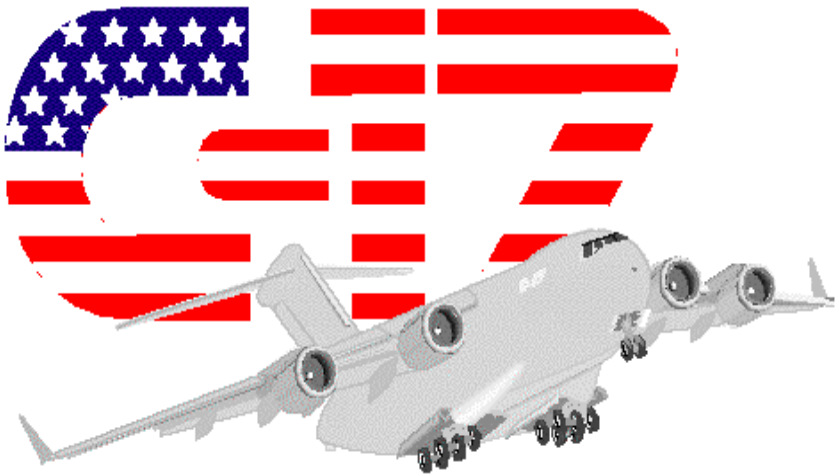
Systems Engineering Conference

C-17 Systems Engineering Process
to Prioritize
Material Improvement Program (MIP) Projects



Major Lardner
516 AESG
DSN: 986-9320, Commercial (937) 656-9320
christopher.lardner@wpafb.af.mil

Tom Condron
516 AESG
DSN 986-4314, Commercial (937) 656-4314
thomas.condron@wpafb.af.mil

Outline Slide

- Purpose of Briefing
- Background
- Provide User with recommendation on how to spend their Material Improvement Program (MIP) money
  - Starting point only, user makes final decision
  - Proved to be difficult
- Approach used to provide recommended MIP Priority

Purpose of Briefing

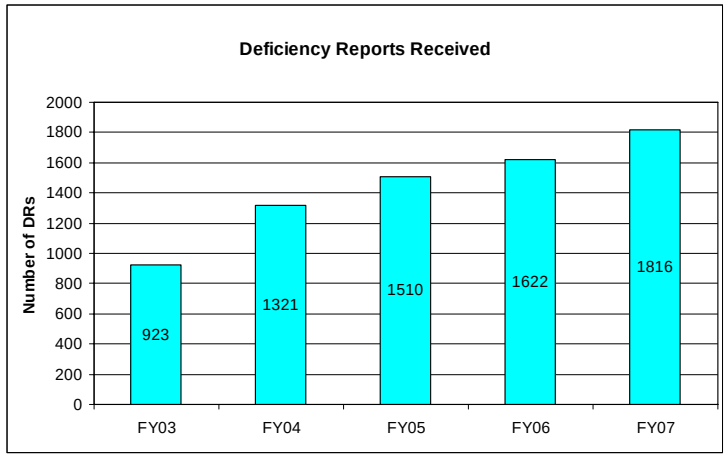
- **Outline the approach the C-17 is using to prioritize Material Improvement Projects (MIPs) for funding**

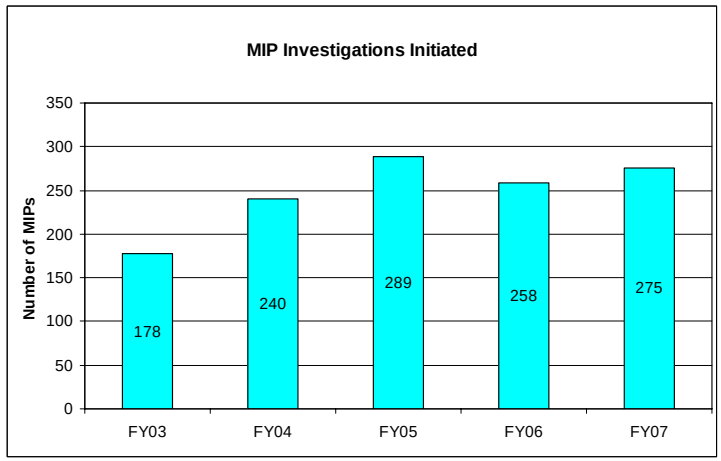
Definitions

- **Material Improvement Project (MIP) investigations are initiated when a Deficiency Report (DR) is determined to warrant further investigation.**
- **MIPs are planned engineering investigations to find root cause and corrective action or evaluate proposed enhancements.**

