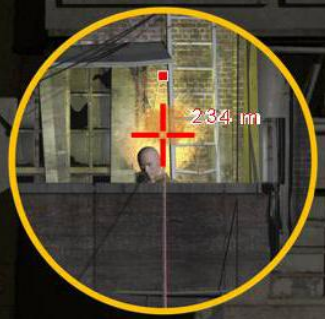
ISAAS

ATK

NDIA
NATIONAL DEFENSE INDUSTRIAL ASSOCIATION
STRENGTH THROUGH INDUSTRY & TECHNOLOGY

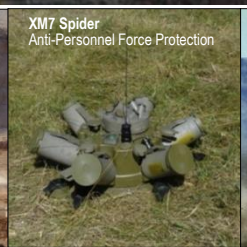
15th Annual Systems Engineering Conference
Hyatt Regency Mission Bay
San Diego, California
22-25 October 2012

ISAAS
Individual Semi-Automatic
Airburst System



System Requirements Traceability and System Verification Rigor and Planning

Joel Feigum
Chief Engineer
ATK Advanced Weapons



Agenda

Problem Statement

Program Summary

Process

Implementation Details

Conclusions

- **Problem Statement**
- **Program Summary**
- **Process**
- **Implementation Details**
- **Conclusions**

Problem Statement (The Perfect Storm)

- **Aggressive schedules**
- **Limited funding**
- **Increased requirement complexity**
  - Performance, Environment and Testing
- **Increased rigor in testing**
- **Increased testing complexity**
  - Multiple requirements → 1 Test
  - Multiple test → 1 requirement
- **Multifaceted program**
  - TD → FOA-1
  - TD → EMD → Milestone C Decision
  - EMD → FOA-2

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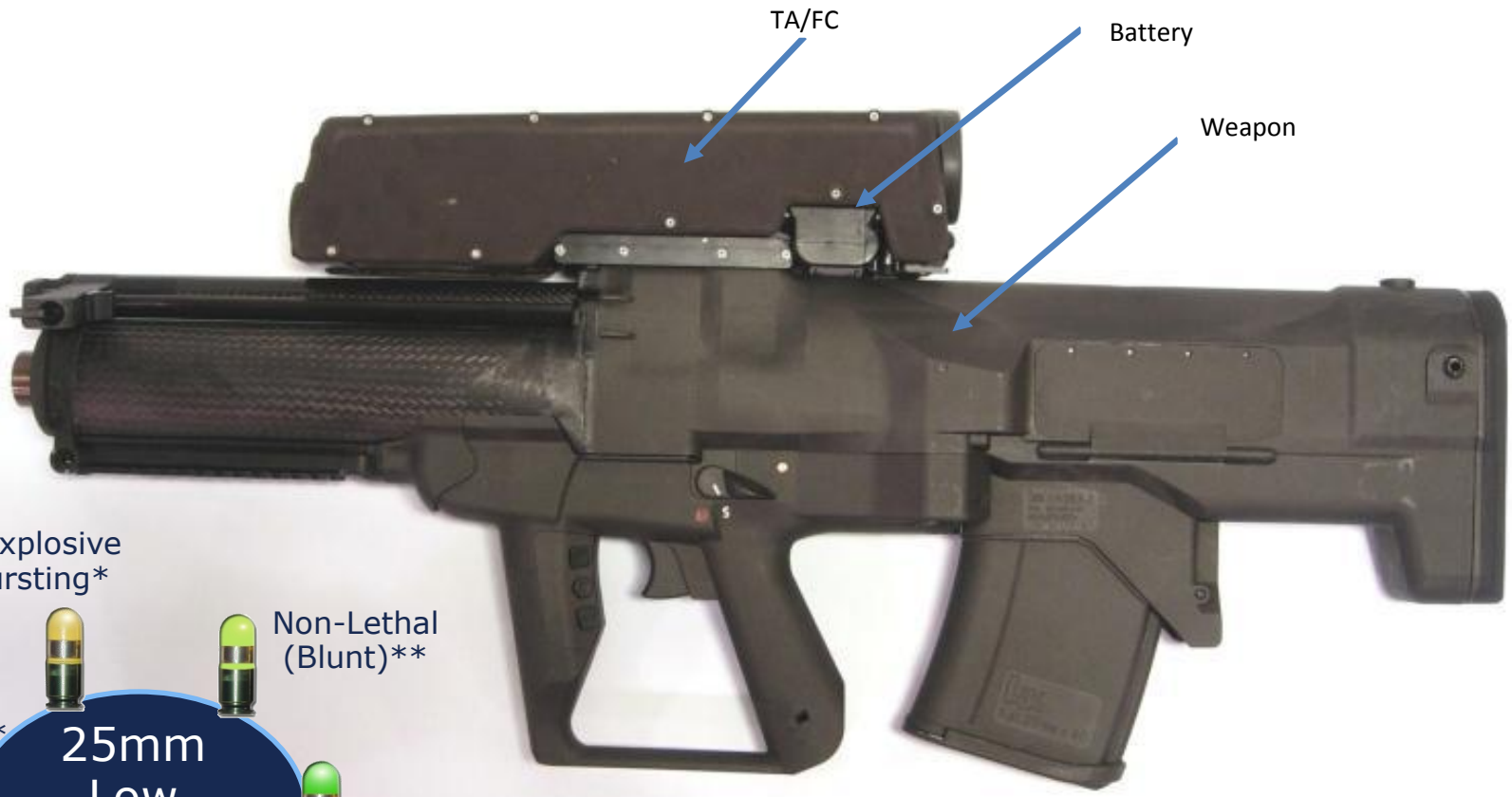
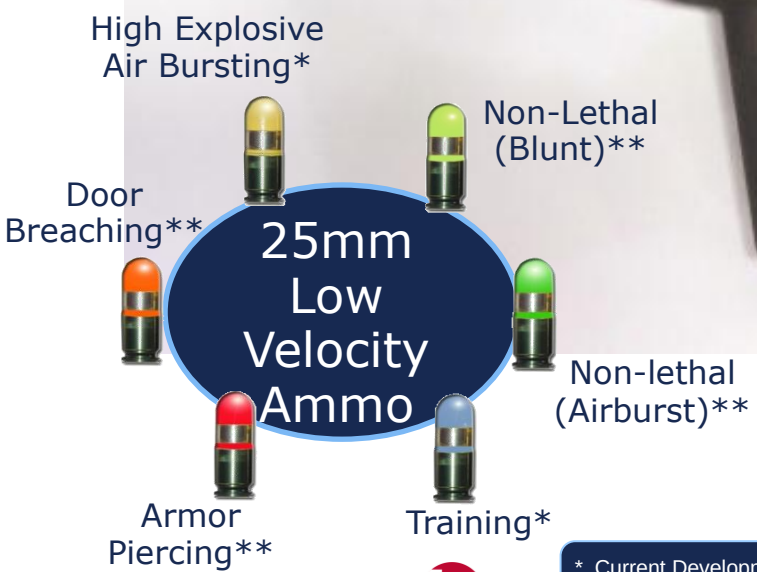
ISAAS System





