

U.S. Army Evaluation Center

ATEC



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Battle Ready*

ATEC Reliability Growth Case Studies and Lessons Learned

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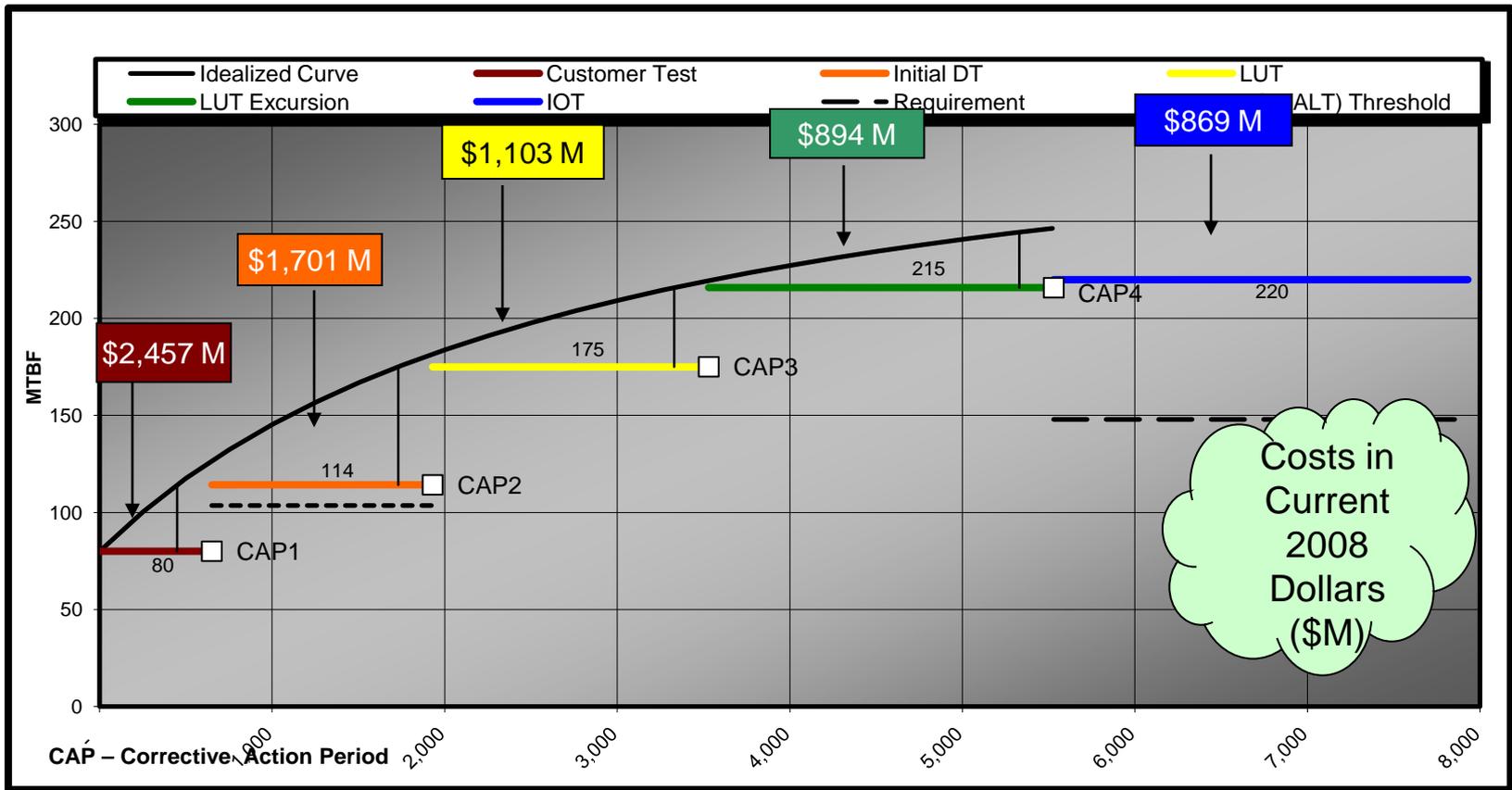
15 Aug 12