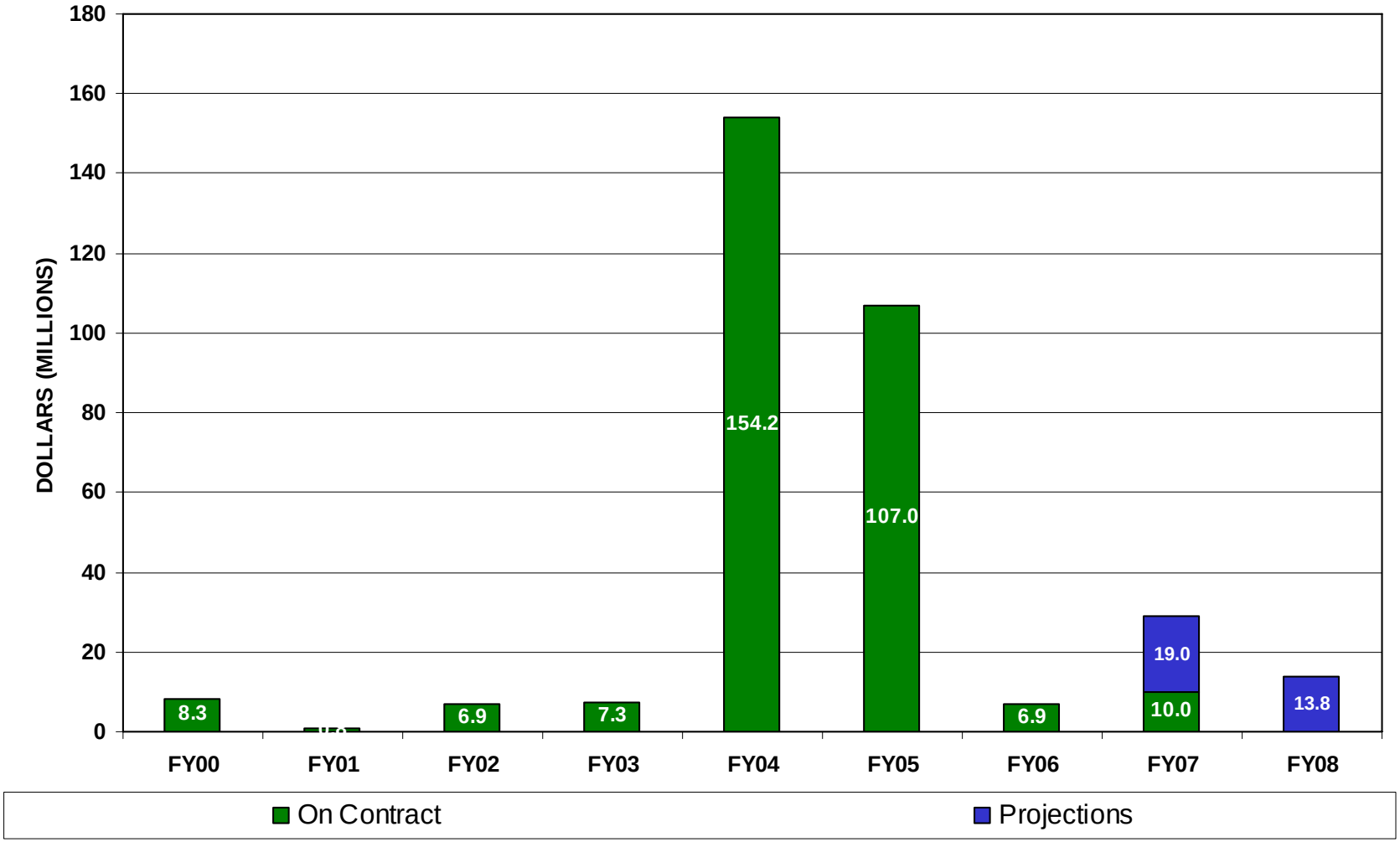
Background

- **Deficiency Reports continue to rise**
  - **1800+ in FY07**
  - **2000+ projected for FY08**
- **About 250 - 275 Material Improvement Projects initiated annually**
- **DRs & MIPs expected to rise as more aircraft are produced and as the jet gets older**





MIP Funding


180
160
140
120
100
80
60
40
20
0
DOLLARS (MILLIONS)
8.3
6.9
7.3
154.2
107.0
6.9
19.0
10.0
13.8
FY00
FY01
FY02
FY03
FY04
FY05
FY06
FY07
FY08
On Contract
Projections

Background

- **C-17 Supportability Model previously used to for initial prioritization**
  - **Did not work well – Highest priority projects often ranked in middle of model**
  - **Specific concerns:**
    - » **Safety – Considers only the initial safety RHI**
    - » **R&M -- No “bang for the buck” comparison ability**
    - » **Subjectivity in many fields**
    - » **Does not consider MMH or RoR Cost**
    - » **Subjective factors used to evaluate operational impact**
    - » **Attempted to assign values to each field**

Provide C-17 Systems Group Recommendation to HQ AMC

- Relatively easy to prioritize the top few projects
- Very hard to distinguish between lower than “top” priority, but still good projects
  - Particularly true when comparing fundamentally different systems (e.g. hydraulic pump reliability versus battery charger algorithm change)
  - Tried and failed to reach consensus with team looking at narrative description of change
- Clearly we needed a tool to help develop a priority recommendation

MIP Prioritization Tool

- **Two most common types of MIPs are R&M and Safety improvements**
  - **All R&M projects can be converted into dollar savings**
    - » **Those dollar savings can be converted into payback period**
  - **Safety projects can be quantified in terms of reduced Real Hazard Index (RHI)**

MIP Prioritization Tool

- **Other reasons exist for MIPs also**
  - **Eliminate dropped objects**
  - **Special interest item (Flight Crew or Maintenance working groups)**
    - » **Often these items are included in safety or R&M concerns**
  - **Over and Above funding drivers during depot maintenance**
  - **Pilot workload**
  - **Survivability / vulnerability**
  - **Other**
- **Difficult to convert these considerations into common terms**