* Current Development
** Future Development

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PROJECT MANAGER SOLDIER WEAPONS

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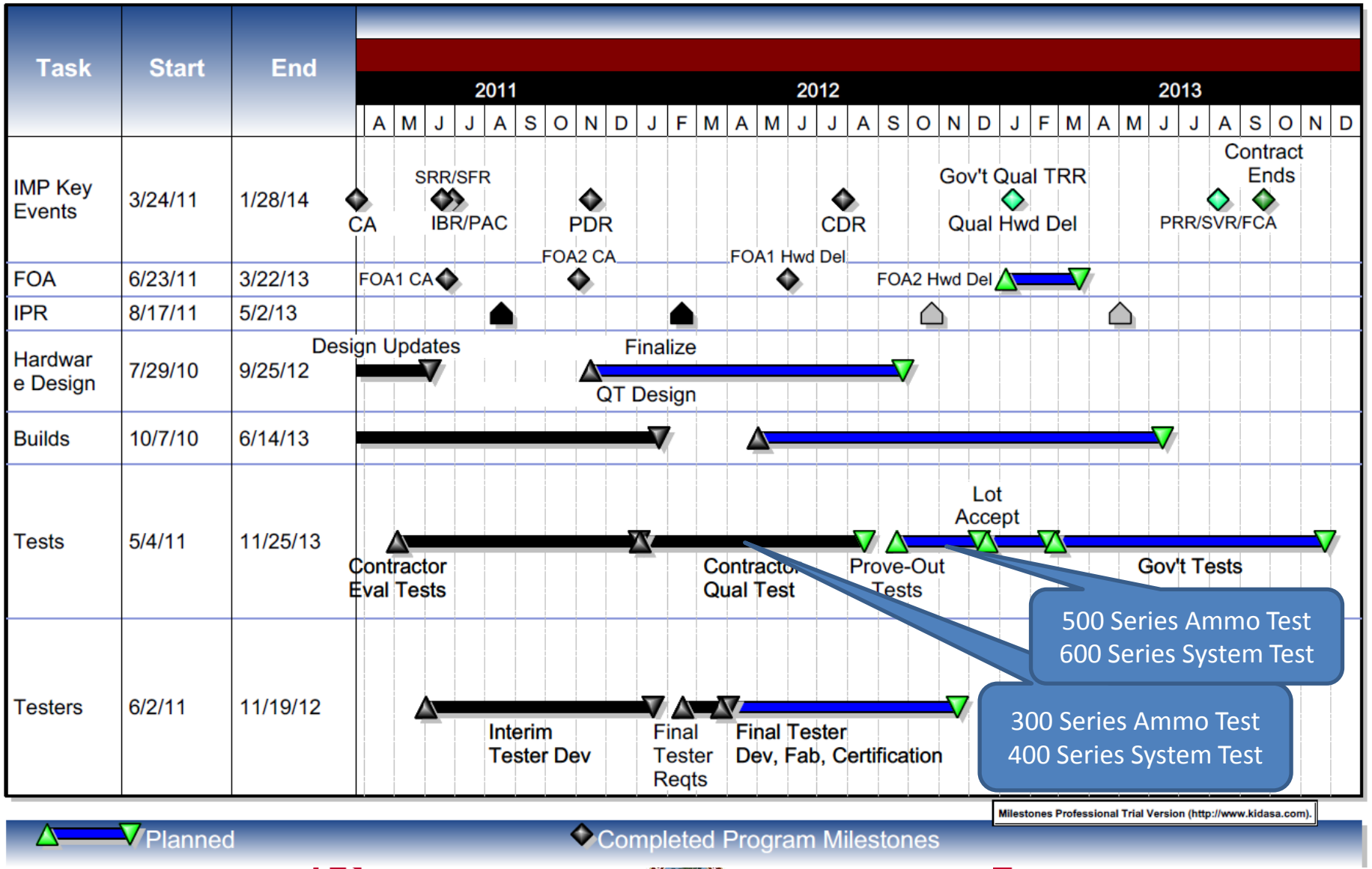
ISAAS Con-Ops

