Improving Our Leaders' Ability to Understand and Manage Risks, Issues, and Opportunities

Mr. Chris DeLuca
Office of the Deputy Assistant Secretary of Defense for Systems Engineering

18th Annual NDIA Systems Engineering Conference
Springfield, VA | October 28, 2015

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DASD, Systems Engineering Mission

Systems Engineering focuses on engineering excellence – the creative application of scientific principles:

- **To design, develop, construct and operate complex systems**
- **To forecast their behavior under specific operating conditions**
- **To deliver their intended function while addressing economic efficiency, environmental stewardship and safety of life and property**

DASD(SE) Mission: Develop and grow the Systems Engineering capability of the Department of Defense – through engineering policy, continuous engagement with component Systems Engineering organizations and through substantive technical engagement throughout the acquisition life cycle with major and selected acquisition programs.

A Robust Systems Engineering Capability Across the Department Requires Attention to Policy, People and Practice

- ***US Department of Defense is the World's Largest Engineering Organization***
- ***Over 108,000 Uniformed and Civilian Engineers***
- ***Over 39,000 in the Engineering (ENG) Acquisition Workforce***

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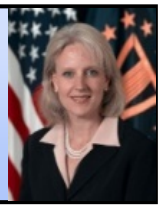
DASD, Systems Engineering

DASD, Systems Engineering
Stephen Welby
Principal Deputy Kristen Baldwin



Major Program Support
James Thompson

Supporting USD(AT&L) Decisions with Independent Engineering Expertise

- **Engineering Assessment / Mentoring of Major Defense Programs**
- **Program Support Assessments**
- **Overarching Integrated Product Team and Defense Acquisition Board Support**
- **Systems Engineering Plans**
- **Systemic Root Cause Analysis**
- **Development Planning/Early SE**
- **Program Protection**

Engineering Enterprise
Robert Gold

Leading Systems Engineering Practice in DoD and Industry

- **Systems Engineering Policy and Guidance**
- **Technical Workforce Development**
- **Specialty Engineering (System Safety, Reliability and Maintainability, Quality, Manufacturing, Producibility, Human Systems Integration)**
- **Security, Anti-Tamper, Counterfeit Prevention**
- **Standardization**
- **Engineering Tools and Environments**

Providing technical support and systems engineering leadership and oversight to USD(AT&L) in support of planned and ongoing acquisition programs

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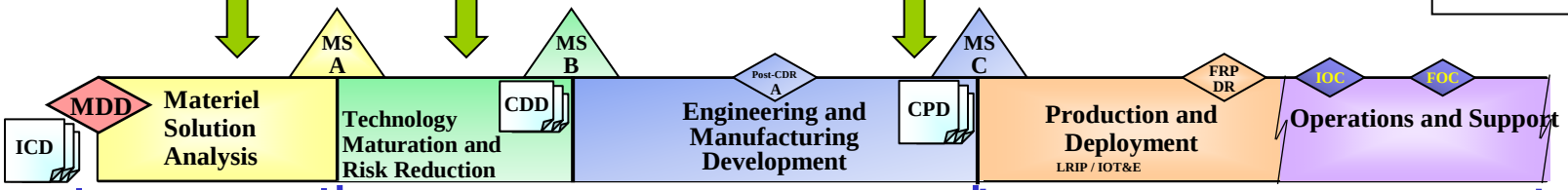
DoDI 5000.02 - Risk Management Policy

- **DoDI 5000.02 Operation of the Defense Acquisition System directs programs to understand and manage risks**
  - Risk is mentioned over 200 times in the document

Make key trades between cost and performance; risk analysis and mitigation

Reduce technology, engineering, integration, and life cycle cost risk

Completes design; <u>retires any open risks</u>; and prepares for production or deployment



Identify materiel solution with acceptable risk

Manage programmatic, technology and development risks

Manage production and sustainment risks

"The PM is responsible for implementing effective risk management and tracking…analysis of mitigation options… execution of those actions. Risk management is proactive…not just risk identification and tracking."

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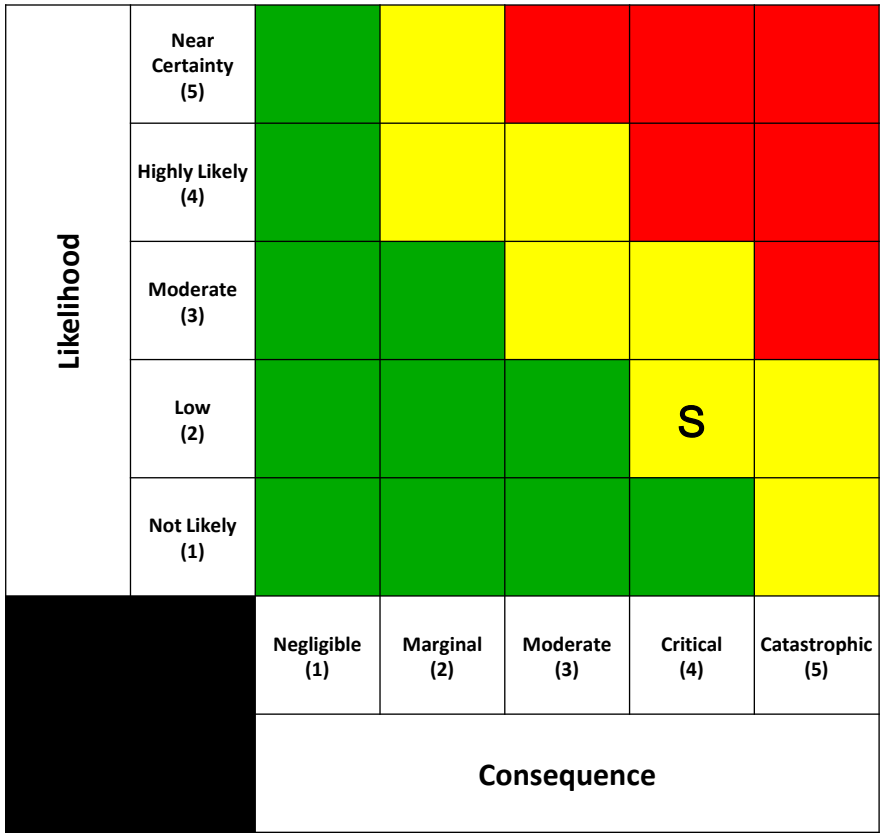
What We Often See…



Risk S: Turbine generator performance
- Based on evaluation of potential test results

- What is the actual risk?
- What is the cause(s) of the risk?
- What is the program doing to manage the risk?
- When does the program expect to close this risk?