Purpose

To provide emerging reliability growth lessons learned

Reliability Growth and Its Impact on Support Costs





Recent RAM Policy Initiatives-Reliability Growth Curves



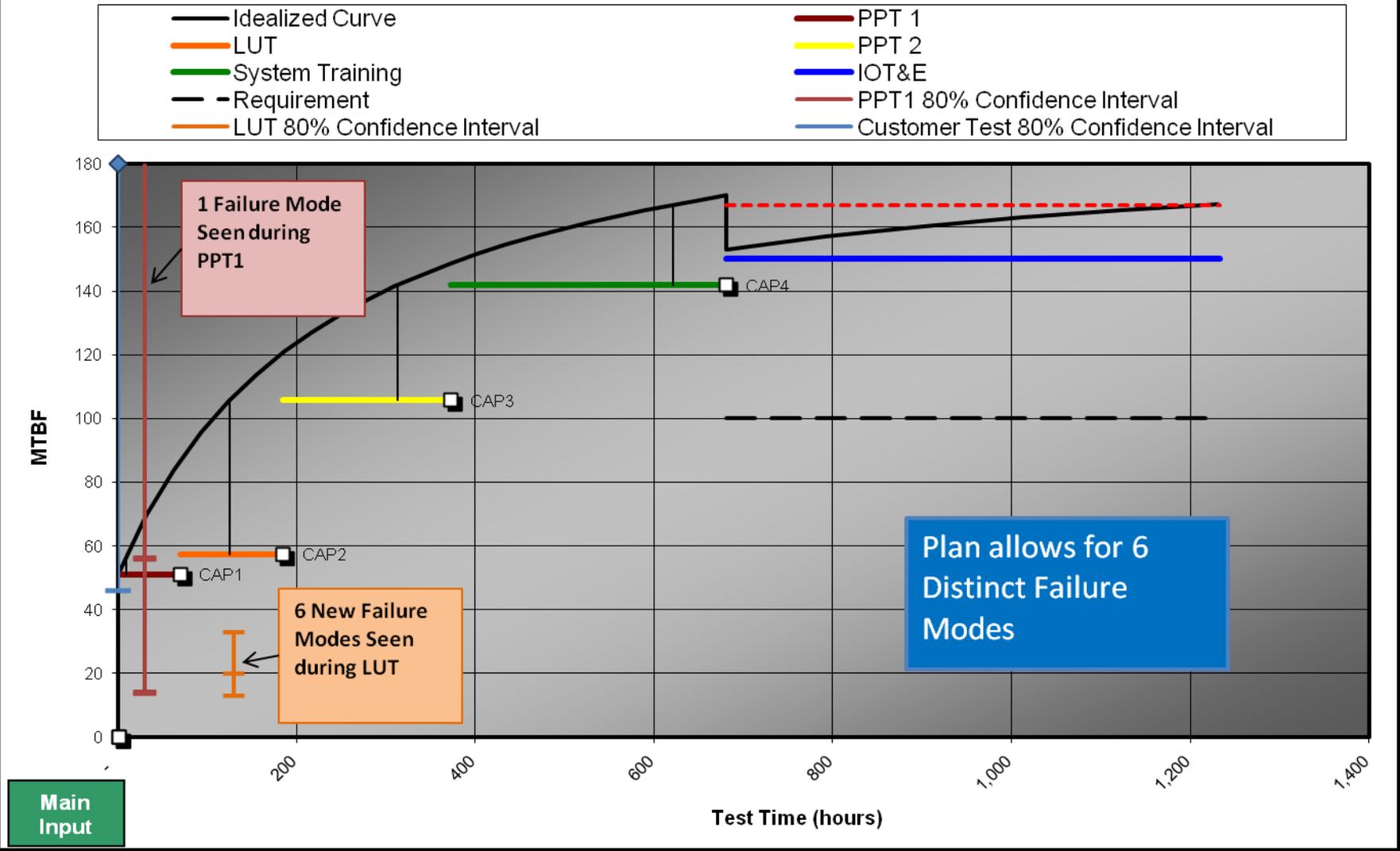
21 March 2011 OSD Reliability Policy DTM