Program Schedule



ISAAS is in Theater

Forward Operational Assessment (FOA) running in parallel with EMD program

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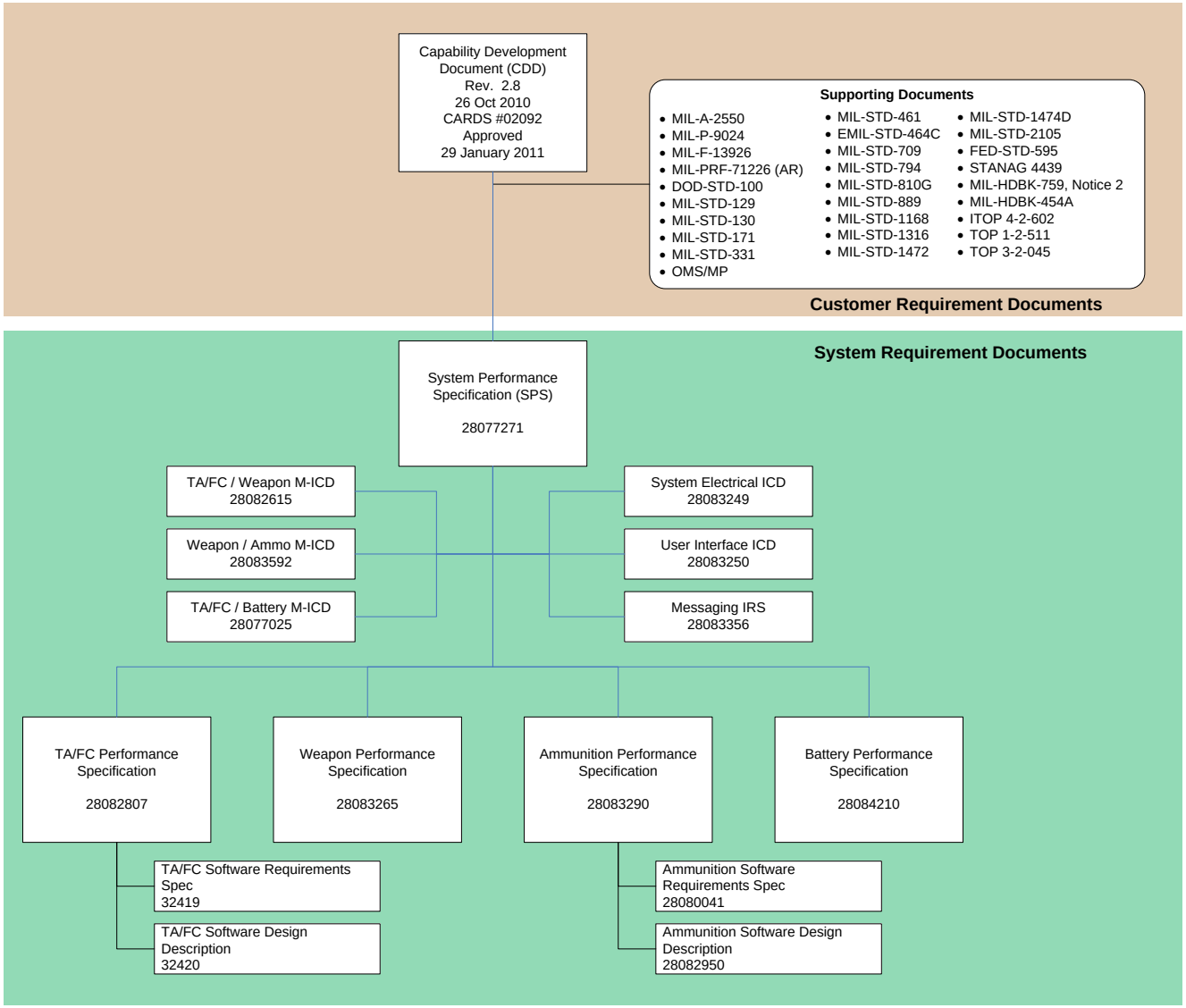
Structured Requirements



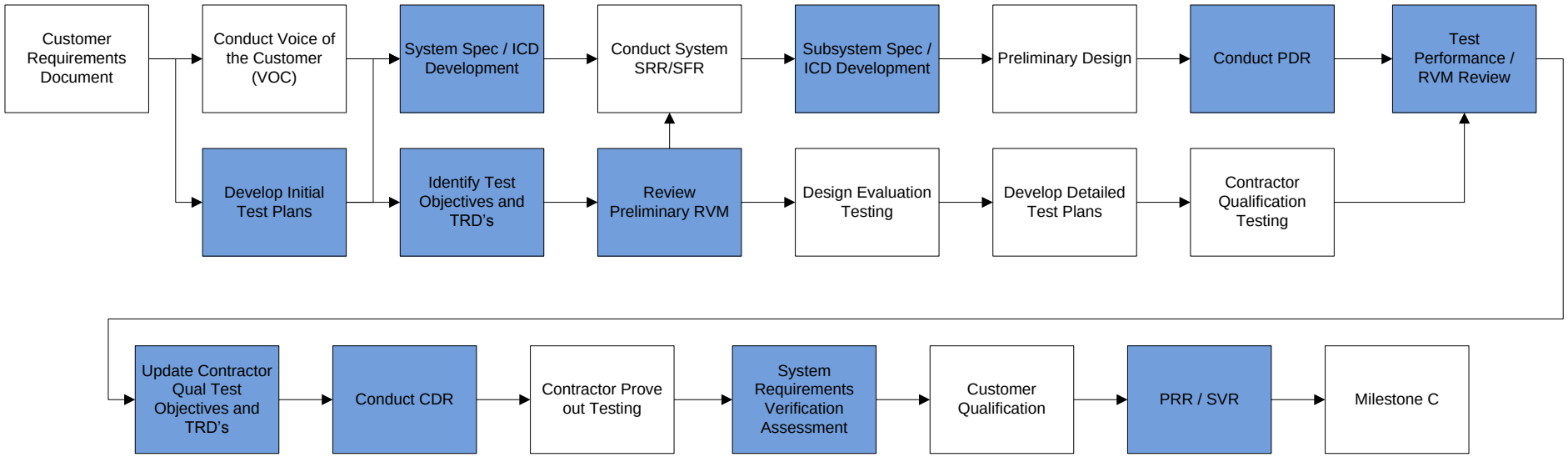
Requirement Decomposition

- **Understanding user requirements decomposition key to verification planning**
  - Focused test planning
  - Customer/User focus