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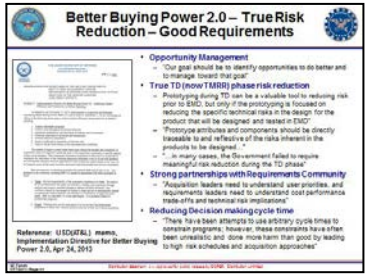
Themes from USD(AT&L) -
True TD Phase Risk Reduction

- **Better Buying Power 2.0**
  - Manage Opportunities
  - True TD (now TMRR) phase risk reduction
  - Strong partnerships with Requirements Community


Better Buying Power 2.0 – True Risk Reduction – Good Requirements

- Opportunity Management
  - "Our goal should be to identify opportunities to do better and to manage toward that goal"
- True TD (now TMRR) phase risk reduction
  - Prototyping during TD can be a valuable tool to reducing risk prior to EMD, but only if the prototyping is focused on reducing the specific technical risks in the design for the product that will be designed and tested in EMD"
  - "Prototype attributes and components should be directly traceable to and reflective of the risks inherent in the products to be designed…"
  - "…In many cases, the Government failed to require meaningful risk reduction during the TD phase"
- Strong partnerships with Requirements Community
  - "Acquisition leaders need to understand user priorities, and requirements leaders need to understand cost performance trade-offs and technical risk implications"
- Reducing Decision making cycle time
  - "There have been attempts to use arbitrary cycle times to constrain programs; however, these constraints have often been unrealistic and done more harm than good by leading to high risk schedules and acquisition approaches"

Reference: USD(AT&L) memo, Implementation Directive for Better Buying Power 2.0, Apr 24, 2013

- **USD(AT&L) emphasized managing technical risks**
  - ***"Our acquisition professionals must have a deeper understanding of the risk inherent in products under consideration and of the steps needed to reduce that risk…"***
  - ***"Prototyping during the TD Phase can be a valuable tool to reducing risk prior to entering EMD, but only if the prototyping is focused on reducing the specific <u>technical</u> <u>risks</u> in the design for the actual product…"***

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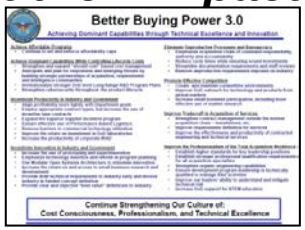
Themes from USD(AT&L)

Improve leaders' ability to mitigate technical risk

- **BBP 3.0: USD(AT&L) emphasized proactive risk management**
  - ***"…PMs and staff should shape and control risk, not just observe progress and react to risks …. Anticipating possible adverse events, evaluating probabilities of occurrence, understanding cost and schedule impacts, and deciding to take cost effective steps …to limit their impact …is the essence of effective risk management."***



- **USD(AT&L) Article:**
  - It is our job to anticipate surprises, assess consequences and do something either to prevent them or to limit their impacts
  - Most decisions to control risk are made in the earliest stages of a program
    - We determine the basic program structure
    - Whether we will have a dedicated risk reduction phase
  - Reduce uncertainty of the program
    - Defining requirements, conducting trade studies
    - Building prototypes and conducting tests

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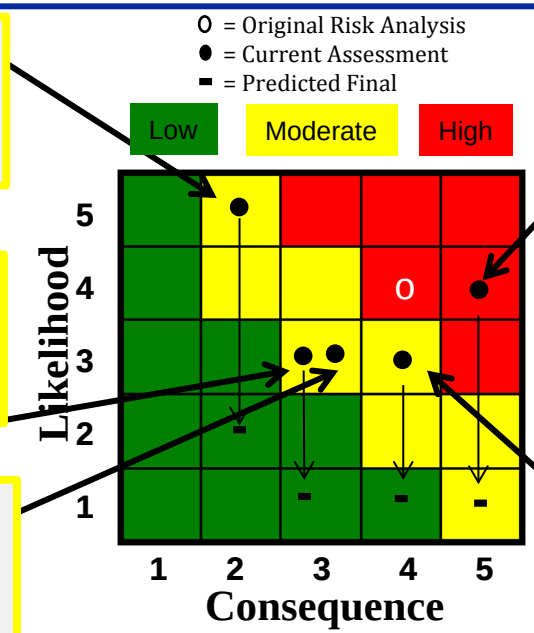
What We Would Rather See

Risk
Consequences if Realized:
Mitigation Method: Avoid - Key activities:
Planned Closure Date:

Risk
Consequences if Realized:
Mitigation Method: Transfer - Key activities:
Planned Closure Date:

Risk:
Consequences if Realized:
Mitigation Method: Accept - Key activities:
Planned Closure Date: Feb 2016



Risk: If turbine generator performance cannot be improved beyond 90% demonstrated during TMRR, then jammer effectiveness will be reduced by 8% and fall below the KPP threshold

Consequences if Realized:

- Performance - unmet KPP

Mitigation Method: Control- Key activities:

1. Develop redesigned higher efficiency magnets; verify magnetic field strength ≥ H_1 A/m (Aug 2015)
2. Integrate redesigned magnets in turbine; verify power output ≥ KW_b watts in bench testing (Sep 2015)
3. Integrate prototype turbine in UAV; verify power output ≥ KW_f watts in flight testing (Nov 2015)

Planned Closure Date: Dec 2015

Risk: If software build 757, with acceptable flying qualities, is not released by Dec 2015, then the UAV will not be ready for Jun 2016 first fielding

Consequences if Realized:

- Cost - $5M (O&M) to continue legacy UAV use
- Schedule - 8-month delay to IOC

Mitigation Method: Control- Key activities:

1. Evaluate HMI and obtain feedback (Jul 2015)
2. Based on feedback, implement control-law changes such than no maneuver is > 3 on the Cooper Harper scale (Aug 2015)
3. Verify changes via M&S, with users (Sep 2015)
4. Conduct SIL testing and compare actual with expected results (Oct 2015)
5. Fix Priority 1 defects and retest (Oct 2015)
6. Validate no remaining Pri 1 defects via ground and flight tests (Nov 2015)