26 June 2011 Army Reliability Policy Update

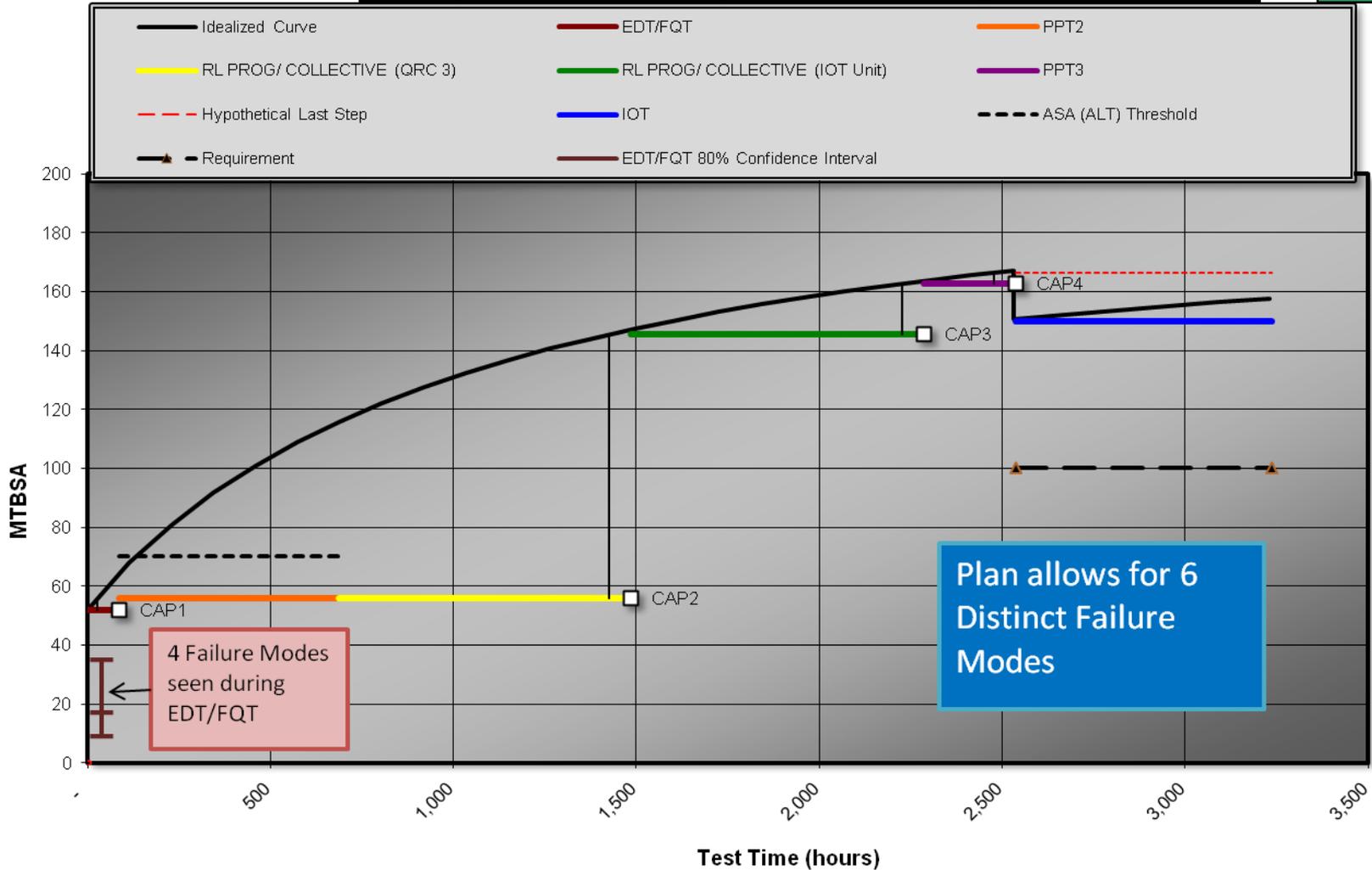
- Applies to ACAT I and ACAT II systems that are pre-Milestone B or that have increments pre-Milestone B
 - Does not apply to IT systems w/o hardware procurement
- Reliability Growth Planning Curve (RGPC) Required
 - Must be incorporated in SEP, Life Cycle Sustainment Plan, TES, TEMP and EMD contract
 - Critical to ensure program is properly resourced to achieve requirements
 - Crafted using AMSAA Planning Model based on Projection Methodology (PM2)
 - Includes initial and goal reliability targets, test phases, corrective action periods, management metrics
 - O&S costs overlaid on the RGPC
- An early EMD reliability threshold must be established and demonstrated during the first full-up, system-level developmental test event
- An early engineering-based reliability program review using AMSAA Reliability Scorecard must be performed