KPP / KSA	System Req's	TA/FC Req's	Weapon Req's	Ammo Req's
KPP 1 - System Effectiveness	17	29	5	16
KPP 2 – Operational Availability	2	7	6	1
KSA 1 – Target Acquisition	2	4	0	0
KSA 2 - Reliability	3	3	2	1
KSA 3 – Degraded Operation	3	1	2	0
KSA 4 – Dispersion	1	0	2	2
KSA 5 – Engagement Time	10	27	6	14
KSA 6 – Zero Retention/Repeatability	3	3	4	0

Early Test Planning is Critical

- **Process demonstrates the key activities required to verify requirements**
- **Requirements management tool used to tie the testing and requirements**
- **Test planning driven by SE tools and team**
- **Early involvement of the customer and government test facilities**
- **Harvest data from FOA activities**



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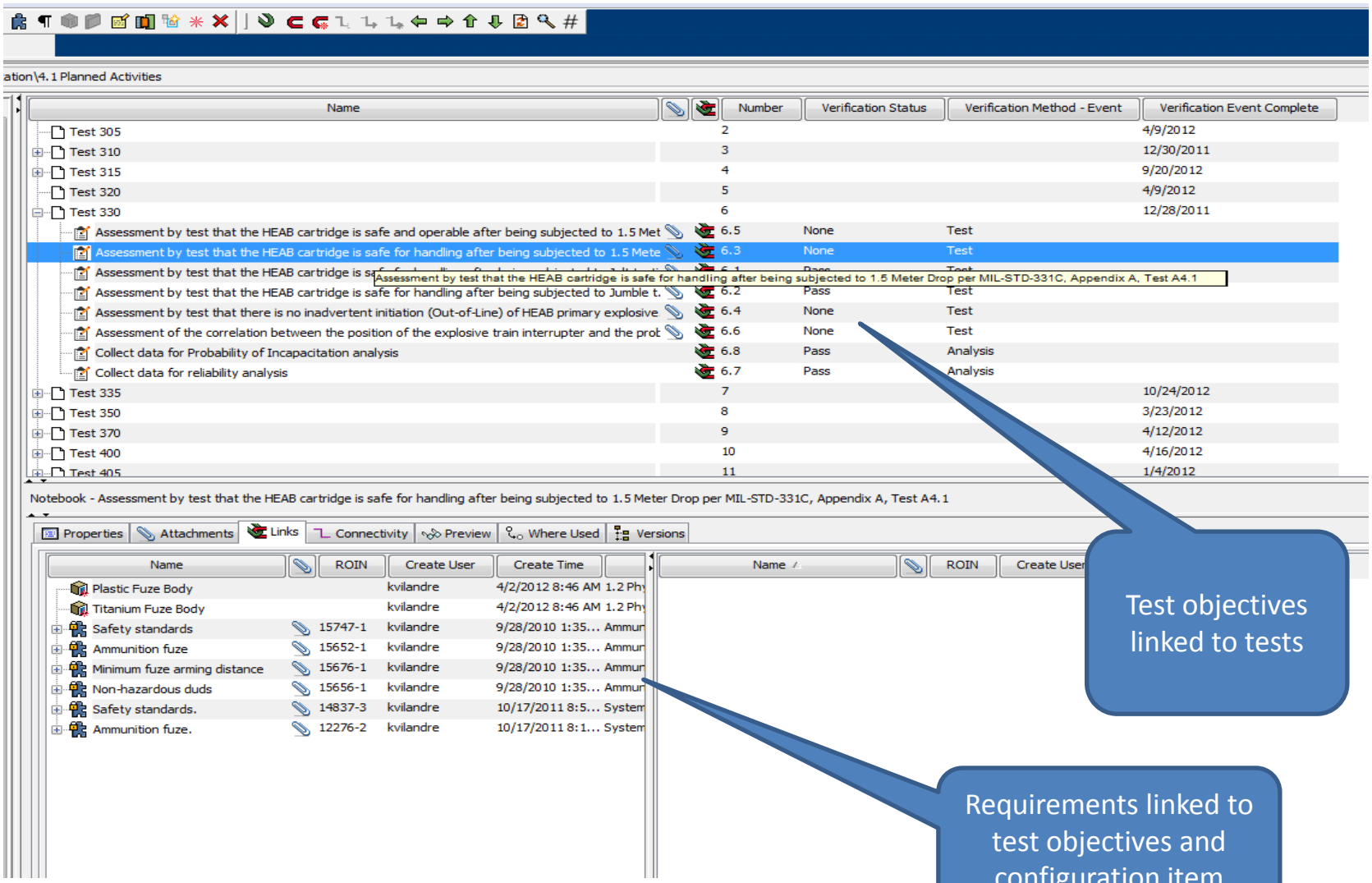
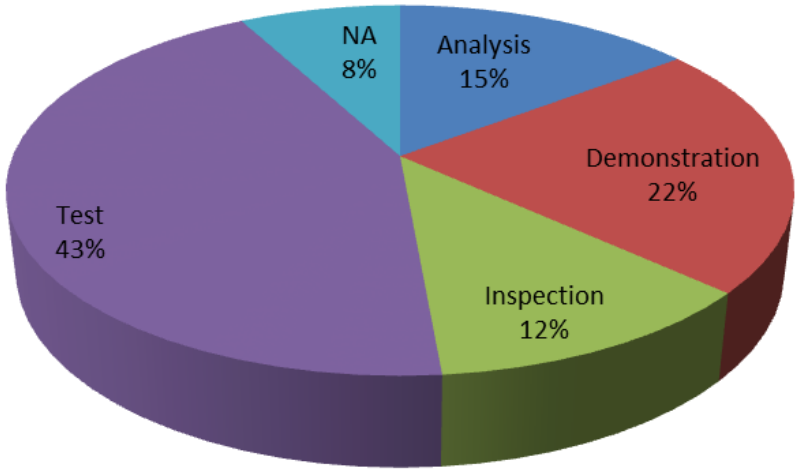
SE Tools Supports