Planned Closure Date: Nov 2015

- Clear statement of risk, using "if-then" construct
- Consequences of risk quantified (C/S/P)
- Management method identified with significant, measurable activities with dates for completion
- Planned risk closure date
- Risk Matrix can show original risk level, current, and predicted final following mitigation

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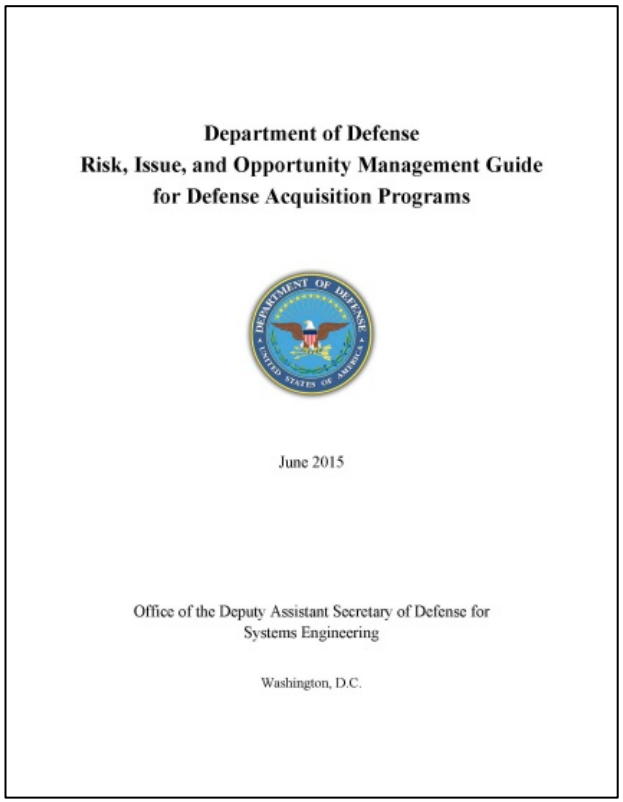
What We Did

- **Made a Good Guide a Better Guide**
- **Aligned it with DoDI 5000.02 and Better Buying Power**
- **Introduced complementary processes of Issue and Opportunity Management**
- **Updated content to be more professional, consistent, and technically accurate**
- **Provided broad guidance, expectations, and terms of reference/definitions**
- **Vetted with practitioners (Services, DAU, NDIA)**



Department of Defense
Risk, Issue, and Opportunity Management Guide
for Defense Acquisition Programs

June 2015

Office of the Deputy Assistant Secretary of Defense for
Systems Engineering

Washington, D.C.

Department of Defense Risk, Issue, and Opportunity Management Guide for Defense Acquisition Programs (DoD RIO Guide) published June 2015
http://www.acq.osd.mil/se/docs/RIO-Guide-Jun2015.pdf

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Key Terminology
Risk, Issue, and Opportunity

- **Risks are future events or conditions that may have a negative effect on achieving program objectives for cost, schedule, and performance. Risks are defined by (1) the probability (greater than 0, less than 1) of an undesired event or condition and (2) the consequences, impact, or severity of the undesired event, were it to occur.**
- **Issues are events or conditions with negative effect that have occurred (such as realized risks) or are certain to occur (probability of 1) in the future that should be addressed.**
- **Opportunities are potential future benefits to the program's cost, schedule, and/or performance baseline, usually achieved through reallocation of resources.**

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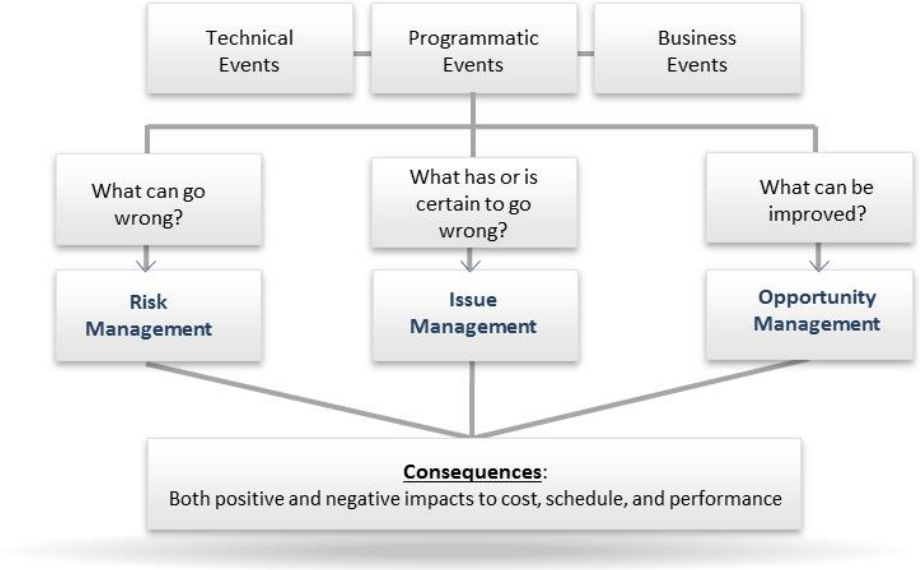
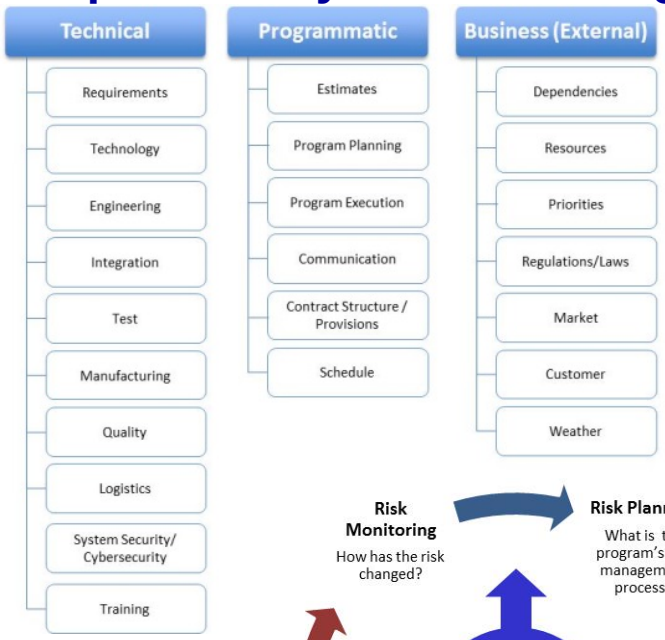
Technical vs. Other Risks
Early Sections