- Establishes comprehensive RAM program with reliability growth strategy
- Reliability Growth Curves shall be
 - Employed to plan, illustrate, and report reliability growth status at Defense Acquisition Executive System reviews
 - Included in the SEP at MS A and updated in the TEMP at MS B
 - Tracked through fully integrated, system level T&E events until the threshold is achieved
 - Used to assess the RG required for system to achieve threshold during IOT and report results to MDA at MS C

UAV System 1 Reliability Growth Planning Curve - ORIGINAL



UAV System 1 Reliability Growth Planning Curve - REVISED





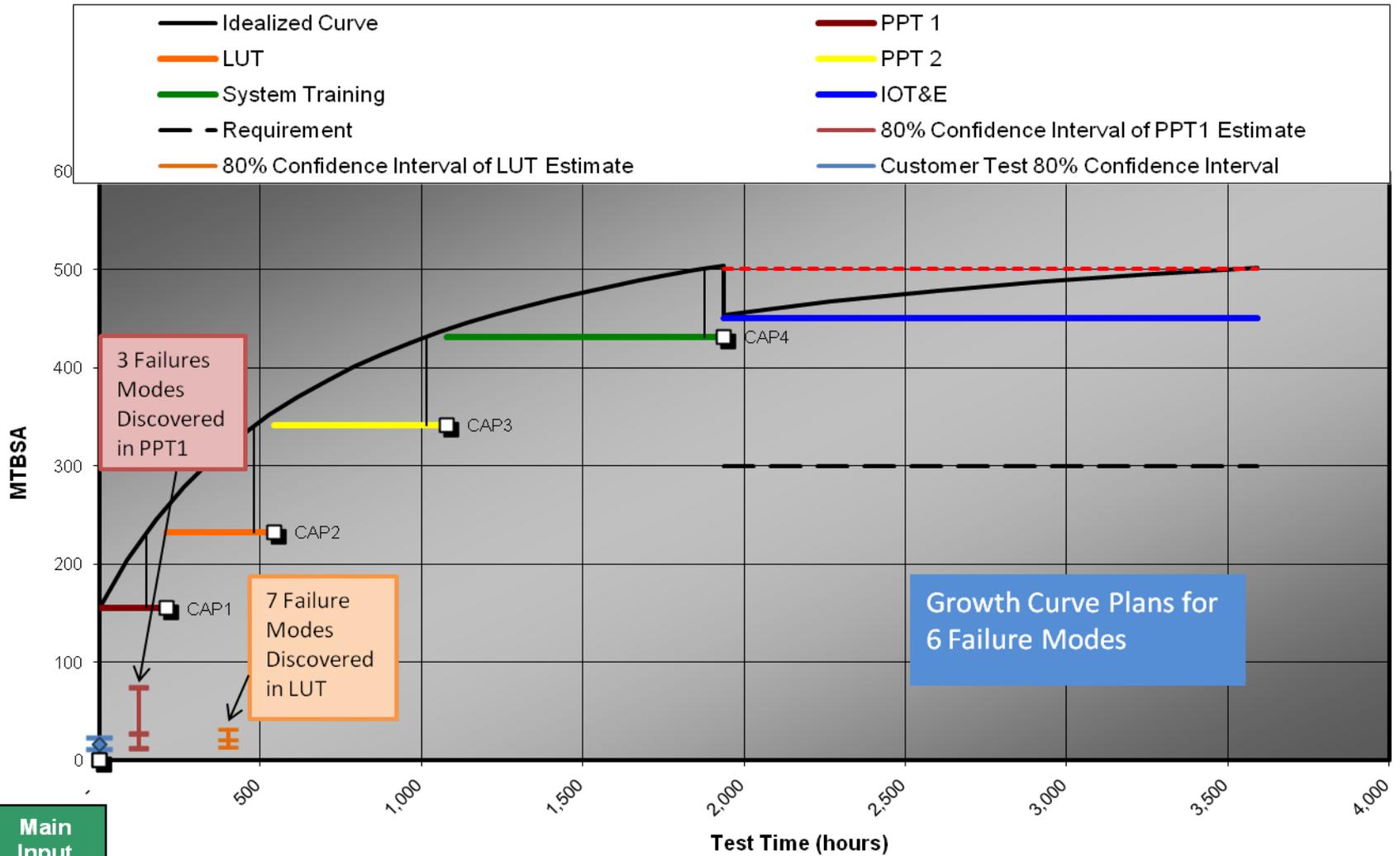
Reliability Growth Results, Post-MS B Start Continuous Use Systems

