



Stratospheric Aerosol and Gas Experiment

SAGE III on ISS

An Earth Science Mission on the International Space Station

Schedule Risk Analysis A Project Perspective

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Agenda



- **Introduction**
- **Project Overview**
- **Schedule Risk Analysis Process**
- **Continuous Risk Management Process**
- **Risk Model and Inputs**
- **Results and Response**
- **Lessons Learned**
- **Next Steps**



Introduction



- **The SAGE III on ISS Project uses schedule risk analysis products to support informed decision making**
- **Today's Presentation Focus:**
 - Inputs used to capture a complete project risk profile
 - Implementation of active schedule management
 - Method of monitoring project schedule reserve, and communication of project progress to stakeholders



SAGE III on ISS Project Overview



- Space Flight Project managed and led by NASA Langley Research Center
- Partnered with the ISS Program for an instrument pointing system developed under the European Space Agency by Thales Alenia Space Italia
- Planned for launch on SpaceX to the ISS in 2016





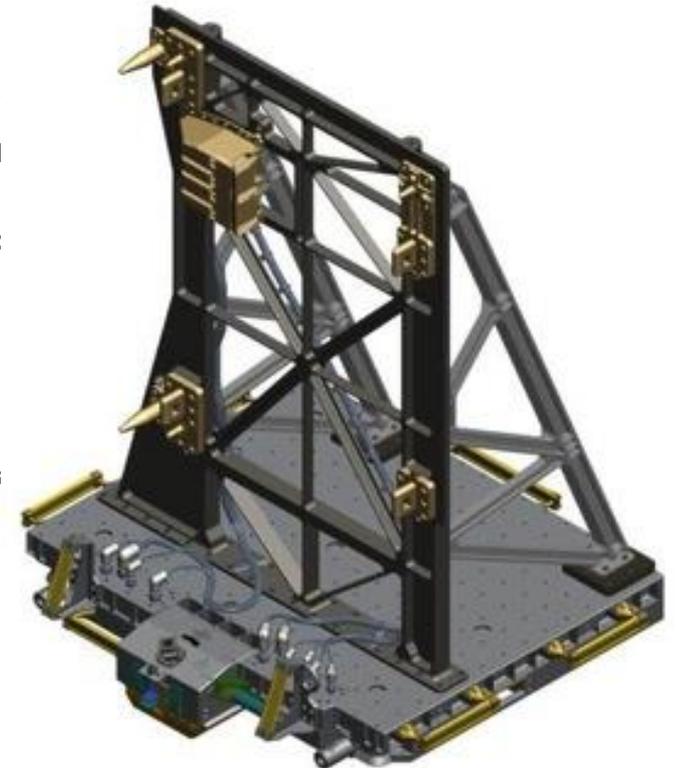
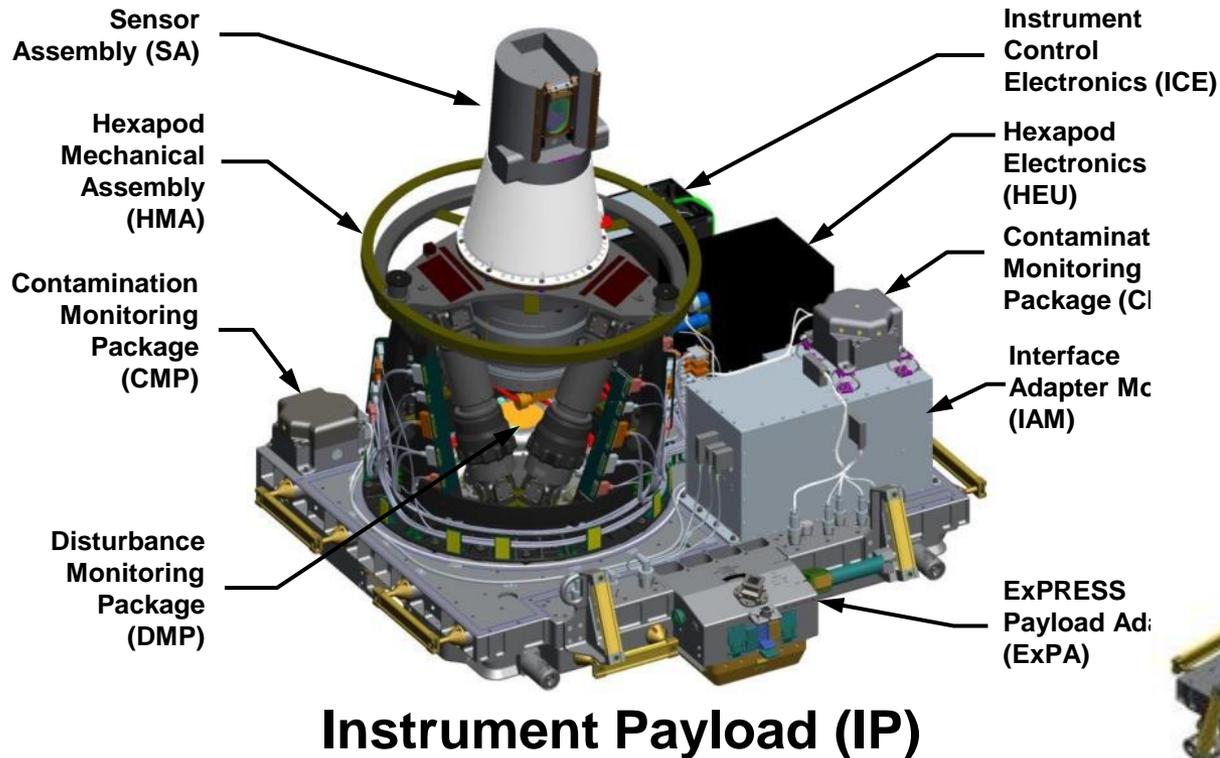
SAGE III on ISS Mission