- **Conditions or Events have potential risks, issues, and/or opportunities**
- **Issue and opportunity management are complementary to Risk Management**





- **Five steps in the Process**
- **Risk ~~Mitigation~~ to ~~Handling~~ to Mitigation**
  - Accept risk
  - Avoid risk
  - Transfer risk
  - ~~Control~~ ~~Mitigate~~ Control risk

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What is Technical Risk? Our View

Programmatic
- Estimates
- Program Planning
- Program Execution
- Communication
- Contract Type / Incentives

Business
- Dependencies
- Resources
- Priorities
- Regulations/ Laws
- Market
- Customer
- Weather

Technical
- Requirements
- Technology
- Engineering
- Integration
- Test
- Manufacturing
- Quality
- Logistics
- Training

Often, program managers only brief these risks

Programmatic – risks that are generally within control or influence of the Program Manager. Can be associated with program estimating (including cost estimates, schedule estimates, staffing estimates, facility estimates, etc.), program planning, program execution, communications, and contract structure

Business – risks that are generally externally driven (originate outside the program office) or are not within the control or influence of the Program Manager. Can come from areas such as program dependencies, resources (funding, people, suppliers, tools, etc.), priorities, regulations/laws, Stakeholders (Users, acquisition officials, etc.), market, and weather

Technical – risks that may prevent the end item from performing as intended or failing to meet performance expectations. Can be internally or externally generated. Typically emanate from areas such as requirements, technology, engineering, integration, test, manufacturing, quality, logistics, and training

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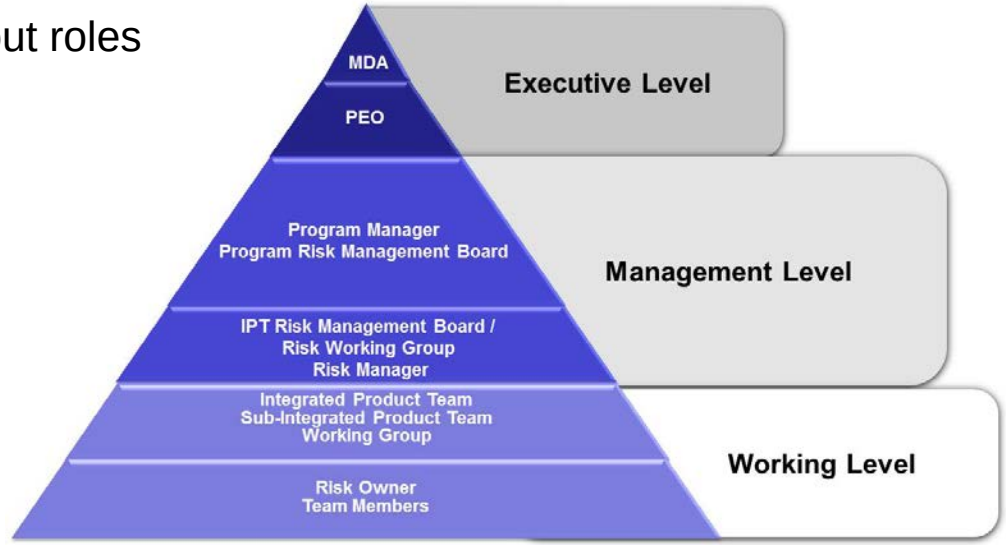
Process and Procedures Overview
Section 2

- **Recommends contents for a Risk Management Plan**
- **Government and Contractor processes should be aligned**
  - Establish and stick with a meeting battle rhythm
  - Select a common or electronically compatible tool
- **Recommends Roles and Responsibilities**
  - PM, RMB, RWG, Risk Manager, Risk Owner, etc
  - Better discussion of the differences between the Government and Contractors
  - Contractors should provide all candidate risks to the Gov't
  - Roles and responsibilities for each tier are addressed
  - Appendix D breaks out roles



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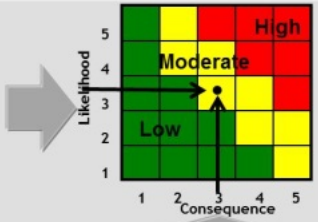
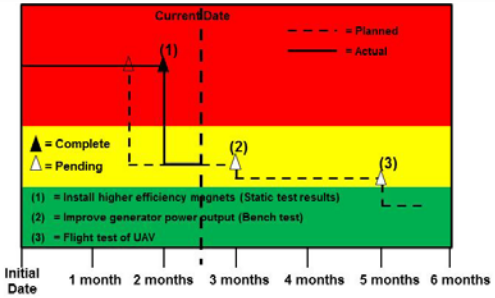
Risk Management
Section 3

- **Expanded discussion for Risk Identification methods**
- **Risk Mitigation (~~Handling~~)**
- **Management options: Accept, Avoid, Transfer, Control (~~Mitigate~~)**
- **Changed values of likelihood table**
  Example: from ~10% to 5%-20%
- **Improved Consequence criteria**
  - Detailed cost criteria
  - Schedule criteria
  - Performance criteria
- **Risk Statement construct with examples**
  Preferred "if…then…"
- **Burn-down plans to monitor progress**
  - Identify management activities
  - Clearly define activities
    - Objective – not subjective
    - Have specific measurable outcomes
    - Likelihood and consequence value for each activity
    - Track activities in IMS

Level	Likelihood	Probability of Occurrence
5	Near Certainty	> 80% to ≤ 99%
4	Highly Likely	> 60% to ≤ 80%
3	Likely	> 40% to ≤ 60%
2	Low Likelihood	> 20% to ≤ 40%
1	Not Likely	> 1% to ≤ 20%