Reliability Growth Planning Curve (RGPC) Events

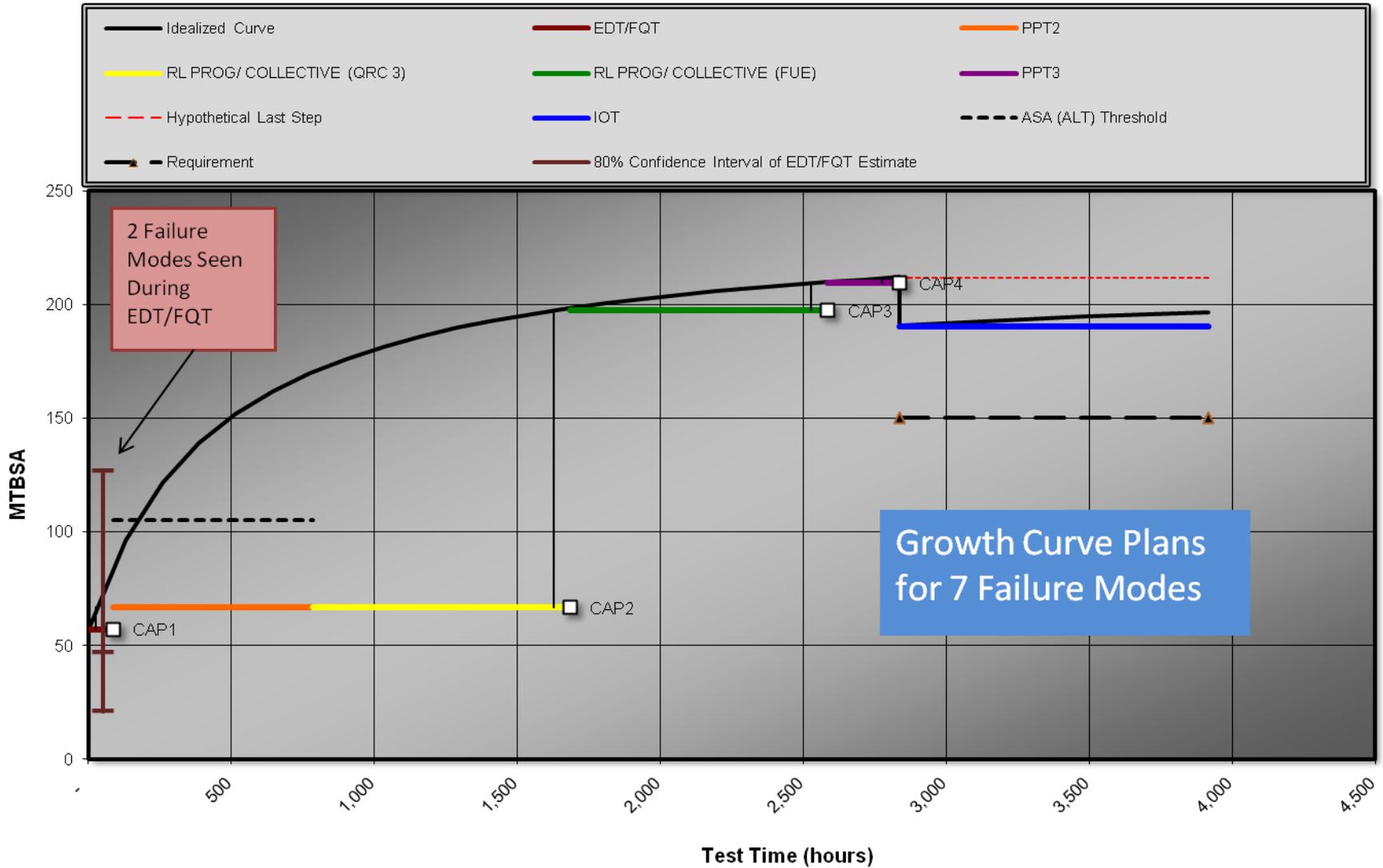
Program	EMD Contract	1 st Test	2 nd Test	3 rd Test
Unmanned Air Vehicle 1	<ul style="list-style-type: none"> Tasks: Allocations & Predictions, FMECA, FRACAS Prediction = 362 	<ul style="list-style-type: none"> GDT w/o Soldiers PE = 56 hrs vs. req'ment 100 #FM = 1 RGPC developed w/ this event as 1st step #FM RGPC = 6 	<ul style="list-style-type: none"> OT Functionality added PE = 20 RGPC Step = 58 #Add'l FM = 6 RGPC revised #FM RGPC = 6 	<ul style="list-style-type: none"> CDT w/o Soldiers Functionality added PE = 17 RGPC Step = 52 # Add'l FM = 4 <div style="border: 1px solid black; padding: 5px; width: fit-content;"># FMs to date = 11</div>
Ground Control Station 1	<ul style="list-style-type: none"> Tasks: Allocations & Predictions, FMECA, FRACAS Prediction = 319 CT w/ Soldiers, PE = 16 vs. req'ment = 300 RGPC developed, #FM = 6 	<ul style="list-style-type: none"> GDT w/o Soldiers PE = 27 RGPC Step = 160 #FM = 3 	<ul style="list-style-type: none"> OT PE = 20 RGPC Step = 230 #Add'l FM = 7 Req'ment 300 to 150 New RGPC, #FM = 7 	<ul style="list-style-type: none"> CDT w/o Soldiers PE = 47 RGPC Step = 60 #Add'l FM = 2 <div style="border: 1px solid black; padding: 5px; width: fit-content;"># FMs to date = 12</div>
Sensor Payload 1	<ul style="list-style-type: none"> Tasks: Req'ment = 500 #FM RGPC = 6 <div style="border: 1px solid black; padding: 5px; width: fit-content;"># FMs to date = 30</div>	<ul style="list-style-type: none"> Chamber Test , extra 2000 hrs PE = 800 RGPC Step = 270 #FM = 25 	<ul style="list-style-type: none"> On Aircraft PE = 30 RGPC Step = 400 # Add'l FM = 5 	<div style="background-color: yellow; padding: 5px;"> <ul style="list-style-type: none"> <input type="checkbox"/> Struggling to get on RGPCs – too many FMs <input type="checkbox"/> Predictions and chamber testing highly optimistic <input type="checkbox"/> Requirements reduced </div>