MIP Prioritization Tool

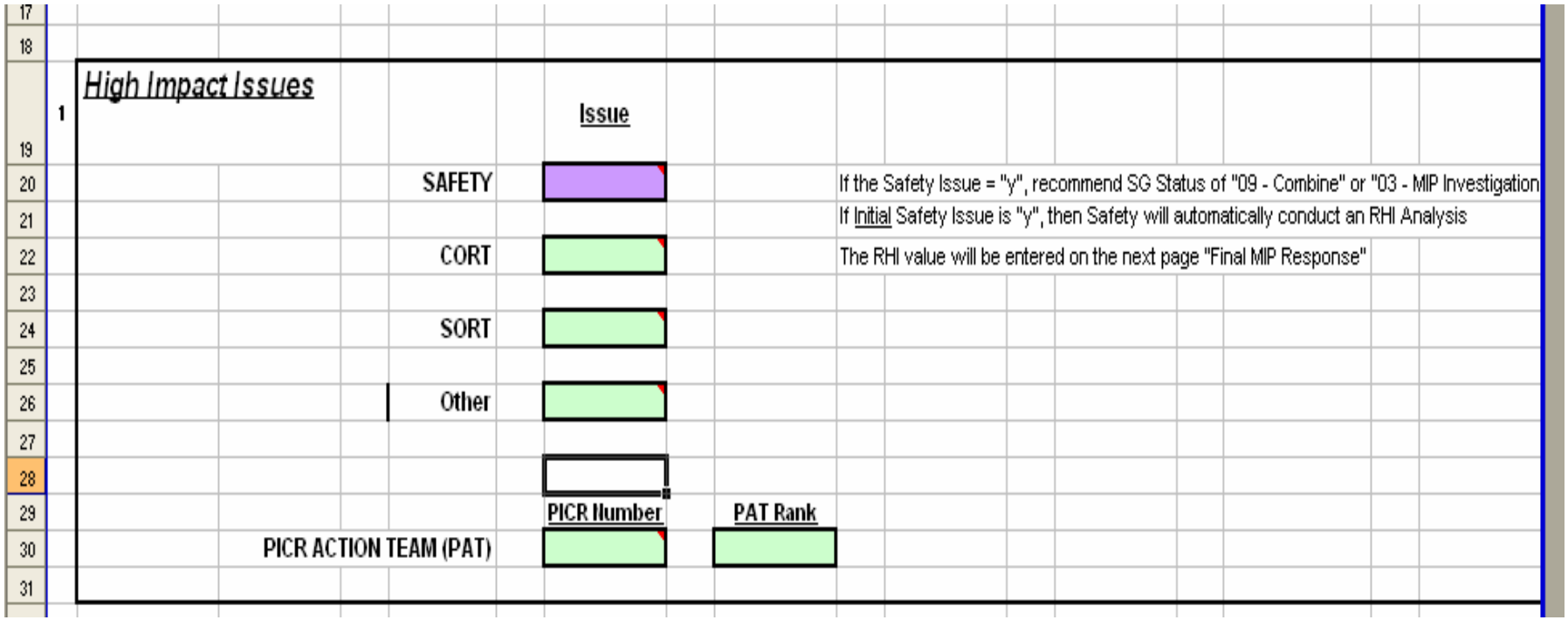
- **Nomenclature: Deficiency / MIP Payback Model (Link to DMPM)**
- **Excel Spreadsheet tool**
  - **Initial DMPM for new Deficiency Reports (DRs)**
    - » **“Is this DR worth investigating?”**
  - **Final DMPM for MIPs “Open Awaiting Funding”**
    - » **Calculates/summarizes key prioritization information**
    - » **Provides a “bang for the buck” estimate in terms of simple Payback Period calculation**

Top Section of Initial Evaluation DMPM

	A	B	C	D	E	F	G	H	I	J	K	L	O	P	Q	R	S
1			Boeing Proprietary - When populated with Data														
2																	
3			Initial DR Response										Revision: 0.9				
4																	
5		DR Title:											Date:				
6																	
7													DR Number:				
8			Name						Phone Number								
9		COG Engineer											Part Number:				
10		SG Engineer															
11		Safety Engineer											WUC:				
12		R&M Engineer															
13																	
14					Is there already an existing investigation/project in progress for this Failure Mode?									YES	Combine With DR#		
15														NO	Continue with this Worksheet		
16																	
17																	