Level	Cost			Schedule	Performance
	RDT&E	Procurement	Operations & Maintenance/Sustainment		
5	Major impact. 10% or greater increase over APB threshold, or >SD. Management reserve depleted.	Major impact. Budget or unit production cost (e.g., APUC) increasing to a significant Nunn-McCurdy breach, or increase of more than $XX in programmed dollars (POM)	Costs exceed life cycle ownership cost by 10%. Ability to sustain system in jeopardy.	Schedule slip that requires a major schedule re-baselining; precludes program from meeting its APB schedule objectives by more than 6 months; negative float to program completion.	Severe degradation precludes system from meeting a KPP or key technical/supportability threshold; will jeopardize program success; design or supportability margins exceeded; unable to meet mission objectives (defined in mission threads, ConOps, OMS/MP)
4	Significant impact. 5% <10% increase over APB threshold, or SC ≤SD. Requires use of significant management reserves.	Significant impact. Costs that drive a unit production cost (e.g., APUC) increasing to an APB threshold breach of SC > ≤ SD, or increase of $YY-XX in programmed dollars (POM)	Costs drive increase of more than 5% over program's lifecycle cost estimate; costs drive program to exceed life cycle ownership cost KSA.	Significantly impacts ability to meet planned milestones and/or other key dates. Established acquisition decision points or milestones will be delayed, impacting APB schedule objectives by less than 6 months. Slip puts funding at risk; <5% float to major milestones or program completion	Significant degradation impairs ability to meet a KSA; Technical design or supportability margin exhausted in key areas; able to meet one or more mission tasks (defined in mission threads, ConOps, OMS/MP); workarounds required to meet mission objectives
3	Moderate impact. 3% <5% increase over APB threshold, or SB - ≤ SC; manageable with reserves; inability to meet key cost metrics	Moderate impact. Costs that drive unit production cost (e.g., APUC) increase of SB - ≤ SC, or $ZZ-YY in programmed dollars (POM); inability to meet key cost metrics	Costs drive increase of y - z% over program's lifecycle cost estimate or within 2% of life cycle ownership cost KSA; inability to meet key cost metrics	Minor schedule slip, able to meet key milestones. Total program float decreased by X-X% with float remaining positive, but nearly consumed. <10% float to major milestones or program completion, inability to meet key schedule metrics	Moderate reduction in technical performance or supportability, unable to meet lower tier attributes (e.g. PAs); planned design or supportability margins reduced; inability to meet key TPMs, CTPs; Workarounds required to achieve mission tasks (defined in mission threads, ConOps, OMS/MP)
2	Minor impact. 1% - <3% increase over APB threshold, or SA - ≤ SB; exceeding cost metrics triggers	Minor impact. Costs that drive unit production cost (e.g., APUC) increase of SA ≤ SB, or $AA-ZZ in programmed dollars (POM); exceeding cost metrics triggers	Costs drive increase of x- y% over program's lifecycle cost estimate; exceeding cost metrics triggers	Able to meet key dates. Total program float decreased by less than X%, with 10% or greater positive float remaining.; exceeding schedule metrics triggers	Minor reduction in technical performance or supportability; can be tolerated with little or no impact on program objectives. Design margins will be reduced, but within limits / tradespace; exceeding key TPMs, CTPs triggers
1	Minimal impact. <1% increase over APB threshold, or <SA. Costs expected to meet approved funding levels, not projected to increase above thresholds	Minimal impact. Costs that drive APUC increase of ≤ SA, or less than $AA in programmed dollars (POM). Costs expected to meet approved funding levels, not projected to increase above thresholds	Costs drive increase of ≤x% over program's lifecycle cost estimate.	Minimal or no schedule impact.	Minimal or no consequences to meeting technical performance or supportability requirements. Design margins will be met; margin to planned triggers.



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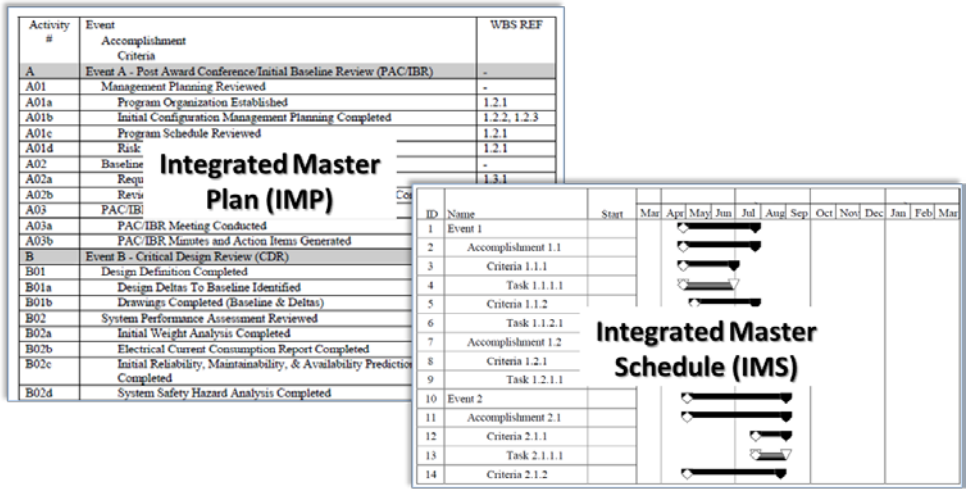
Risk Management and Other Tools
Section 4

- **Integrate risk management activities into other tools: IMS, EVM, etc.**
- **Need quality schedule health to conduct SRA**
  - Traceability between WBS, IMP/IMS and EVM
  - Refers to DCMA manual for more info



Metric	Goal	Status
Logic – incomplete tasks with missing predecessor or successor logic links	<5%	
Leads – number of leads (overlap between tasks with logic dependencies)	0 tasks	
Lags – number of tasks with lags (delay between a predecessor task's completion and successor's start date)	<5%	
Relationship Type – establishes the order in which each task should be completed	<10% non-Finish-Start	
Hard Constraints – fixed task start or finish date that prevents tasks from being moved by their logic-driven dependencies	<5%	
High Duration – unfinished tasks with a baseline duration of greater than 44 working days	<5%	
High Float – incomplete tasks with total float greater than 44 working days	<5%	
Negative Float – less than zero float, forecasted date may be unrealistic	0 tasks	
Invalid Dates – incomplete tasks with actual start /finish date in the future; forecast dates prior to status date	0%	
Resources – allocated resources (hours/dollars)	0 improper	
Missed Tasks – tasks that do not finish as planned	<5%	
Critical Path Test – identifies broken logic, usually missing predecessors and/or successors	0 days	
Critical Path Length Index (CPLI) – measures the efficiency to finish on time	>=.95	
Baseline Execution Index (BEI) – efficiency with which actual work has been accomplished	>=95%	