Verification Identification



- **Early identification of the "how to" during the verification process is critical to ensuring program success**
  - Test planning
  - Test objectives
  - Success criteria

User Focused Verification Event Summary

CDD Requirement	Test 300	Test 310	Test 330	Test 350	Test 370	Test 400	Test 405	Test 410	Test 412	Test 420	Test 422	Test 423	Test 424	Test 425	Chemical Analysis	Cleaning Demonstration	Drawing Inspection	EMQRB Results	Government Arena Testing	Human Engineering Analysis	Logistics Analysis	Logistics Inspection	Maintenance Analysis	Nuclear Event Analysis	Operational Availability Analysis	Physical Inspection	Probability of Incapacitation Analysis	Recognition Analysis	Reliability Analysis	Tactical Transportation Shock Analysis	Transportation Analysis
KPP-1	X			X		X	X				X			X					X							X					
KPP-2							X		X			X													X			X			
KSA-2																													X		
KSA-3						X	X				X																				
KSA-4							X		X		X			X																	
KSA-5	X					X	X				X																				
KSA-6							X		X																						
APA-1											X																				
APA-2							X																								
APA-3												X																			
APA-4																										X					
APA-5																										X					
APA-6						X	X																								
APA-7									X		X			X												X	X				
APA-8							X					X																			
APA-9												X								X											
APA-10												X																			
APA-11							X									X															
APA-12										X			X		X		X														
APA-13								X			X	X	X							X										X	X
APA-14																															
APA-15						X	X							X																	
APA-16							X					X								X											
APA-17												X																			
APA-18							X																								
APA-19									X																						

Test Planning

Summary Test Information

- Purpose of Test – Perform testing to confirm that soldiers can operate ISAAS weapon systems effectively and safely.
- Type of Test –
  - Detailed instructions for human factors tests are given in TOP 1-2-61020,
  - Human Factors Engineering, Part I, Test Procedures, and
  - TOP 1-2-61021, Part II, HEDGE, Human Factors Engineering Data Guide
- Month/Year Scheduled – February-March 2012
- Test Location –
  - Aberdeen Proving Grounds (APG)
  - Firings at APG Test Firing Ranges

ISAAS Test Description Document

Individual Semi Automatic Airbursting System

ISAAS

TEST #: 423

Test Name: Wpn Sys Human Factors Assessment

Contract Number: W19CRB-11-C0024
Contracting Agency: U.S. Army RDECOM CONTR CTR-WS1CRB
Date: May 24, 2011

Test Objectives/Success Criteria/Data

Weapon System Human Factors Test 423			
Objective	Test Objective	Success Criteria	Data Requirements
P1	Verify that the weapon system is aurally non-detectable by a soldier in accordance with MIL-STD-1474, without additional sensors SPS Requirement - 3.3.2.2	• Weapon systems is not aurally detectable by a soldier (human ear) in accordance with MIL-STD-1474, without additional sensors • Audio sensor measurements confirm weapon systems aural noise levels are less than levels specified MIL-STD-1474, without additional sensors	• Observer (human) feedback • Audio sensor data logs • Captured digital scope trace • Test data sheets
P2	Verify that the weapon system does not generate visually-detectable emissions by a soldier without additional sensors at 5 meters and beyond while performing any of its functions, other than firing SPS Requirement - 3.3.2.3	• Weapon system does not generate visual-detectable emissions while performing all operational functions except firing: • No shiny surfaces • No glint generator surfaces Note – Only exception is the TA/FC lenses with protective covers removed.	• Observer (human) feedback • Video recorder data • Test data sheets
P3	Verify (by demonstration) that the weapon system is equipped with a hands-free carrying sling. SPS Requirement - 3.2.8.1	• Weapon has fasteners for a hand-free carrying sling	• Operator demonstration • Photos and videos
P4	Verify (by demonstration) that the weapon system carrying sling has quick release fasteners. SPS Requirement - 3.2.8.2	• Weapon hand-free carrying sling fasteners are quick release designed	• Operator demonstration • Photos and videos
P5	Verify (by demonstration) that the weapon system has a magazine	• Weapon with magazine inserted is operationally compatible with current	• Operator demonstration • Photos and videos

SPS Requirements Assessed

3.3.2.2	Aural detectability.
3.3.2.3	Visual detectability.
3.2.8.1	Carrying sling operation.
3.2.8.2	Carrying sling attachment.
3.3.1.8.5	Magazine carrier.
3.3.2.1	Handgrip/bipod.
3.5.6.6	Overpressure.
3.5.6.7	Cartridge case ejection.
3.5.10.4	Normal combat load.
3.5.10.5	Mission Oriented Protective Posture (MOPP IV).
3.5.10.6	Body armor.
3.5.10.7	Cold weather gear.
3.5.10.9.1	Ambidextrous use degradation.