Summary information at top of DMPM tool

High Impact Issues Section of Initial Evaluation DMPM

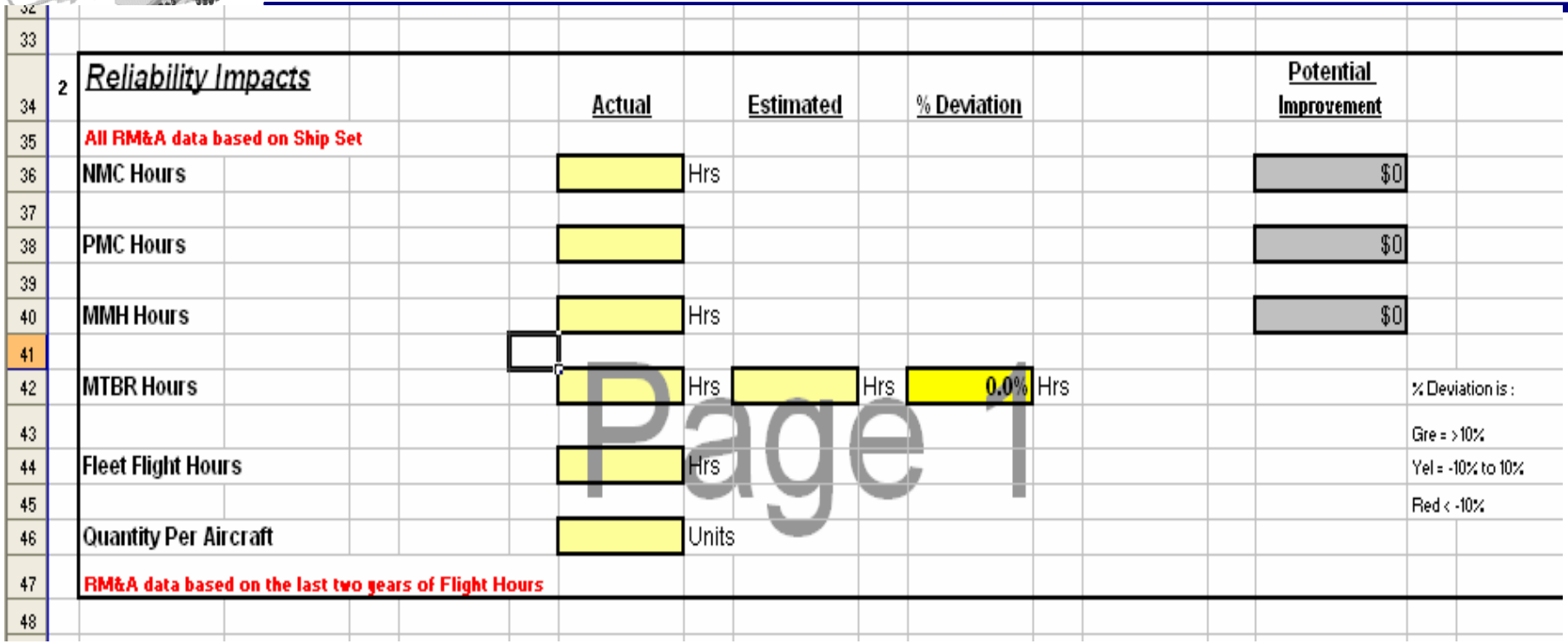


1	*High Impact Issues*	Issue		
	SAFETY			If the Safety Issue = "y", recommend SG Status of "09 - Combine" or "03 - MIP Investigation
				If Initial Safety Issue is "y", then Safety will automatically conduct an RHI Analysis
	CORT			The RHI value will be entered on the next page "Final MIP Response"
	SORT			
	Other			
		PICR Number	PAT Rank	
	PICR ACTION TEAM (PAT)			

If the answer is “Yes” to any of these questions – The Deficiency Report is investigated

- Other includes factors such as “Dropped Object” and “Pilot Workload”

Reliability Impacts Section of Initial Evaluation DMPM



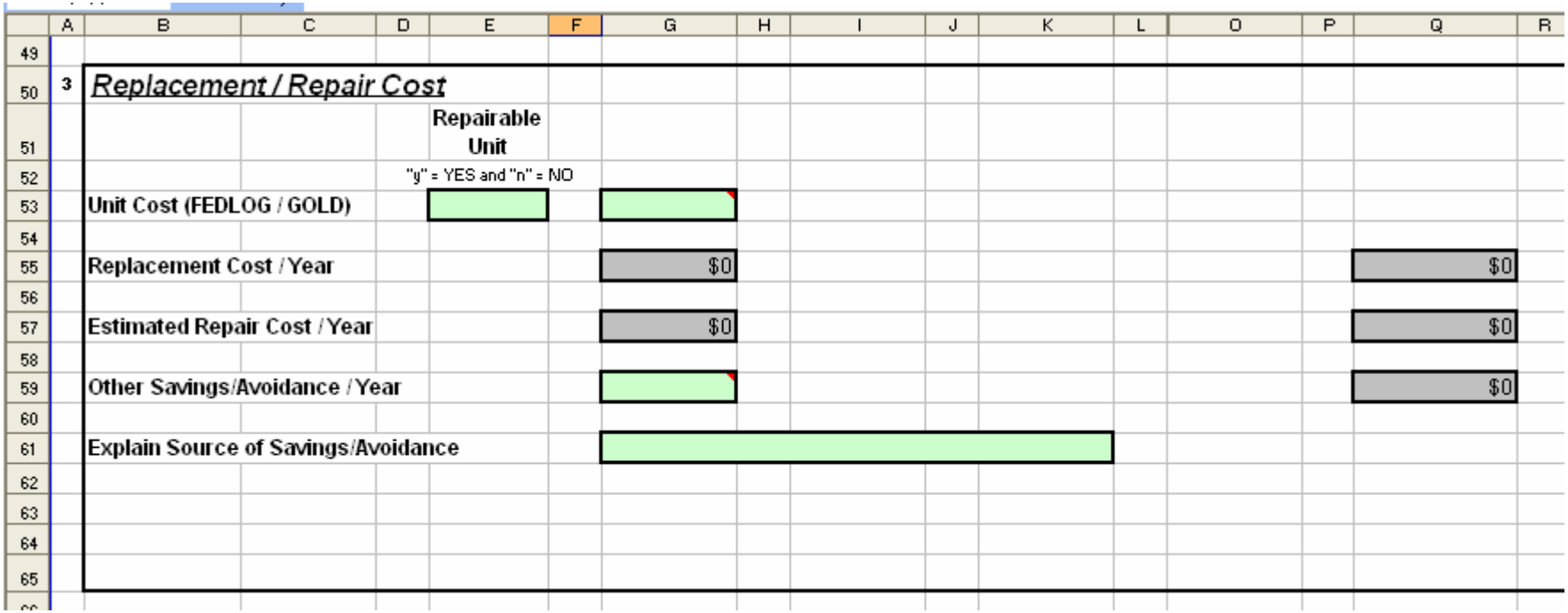
2	Reliability Impacts	Actual		Estimated		% Deviation		Potential Improvement
	All RM&A data based on Ship Set							
	NMC Hours		Hrs					$0
	PMC Hours							$0
	MMH Hours		Hrs					$0
	MTBR Hours		Hrs		Hrs	0.0%	Hrs	
	Fleet Flight Hours		Hrs					
	Quantity Per Aircraft		Units					
	RM&A data based on the last two years of Flight Hours							