- **Describes how to use TPMs to track progress to plan**
- **Discusses Schedule, Cost, and Performance Risk Analysis**

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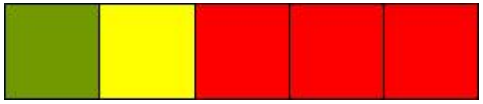
Issue and Opportunity Management
Section 5 & 6

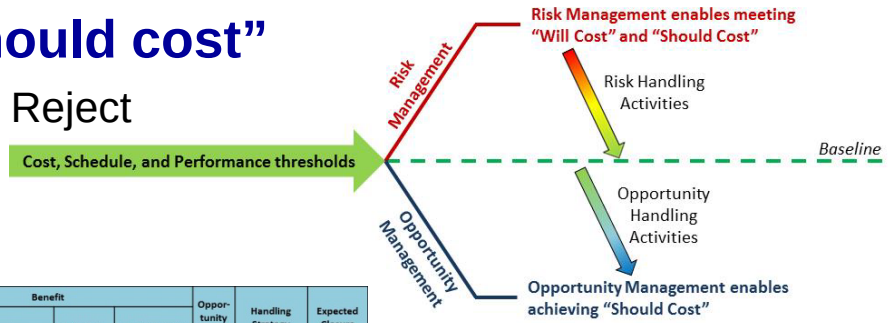
- **Aligned Issue and Opportunity Management processes to be more like Risk Management Process**
  - Log/register of issues
  - Assign owners
  - Identify actions, track in IMS, etc

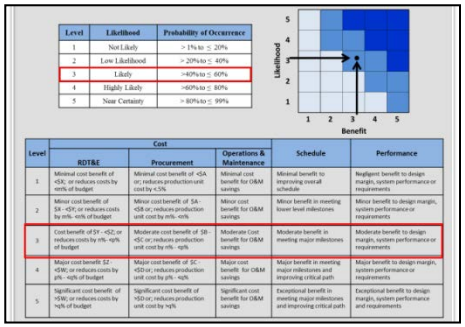
From:

To:



- **Modified Issue scale to match the top row in the Risk Matrix**
  - Issue management options: Accept, Avoid, Transfer, Mitigate
- **Opportunities enable achieving "should cost"**
  - Management options: Pursue, Re-evaluate, Reject
- **Opportunity Management Matrix**
- **Included 5x5**





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1	Not Likely	> 1% to ≤ 20%
2	Low Likelihood	> 20% to ≤ 40%
3	Likely	>40% to ≤ 60%
4	Highly Likely	>60% to ≤ 80%
5	Near Certainty	> 80% to ≤ 99%

Level	Cost			Schedule	Performance
	RDT&E	Procurement	Operations & Maintenance		
1	Minimal cost benefit of <$X; or reduces costs by <n% of budget	Minimal cost benefit of <$A or; reduces production unit cost by <.5%	Minimal cost benefit for O&M savings	Minimal benefit to improving overall schedule	Negligent benefit to design margin, system performance or requirements
2	Minor cost benefit of $X - <$Y; or reduces costs by n%- <n% of budget	Minor cost benefit of $A - <$B or; reduces production unit cost by n%- <n%	Minor cost benefit for O&M savings	Minor benefit in meeting lower level milestones	Minor benefit to design margin, system performance or requirements
3	Cost benefit of $Y - <$Z; or reduces costs by n%- <p% of budget	Moderate cost benefit of $B - <$C or; reduces production unit cost by n%- <p%	Moderate Cost benefit for O&M savings	Moderate benefit in meeting major milestones	Moderate benefit to design margin, system performance or requirements
4	Major cost benefit $Z - <$W; or reduces costs by p%- <q% of budget	Major cost benefit of $C - <$D or; reduces production unit cost by p%- <q%	Major cost benefit for O&M savings	Major benefit in meeting major milestones and improving critical path	Major benefit to design margin, system performance or requirements
5	Significant cost benefit of >$W; or reduces costs by >q% of budget	Significant cost benefit of >$D or; reduces production unit cost by >q%	Significant cost benefit for O&M savings	Exceptional benefit in meeting major milestones and improving critical path	Exceptional benefit to design margin, system performance and requirements

Opportunity	Likeli-hood	Cost to Implement	Benefit					Oppor-tunity Level	Handling Strategy	Expected Closure
			Cost			Schedule	Performance			
			RDT&E	Procurement	O&M					
Opportunity 1: Procure Smith rotor blades instead of Jones rotor blades.	Mod	$3.2M			$4M	3 month margin	4% greater lift		Re-evaluate - Summarize the handling plan	March 2017
Opportunity 2: Describe the opportunity in terms of what it will provide the program, the benefit to the program, and the cost to the program.	Mod	$350K	$25K		$375K				Reject	May 2017
Opportunity 3: Ditto.	High	$211K		$0.4M	$3.6M	4 months less long lead time needed			Summarize the handling plan to realize the opportunity	January 2017