Sample SE Tool Output

	Requirements Data						Verification Objective Data							Verification Event Data		
	Owner	Paragraph	Title	ROIN	Test	Development Verificatio	Objective Priority	Objective Test	Success Criteria	Data Requirements	Status	Verification Method	Comment	Verification Name	Verification Phase	Completion Date
25	s	3.2.7.3	Alignment repeatability.	14969-2	(T), 99% confidence (O).				Analysis-Test	HI			confidence.			
22	System Requirements	3.5.10.9.3	Ambidextrous cartridge case ejection.	14995-3	The weapon system shall allow right or left hand cartridge case ejection that is compatible with ambidextrous change-over modifications.	Demonstration-Test	HI	Verify by demonstration/test that the weapon system allows right or left hand cartridge case ejection, compatible with ambidextrous change-over modifications								9/9/2012
23	System Requirements	3.4.5.4	Airdrop operations	12409-4	The weapon system shall meet performance and safety requirements after airdrop when packed in an individual equipment container worn by the soldier during airborne operations.	Test		Verify that the weapon system meets performance and safety requirements after airdrop when packed in an individual equipment container worn by the soldier during airborne operations.	and disables fire event when Safe/Fire switch is in the Safe position. • Weapon system passes non-firing operational functional assessment testing after impact. • Note – Weapon firing performance will be verified after completing final environment or test.	-Observer Feedback -Test data sheets -Operational functional assessment log sheets (including "Fuze-on-a-Stick" computer data)	None	Test	None	Tactical Transportation Shock Analysis	Development	9/9/2012
24	System Requirements	3.2.7.3	Alignment repeatability.	14969-2	The weapon system shall retain alignment to less than a half mil, when the TA/FC is removed and reinstalled, with 90% confidence (T), 99% confidence (O).	Analysis-Test	HI	Verify that the weapon system retains alignment to less than a half mil, when the TA/FC is removed and reinstalled, with 90% confidence.	Weapon systems alignment error is less than 0.5 mils after TA/FC is removed and reinstalled 1 times	•Pre-test alignment data •Post-test alignment data	Pass	Test	None	Test 412	Development	5/1/2012
25	System Requirements	3.2.7.3	Alignment repeatability.	14969-2	The weapon system shall retain alignment to less than a half mil, when the TA/FC is removed and reinstalled, with 90% confidence (T), 99% confidence (O).	Analysis-Test	HI	Verify that the weapon system retains alignment to less than a half mil, when the TA/FC is removed and reinstalled, with 90% confidence.	Weapon systems alignment error is less than 0.5 mils after TA/FC is removed and reinstalled 1 times	-Pre-test alignment data -Post-test alignment data	Pass	Test	None	Test 412	Development	5/1/2012
26	System Requirements	3.5.10.9.3	Ambidextrous cartridge case ejection.	14995-3	The weapon system shall allow right or left hand cartridge case ejection that is compatible with ambidextrous change-over modifications.	Demonstration-Test	HI	Verify by demonstration/test that the weapon system allows right or left hand cartridge case ejection, compatible with ambidextrous change-over modifications	• Weapon system passes operational functional assessment testing when configured for both right-handed, and left-handed operators.	•Operational functional assessment log sheets (including "Fuze-on-a-Stick" computer data) •Photos of Weapon and TA/FC •Photos of system firings •Test log sheets	Pass	Demonstration	None	Test 405	Development	1/4/2012
27	System Requirements	3.5.10.9.3	Ambidextrous cartridge case ejection.	14995-3	The weapon system shall allow right or left hand cartridge case ejection that is compatible with ambidextrous change-over modifications.	Demonstration-Test	HI	Verify by demonstration/test that the weapon system allows right or left hand cartridge case ejection, compatible with ambidextrous change-over modifications	• Weapon system passes operational functional assessment testing when configured for both right-handed, and left-handed operators. • Flight-handed and left-handed operators fire the weapon system	-Operational functional assessment log sheets (including "Fuze-on-a-Stick" computer data) -Photos of Weapon and TA/FC -Photos of system firings -Test log sheets	Pass	Demonstration	None	Test 405	Development	1/4/2012
28	System Requirements				The weapon system shall achieve ambidextrous operation through	Demonstration		Verify (by demonstration) that the weapon system achieves	without any ambidextrous	•Operational functional assessment log sheets (including "Fuze-on-a-Stick" computer data) •Photos of Weapon		Demonstration				1/4/2012

reinstalled 1 times | •Post-test alignment data | Pass | Test | None | Test 405 | Development | 5/1/2012

• Weapon system passes operational functional assessment testing when configured for both right-handed, and left-handed operators. | •Operational functional assessment log sheets (including "Fuze-on-a-Stick" computer data) •Photos of Weapon and TA/FC •Photos of system firings •Test log sheets | Pass | Demonstration | None | Test 405 | Development | 1/4/2012