- **Third generation in a family of instruments**
- **Study aerosols, ozone and other trace gases in Earth's upper atmosphere**
- **Supports NASA Strategic Goals**
 - Extend and sustain human activities across the solar system
 - Expand scientific understanding of the Earth and the universe in which we live



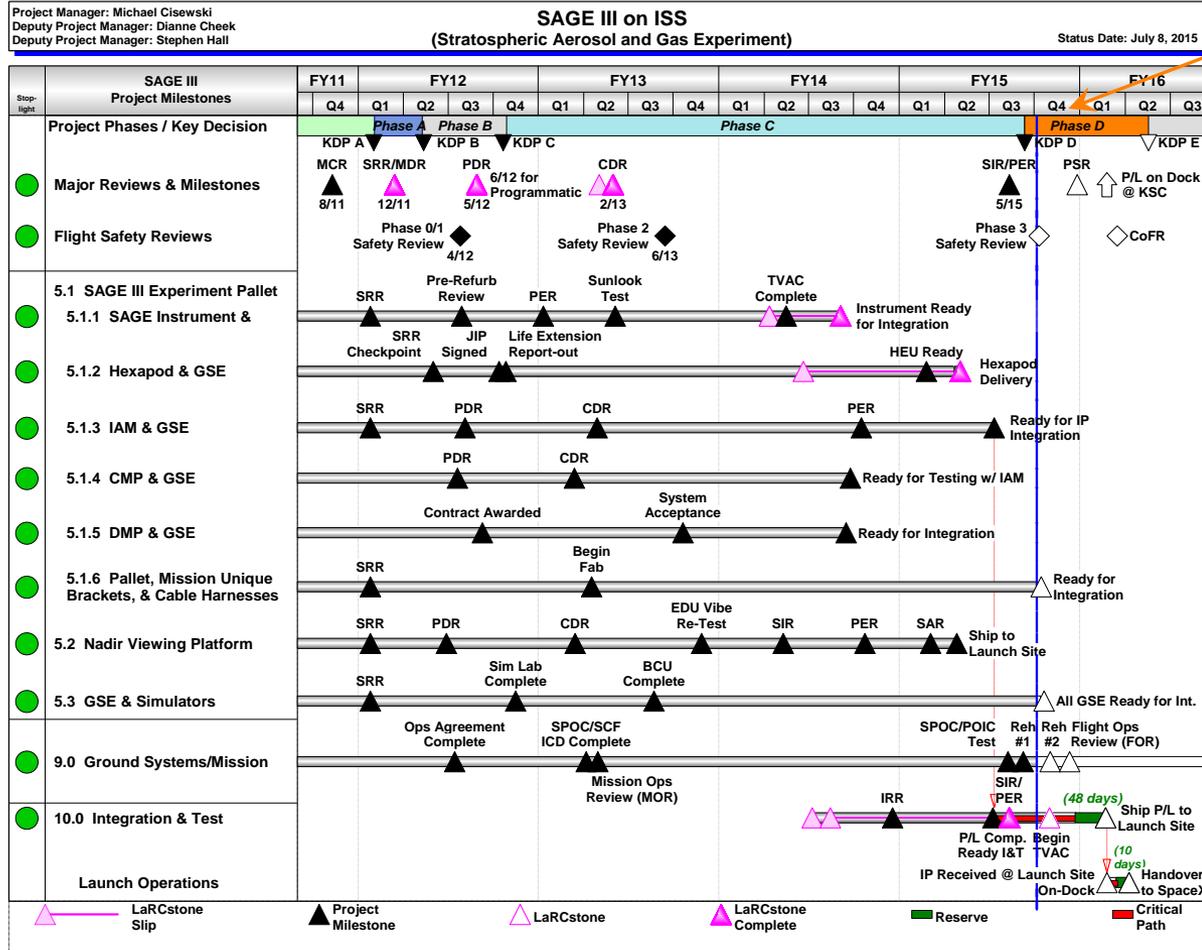
➤ SAGE III on ISS consists of two payloads