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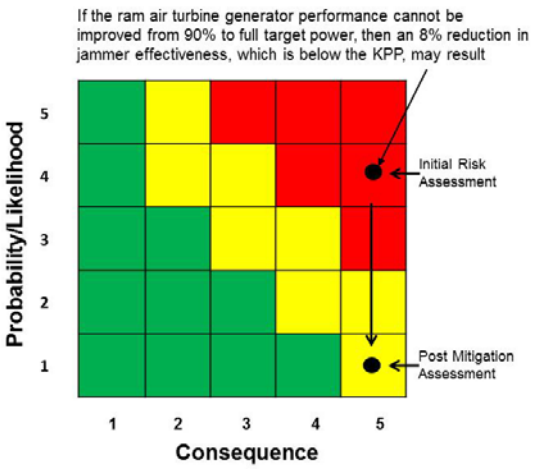
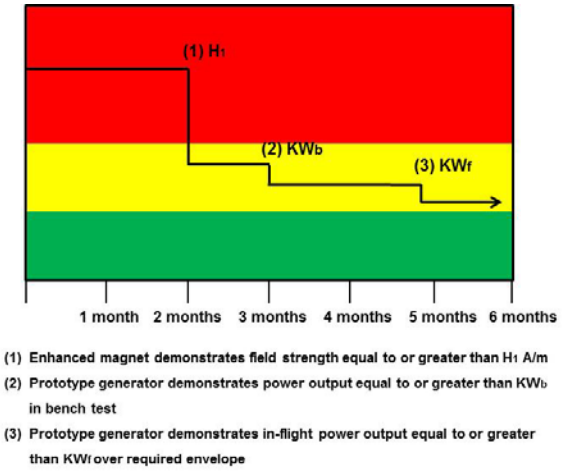
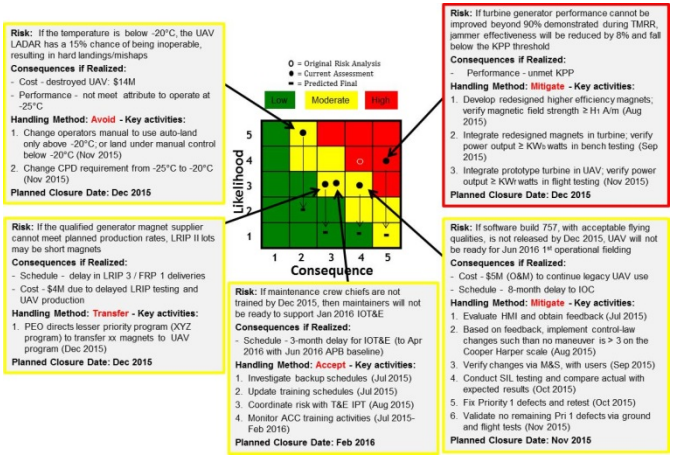
Appendices

- **Appendix A discusses managing risks by lifecycle phase**
- **Appendix B discusses proactive risk management activities**
- **Updated Appendix C figure templates**
- **Appendix D summarizes roles and responsibilities**
- **Created new Appendix E, with example vignette**







- **Added Glossary**

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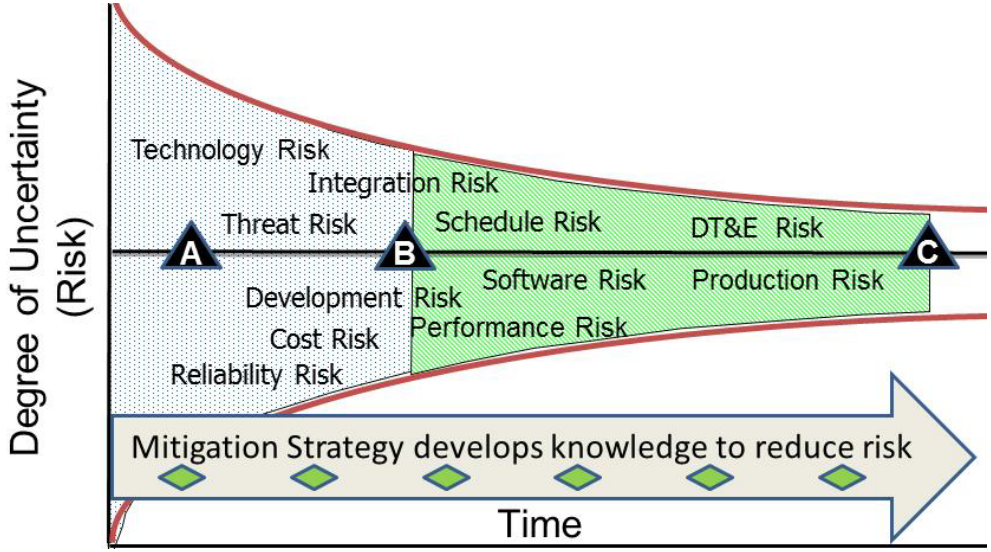
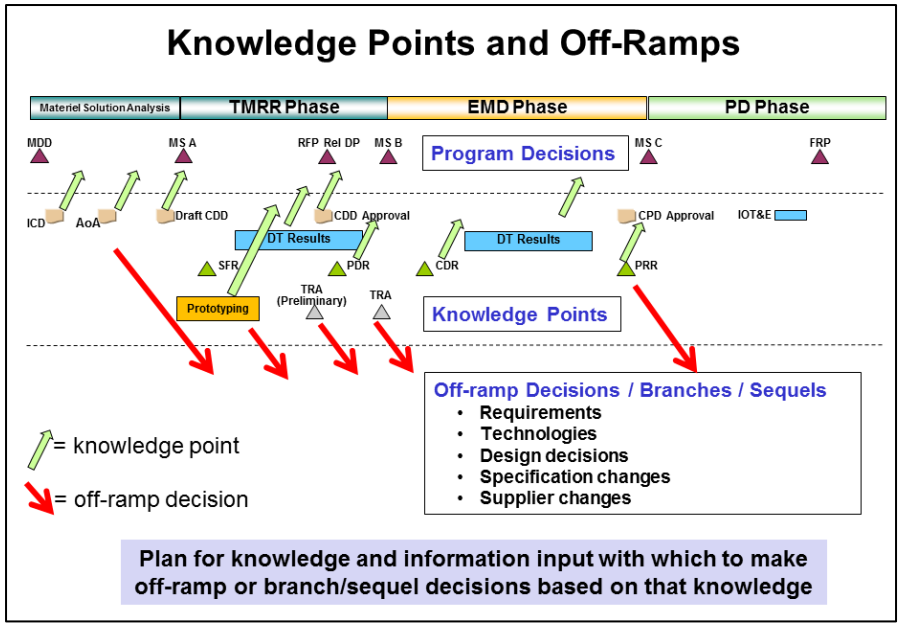
Establishing a Proactive Risk Management Culture

- **Identify key program risks - encourage everyone to identify risks**
- **Develop a strategy and plan to manage key program risks to reduce program uncertainty (risk)**
- **Inspire risk management ownership across team**
- **Open communication with contractors and up and down the chain of command**





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Systems Engineering: Critical to Defense Acquisition

Defense Innovation Marketplace
http://www.defenseinnovationmarketplace.mil

DASD, Systems Engineering
http://www.acq.osd.mil/se

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For Additional Information

Mr. Chris DeLuca

ODASD, Systems Engineering

571-372-4171 | ralph.c.deluca.civ@mail.mil

Mr. John Quackenbush

JJNA

571-372-6037 | john.e.quackenbush2.ctr@mail.mil

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BACKUP

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Tailorable Consequence Criteria