CT=Customer Test CDT=Contractor Developmental Test FM=Failure Mode FMECA=Failure Mode Effects & Criticality Analysis FRACAS=Failure Reporting Analysis & Corrective Action System GDT=Government Developmental Test PE=Point Estimate OT=Operational Test

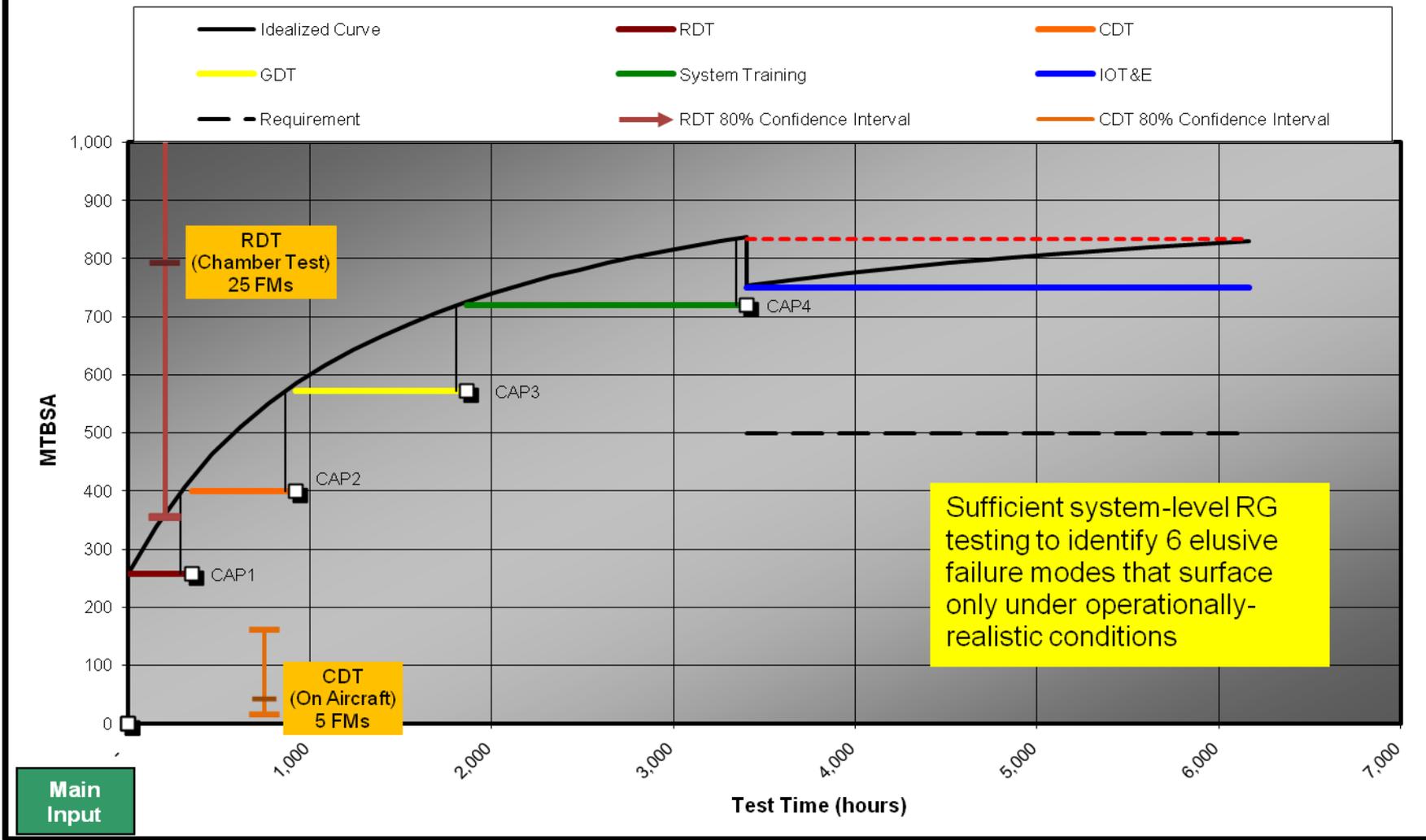
Ground Control Station 1 Reliability Growth Planning Curve - ORIGINAL



Ground Control Station 1 Reliability Growth Planning Curve - REVISED



Sensor Payload System 1 Reliability Growth Planning Curve





Emerging Lessons Learned

- ❑ Reliability predictions and chamber testing estimates are highly optimistic
- ❑ Systems entering system/subsystem RG testing with too many failure modes
- ❑ RG testing programs are appropriate for small number of elusive failure modes that only surface when HW, SW, and Operators use the system under operationally-realistic conditions
- ❑ Need to contract for closed-loop, continuous-improvement effort to identify & mitigate failure modes likely to occur under operationally-realistic loads & stresses using techniques including:
 - engineering- and physics-based failure-mechanism models
 - accelerated and low-level testing of components and assemblies
 - MANPRINT analytical methods (for failure modes that may be charged to Users, Maintainers, or SW)
 - Lean Six Sigma methods (for failure modes that may be induced by manufacturing variation or errors)
 - Can assess before start of system-level RG testing with AMSAA Reliability Scorecard
- ❑ Center for Reliability Growth investigating potential impact of techniques above on sample of commodities
 - Needs to be done during and immediately after test event
 - May be possible to tailor mix of failure-mode identification techniques for particular types of systems