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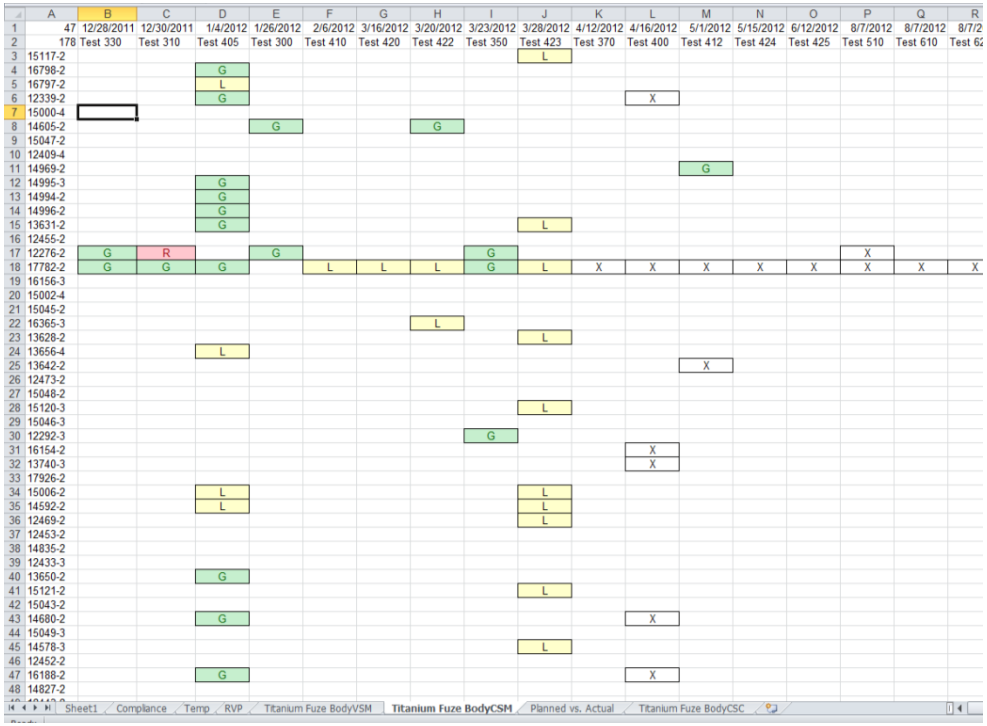
Manage / Identify V&V Issues

- SE tool utilized to monitor V&V process and issues
- V&V updated immediately upon test completion
- Review results as appropriate