Level	Cost*			Schedule	Performance
	RDT&E	Procurement	Operations & Maintenance/Sustainment		
5	Major impact. 10% or greater increase over APB threshold; or >$D. Management reserve depleted.	Major impact. Budget or unit production cost (e.g., APUC) increasing to a significant Nunn-McCurdy breach; or increase of more than $XX in programmed dollars (POM)	Costs exceed life cycle ownership cost by 10%.. Ability to sustain system in jeopardy.	Schedule slip that requires a major schedule re-baselining; precludes program from meeting its APB schedule objectives by more than 6 months; negative float to program completion	Severe degradation precludes system from meeting a KPP or key technical/supportability threshold; will jeopardize program success; design or supportability margins exceeded; unable to meet mission objectives (defined in mission threads, ConOps, OMS/MP)
4	Significant impact. 5% -<10% increase over APB threshold; or $C-≤$D. Requires use of significant management reserves.	Significant impact. Costs that drive a unit production cost (e.g., APUC) increasing to an APB threshold breach of $C - ≤ $D; or increase of $YY-XX in programmed dollars (POM)	Costs drive increase of more than z% over program's life cycle cost estimate; costs drive program to exceed life cycle ownership cost KSA.	Significantly impacts ability to meet planned milestones and/or other key dates. Established acquisition decision points or milestones will be delayed, impacting APB schedule objectives by less than 6 months. Slip puts funding at risk; <5% float to major milestones or program completion	Significant degradation impairs ability to meet a KSA; Technical design or supportability margin exhausted in key areas; able to meet one or more mission tasks . (defined in mission threads, ConOps, OMS/MP); workarounds required to meet mission objectives
3	Moderate impact. 3% -<5% increase over APB threshold; or $B - ≤ $C; manageable with reserves; inability to meet key cost metrics	Moderate impact. Costs that drive unit production cost (e.g., APUC) increase of $B -≤ $C; or $ZZ-YY in programmed dollars (POM); inability to meet key cost metrics	Costs drive increase of y - z% over program's life cycle cost estimate or within 2% of life cycle ownership cost KSA; inability to meet key cost metrics	Minor schedule slip, able to meet key milestones. Total program float decreased by X-Y% with float remaining positive, but nearly consumed; <10% float to major milestones or program completion; inability to meet key schedule metrics	Moderate reduction in technical performance or supportability, unable to meet lower tier attributes (e.g. PAs); planned design or supportability margins reduced; inability to meet key TPMs, CTPs; . Workarounds required to achieve mission tasks (defined in mission threads, ConOps, OMS/MP)
2	Minor impact. 1% - <3% increase over APB threshold; or $A- ≤ $B; exceeding cost metrics tripwires	Minor impact. Costs that drive unit production cost (e.g., APUC) increase of $A-≤ $B; or $AA-ZZ in programmed dollars (POM); exceeding cost metrics tripwires	Costs drive increase of x- y% over program's life cycle cost estimate; exceeding cost metrics tripwires	Able to meet key dates. Total program float decreased by less than X%, with 10% or greater positive float remaining.; exceeding schedule metrics tripwires	Minor reduction in technical performance or supportability; can be tolerated with little or no impact on program objectives. Design margins will be reduced, but within limits / tradespace; exceeding tripwires for TPMs and CTPs
1	Minimal impact. <1% increase over APB threshold; or <$A. Costs expected to meet approved funding levels, not projected to increase above thresholds	Minimal impact. Costs that drive APUC increase of ≤ $A ; or less than $AA in programmed dollars (POM). Costs expected to meet approved funding levels, not projected to increase above thresholds	Costs drive increase of ≤x% over program's life cycle cost estimate.	Minimal or no schedule impact.	Minimal or no consequences to meeting technical performance or supportability requirements. Design margins will be met; margin to planned tripwires.

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Risk Management Process
Then…Now

2006 Guide

2015 Guide

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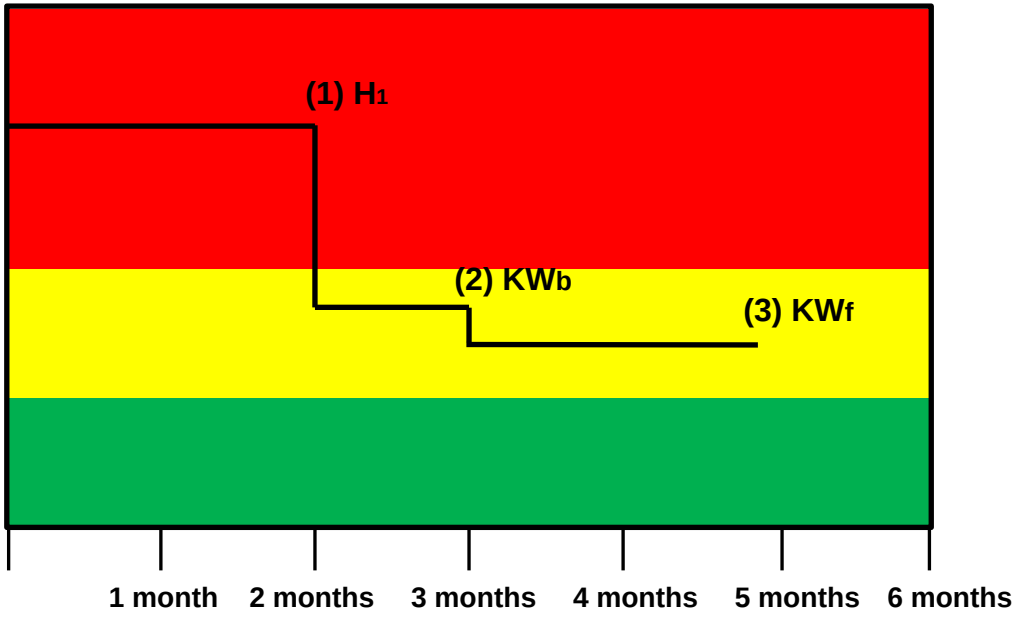
Risk Burn-down



(1) Enhanced magnet demonstrates field strength equal to or greater than H_1 A/m

(2) Prototype generator demonstrates power output equal to or greater than KW_b in bench test

(3) Prototype generator demonstrates in-flight power output equal to or greater than KW_f over required envelope

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