% Deviation is :
Gre = >10%
Yel = -10% to 10%
Red < -10%

Converts Reliability Impacts into cost numbers

- Assumes solution will completely eliminate source of Not Mission Capable (NMC), Partially Mission Capable (PMC), and Maintenance Man Hours (MMH)
- Not Mission Capable Hours = $2000 each
- Partially Mission Capable Hours = $1000 each
- Maintenance Man Hour = $72 each

Replacement / Repair Cost Section of Initial Evaluation DMPM



	A	B	C	D	E	F	G	H	I	J	K	L	O	P	Q	R
49																
50	3	*Replacement / Repair Cost*														
51					Repairable Unit											
52					"y" = YES and "n" = NO											
53		Unit Cost (FEDLOG / GOLD)														
54																
55		Replacement Cost / Year					$0								$0	
56																
57		Estimated Repair Cost / Year					$0								$0	
58																
59		Other Savings/Avoidance / Year													$0	
60																
61		Explain Source of Savings/Avoidance														
62																
63																
64																
65																

Calculates the Repair / Replacement cost

- (Failures per FH) * (QPA) * (FH in a year) * (cost per repair/replacement)

Other Savings – e.g. fuel savings for a nacelle sealing improvement

Summary / Total Section of Initial Evaluation DMPM

	A	B	C	D	E	F	G	H	I	J	K	L	O	P	Q	R
67																
68	4	*Summary Totals*														
69																
70										Potential Savings / Year					$0	
71																
72										Replacement / Repair Costs					$0	
73																
74										*Total Potential Savings / Year*					$0	
75																
76																
77																
78										MIP Investigation Recommended?				NO. ALTERNATIVES?		
79																
80		Instructions:														
81																
82		Section 1 (Lavender color) completed by Safety Engineering								Consider the following Alternative Solutions or Others Not Listed:						
83		Section 2 (Yellow color) completed by AVIET								a. Tech Pub Change (PCR)						
84		Section 3 (Green color) all header boxes completed AVIET								b. Technical Order						
85										c. PICR						
86										d. RIPTA						
87		The Grey boxes are calculations and do not get filled out.								e. Close DR						

Calculates the Repair / Replacement cost

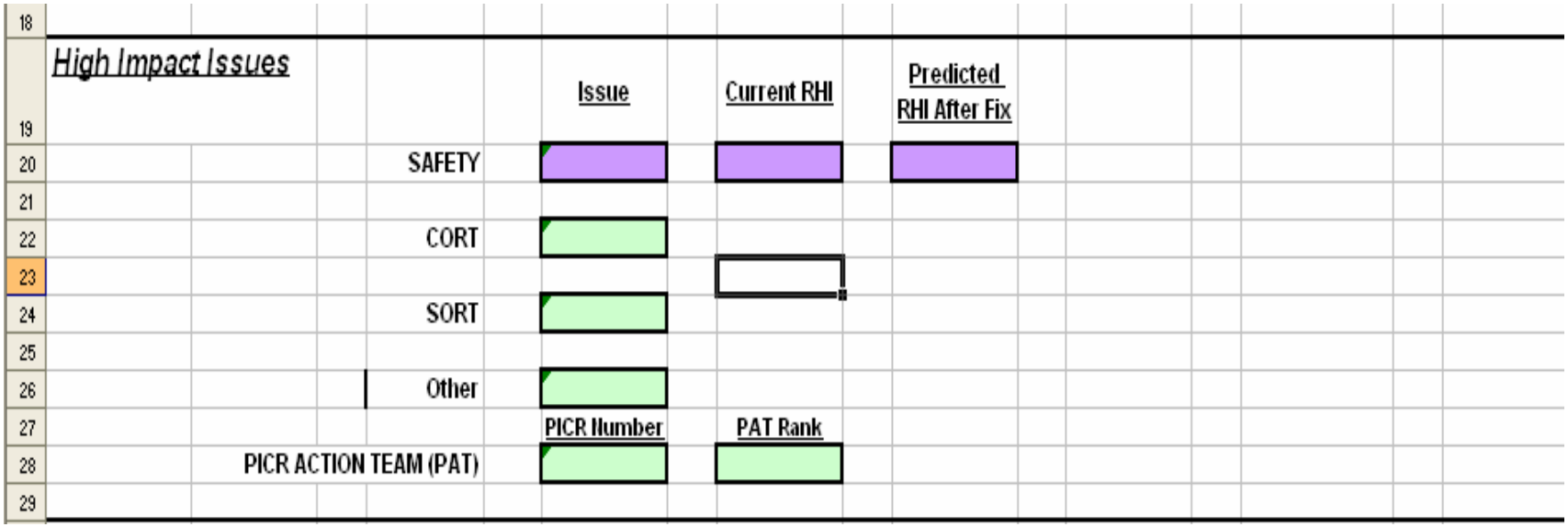
- Total Potential Savings / Year = Sum of “Potential Savings / Year” + “Repair / Replacement Costs”
  - If total Potential Savings / Year exceed $100K – Investigate DR
- If any of the questions in the Top Section of the DMPM are “YES” – Investigate DR

