and in some cases analysis of a full time history may be required so as to avoid missing issues.
- RBA is one of many tools available for analysis. The data analyst must decide how this tool is to be used and what other levels of more detailed analysis will be used to assure adequate product quality.

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Limitations of RBA - Examples

- IMU
  - using RBA to analyze RSS of gravity or body rates may miss an issue with a single axis
  - In this case, recommend running RBA on a three axes, or supplementing RBA of RSS with analysis of time history data
- GPS Satellite Acquisition
  - Examining maximum number of satellites locked or number of satellites locked at a certain point in time, may miss problems with satellite acquisition at other points in time.
  - In this case, recommend supplementing RBA with analysis of time history data

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Benefits of RBA

- **Employs Common Enterprise Application, Matlab©**
- **Provides Simple, Effective, and Comprehensive Solution to Assessing Program Requirements**
- **Evaluates Requirements Using All the Data…Not just Parametric Sampling**
- **Provides Simple Pass/Fail Assessment with Hyperlinks to Requirement Plots and Trends**
- **Provides a Common Analysis Methodology**
  - Common data extraction, data parameters, derivations, and algorithms
  - Evaluating requirement same way across program
  - Establishes common reference point for discussions and comparisons
- **Used Across Multiple Program Teams and Test Levels**
  - Software Formal Qualification Testing (FQT)
  - Integration & Verification Testing
  - Field/Flight Testing