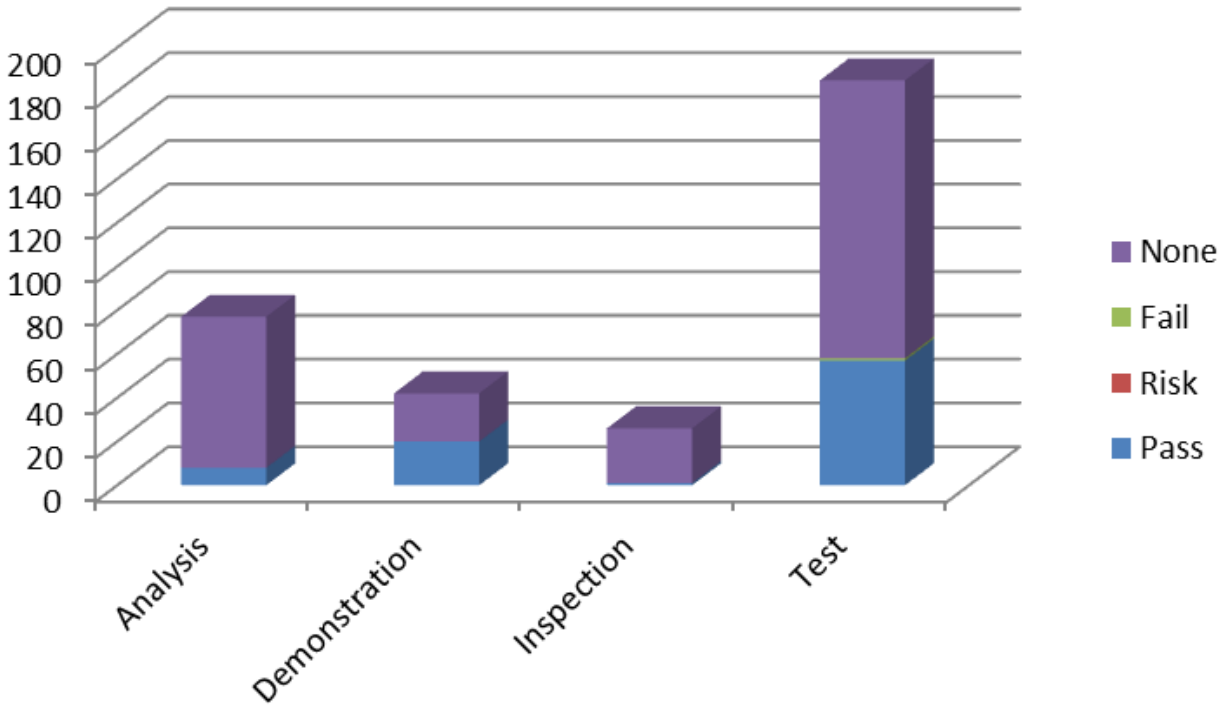


	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1		47	12/28/2011	12/30/2011	1/4/2012	1/26/2012	2/6/2012	3/16/2012	3/20/2012	3/23/2012	3/28/2012	4/12/2012	4/16/2012	5/1/2012	5/15/2012	6/12/2012	8/7/2012	8/7/2012	8/7/2
2		178	Test 330	Test 310	Test 405	Test 300	Test 410	Test 420	Test 422	Test 350	Test 423	Test 370	Test 400	Test 412	Test 424	Test 425	Test 510	Test 610	Test 62
3	15117-2										L								
4	16798-2				G														
5	16797-2				L														
6	12339-2				G								X						
7	15000-4																		
8	14605-2					G			G										
9	15047-2																		
10	12409-4																		
11	14969-2													G					
12	14995-3				G														
13	14994-2				G														
14	14996-2				G														
15	13631-2				G						L								
16	12455-2																X		
17	12276-2	G	R			G				G									
18	17782-2	G	G	G			L	L	L	G	L	X	X	X	X	X	X	X	X
19	16156-3																		
20	15002-4																		
21	15045-2																		
22	16365-3								L										
23	13628-2										L								
24	13656-4				L														
25	13642-2													X					
26	12473-2																		
27	15048-2																		
28	15120-3										L								
29	15046-3																		
30	12292-3									G									
31	16154-2												X						
32	13740-3												X						
33	17926-2																		
34	15006-2				L						L								
35	14592-2				L						L								
36	12469-2										L								
37	12453-2																		
38	14835-2																		
39	12433-3																		
40	13650-2				G														
41	15121-2										L								
42	15043-2																		
43	14680-2				G								X						
44	15049-3																		
45	14578-3										L								
46	12452-2																		
47	16188-2				G								X						
48	14827-2																		

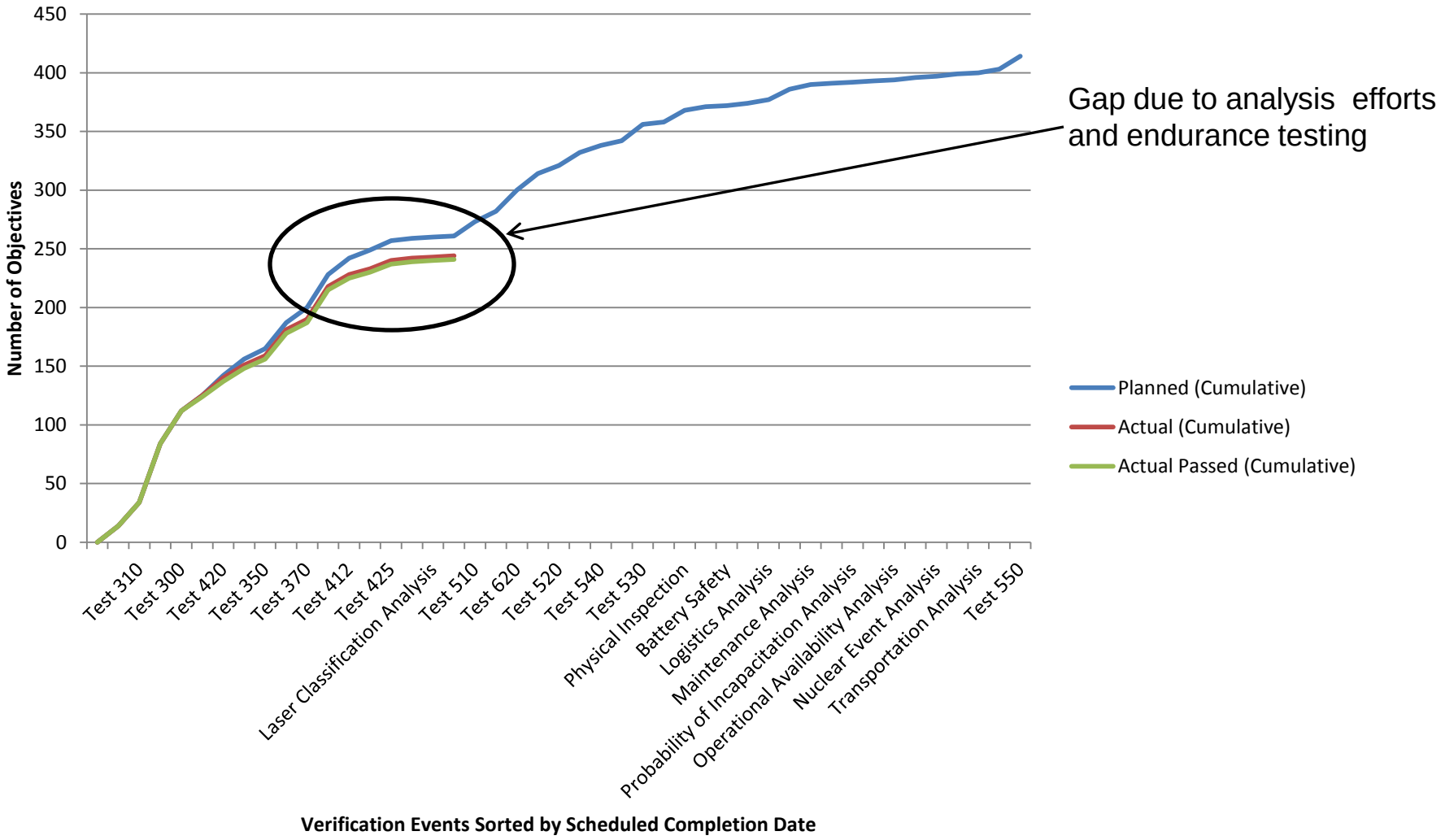
Sheet1 | Compliance | Temp | RVP | Titanium Fuze BodyVSM | Titanium Fuze BodyCSM | Planned vs. Actual | Titanium Fuze BodyCSC

Verification Metrics

- **Constant monitoring of verification activities against plans is critical to ensuring success**



Planned vs. Actual Objectives



Conclusions

- **Emphasis of System Engineering discipline throughout program life cycle**
- **Early collaboration and involvement of the test engineering**
- **System Engineering involvement in test planning and execution**
- **Early and constant monitoring of requirement V&V**
  - Metrics identification and tracking
- **SE Tool usage is critical to tying it all together.**

Acknowledgements

Special thanks to PM-IW:

- Rob Greenfield – SE LEAD
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- Peter Ollis – ATC Test Lead
- Don Kukowski – ATK Test Lead

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Abstract ID Number: **14764**

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