Top Portion of Final Evaluation DMPM

	A	B	C	D	E	F	G	H	I	J	K	L	O	P	Q	R	S
1		Boeing Proprietary - When populated with Data															
2																	
3		Initial DR Response											Revision: 0.9				
4																	
5		DR Title:											Date:				
6																	
7													DR Number:				
8					Name				Phone Number								
9		COG Engineer											Part Number:				
10		SG Engineer															
11		Safety Engineer											WUC:				
12		R&M Engineer															
13																	
14					Is there already an existing investigation/project in progress for this Failure Mode?									YES	Combine With DR#		
15														NO	Continue with this Worksheet		
16																	

Summary information at top of DMPM tool – Same as Initial Evaluation

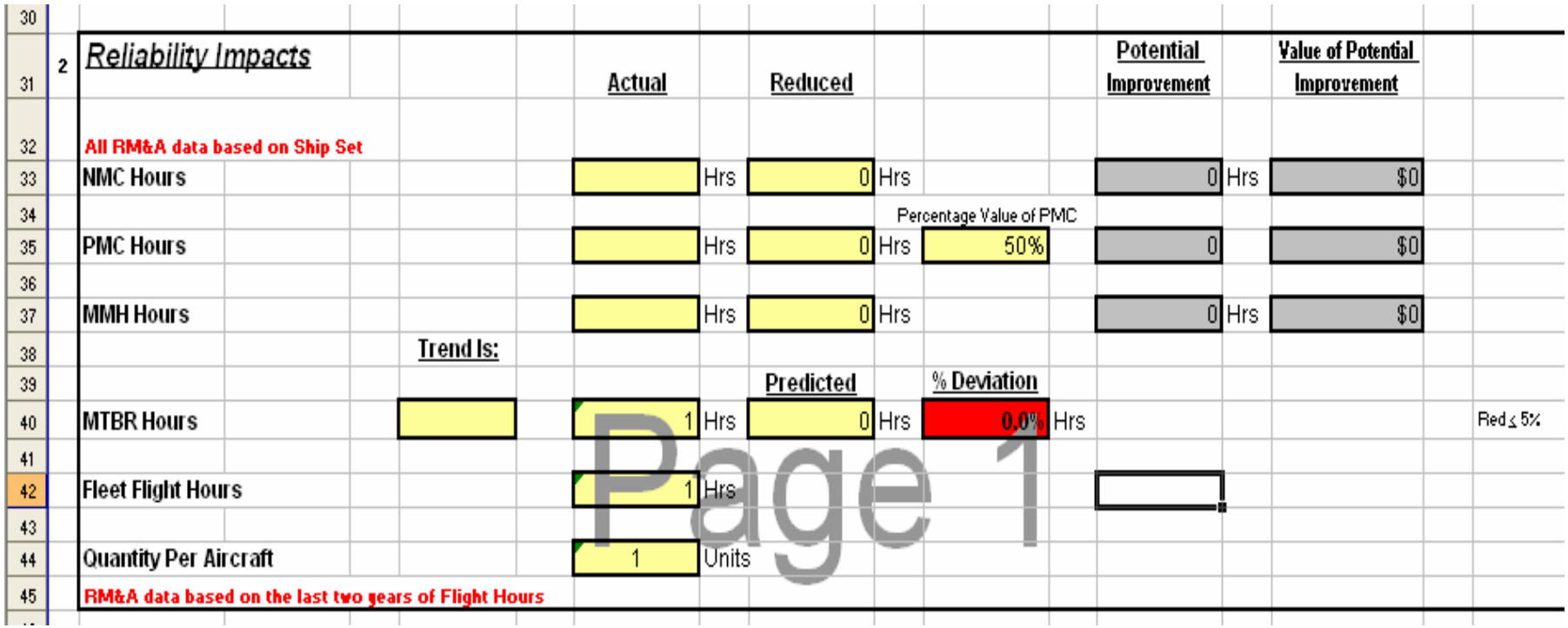
High Impact Issues Portion of Final Evaluation DMPM



	High Impact Issues		Issue	Current RHI	Predicted RHI After Fix
SAFETY					
CORT					
SORT					
Other					
			PICR Number	PAT Rank	
PICR ACTION TEAM (PAT)					

Only difference from Initial Evaluation Tool is Addition of Current Real Hazard Index (RHI) and Predicted RHI after fix

Reliability Impacts Section of Final Evaluation DMPM



2	Reliability Impacts		Actual		Reduced			Potential Improvement		Value of Potential Improvement	
	All RM&A data based on Ship Set										
	NMC Hours			Hrs	0	Hrs		0	Hrs	$0	
							Percentage Value of PMC				
	PMC Hours			Hrs	0	Hrs	50%	0		$0	
	MMH Hours			Hrs	0	Hrs		0	Hrs	$0	
		Trend Is:									
					Predicted		% Deviation				
	MTBR Hours		1	Hrs	0	Hrs	0.0%	Hrs			Red ≤ 5%
	Fleet Flight Hours		1	Hrs							
	Quantity Per Aircraft		1	Units							
	RM&A data based on the last two years of Flight Hours										

Converts Reliability Impacts into cost numbers

- Engineer inputs estimated value for metrics after fix is incorporated
- For PMC hours, engineer also estimates percentage value of a PMC hour
  - For minor items it may be 20 percent, for more significant items it may be 75 percent
- Change from predicted value of MTBR hours is also calculated

Replacement / Repair Cost Section of Final Evaluation DMPM

3 *Replacement / Repair Cost*

	Repairable Unit			
Unit Cost (FEDLOG / GOLD)				
Replacement Cost / Year		$0	$0	$0
Repair Cost / Year		$0	$0	$0
Other Savings/Avoidance / Year		$0		$0
Source of				
Spares (FEDLOG):	Modify Existing Spares		$0	

Calculates the Repair / Replacement cost – Very similar to Initial DMPM

- Based on predicted level of improvement

Summary / Total Section of Final Evaluation DMPM

65	4	*Summary Totals*		
66			Value of Potential Savings / Year	$0
67				
68			Potential Improvement Cost (NRE)	
69			Potential Improvement Cost (Recurring)	
70			*Potential MIP Total*	$0
71			*Payback Period in Years*	0.0
72				
73			Potential Cost for Spares	$0
74			Potential MIP Total plus Spares	$0
75			Payback Period including Spares	0.00
76				
77				
78		Instructions:		
79				
80		Section 1 (Lavender color) completed by Safety Engineering		
81		Section 2 (Yellow color) completed by AVIET		
82		Sections 3 & 4 (Green color) completed by Project Manager or AVIET		
83		The Grey boxes are calculations and do not get filled out.		

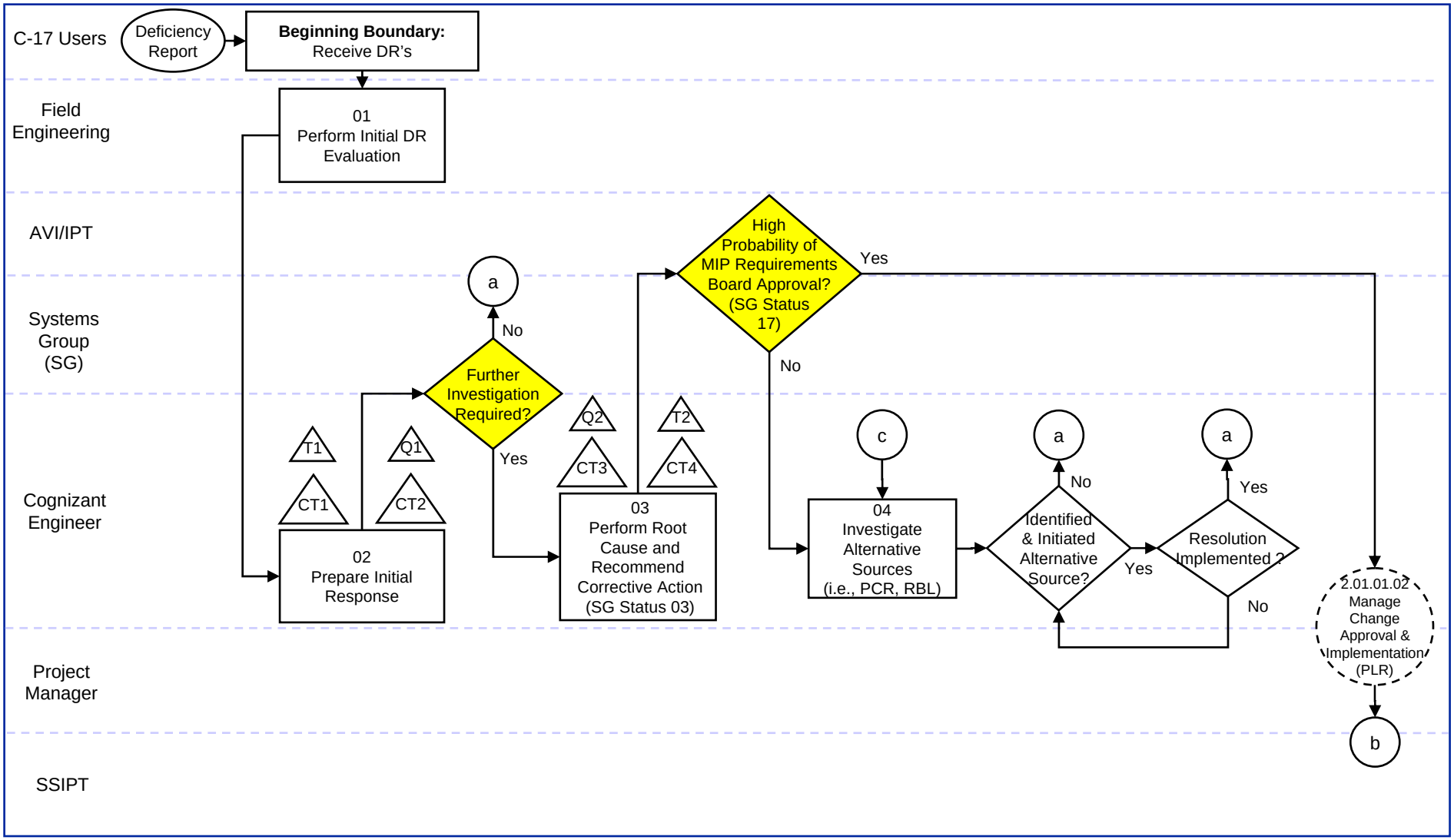
- Calculates Cost of MIP Implementation
- Calculates savings per year
- Calculates Payback Period
  - Both with and without spares cost (spares are not paid out of MIP funds)

Prioritization Process

- Group MIPs Open Awaiting Funding into four categories
  - Top Priority – Fund out of cycle if possible
  - Good Projects if funding is available (in-cycle)
  - More Information Needed to rank
  - Close as acceptable risk – We prefer to close these as early as possible
- Aircraft Systems IPT (ASIPT) rank their MIPs
  - ASIPT has the most MIPs
  - Each MIP has summary data from the DMPM at the top along with a narrative project description
- IPT Technical Leads meet and insert other MIPs into the list
  - A meeting is held with lead using command (HQ AMC) to present C-17 System Group MIP Priority recommendation

Back-Ups

DR/MIP Process

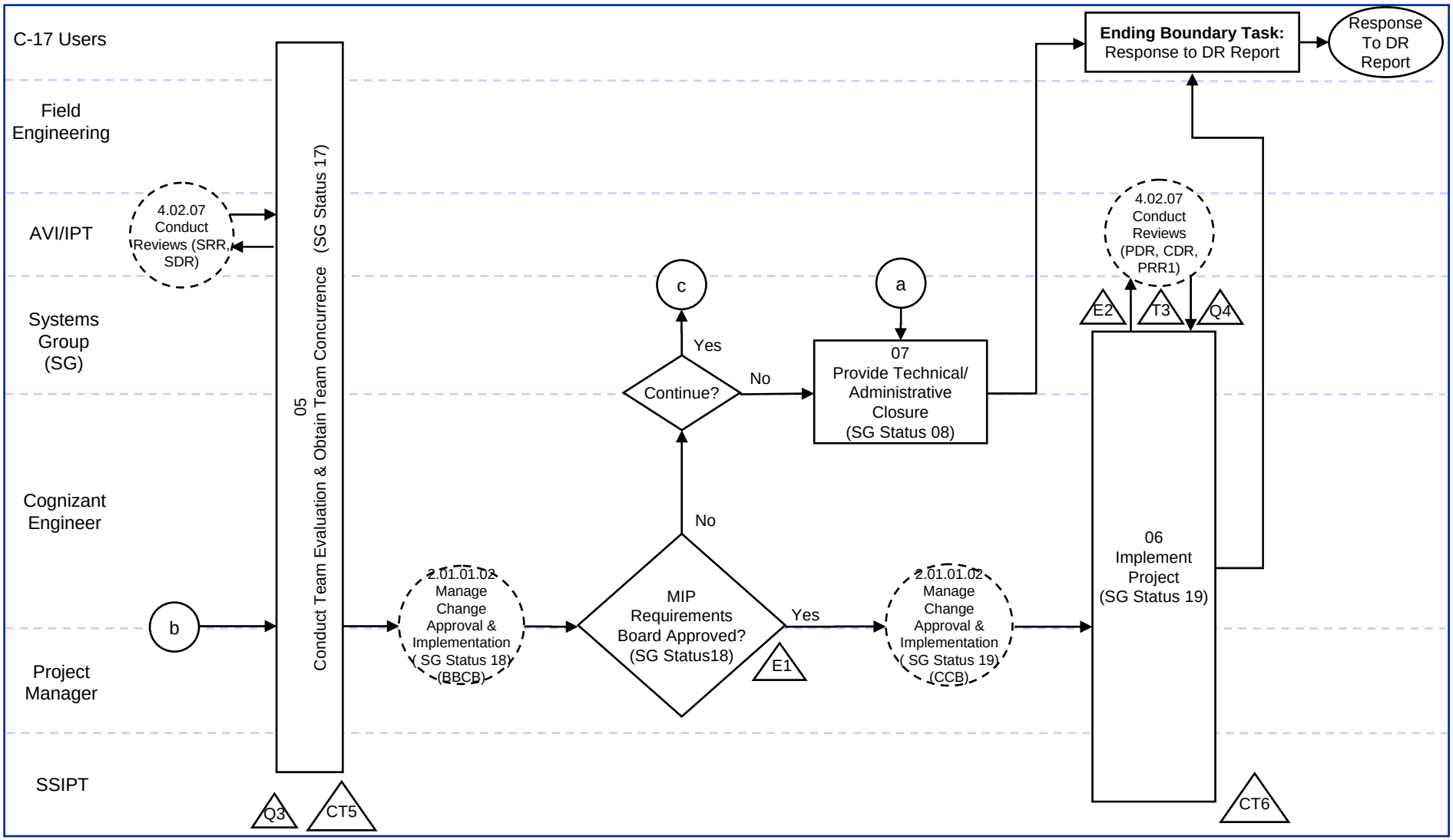


X32629 NEW (05 DEC 2005)

LEGEND

Input/Output | Task | Decision | Go to X.XX In-Process Interface | a Connector | R Record | Control Point

DR/MIP Process



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LEGEND

Input/Output | Task | Decision | Go to X.XX In-Process Interface | a Connector | R Record | Control Point