Nadir Viewing Platform (NVP)



Current Project Status



Currently in Phase D

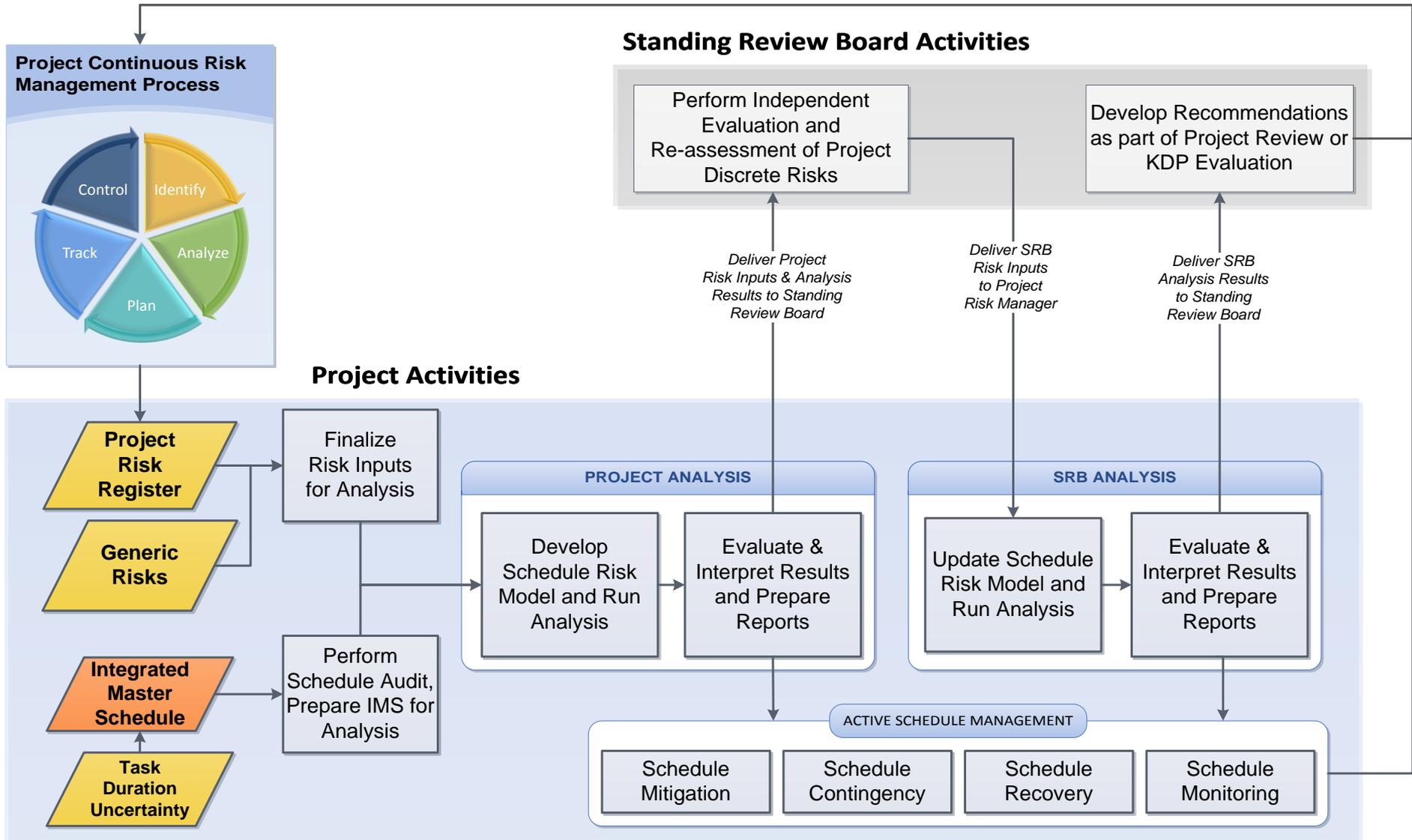


Instrument Payload in Thermal Vacuum Testing

Nadir Viewing Platform Delivered to Launch Site



Schedule Risk Analysis Process





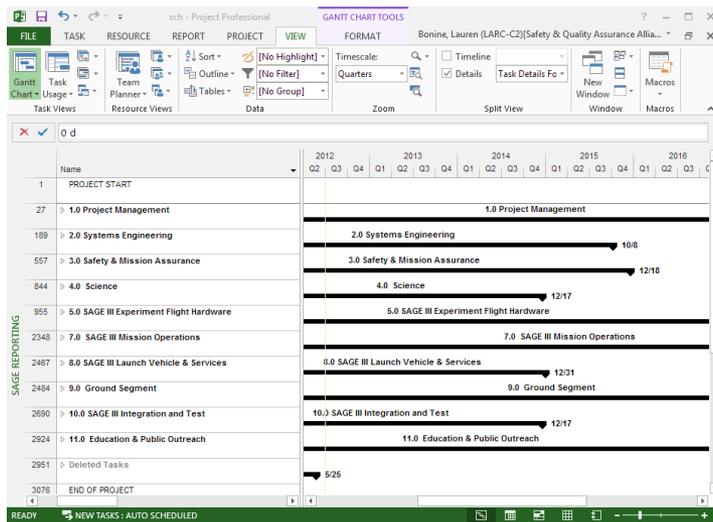
- Implemented at Top Project and subsystem levels
- Subsystem leads and subject matter experts are the primary source of risk identification and analysis inputs
- The RMB oversees the CRM process, makes decisions and allocates resources for risk management activities



Project Analysis Tools

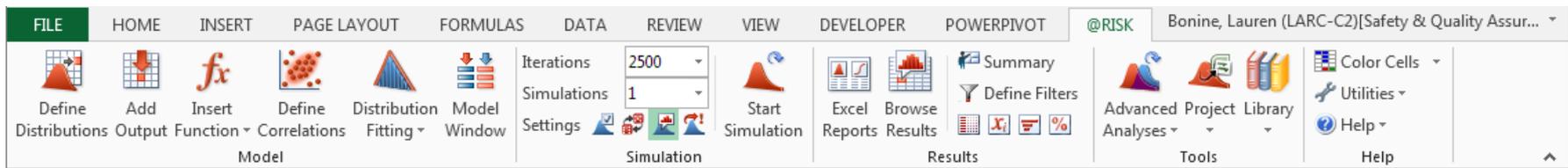


- Integrated Master Schedule: Microsoft Project
- Project Risk Register: Microsoft Excel
- Analysis Software: Palisade's @Risk



The screenshot shows the Risk Register in Microsoft Excel. The title is "SAGE III on ISS: Project Risk Register". The table contains the following data:

Risk #	Risk Title	Category	Affinity	Approach	WBS
047	New SpaceX Launch Vehicle and Spacecraft	Residual (Close by)	Cost	Accept	8 LV&Svc
218	Dragon Trunk Particulate Contamination -- Loss of Science Observations	Candidate	Technical	Research	8 LV&Svc
320	Low Voltage HEU Mode Transitions	Recommend Closure	Schedule	Research	5.1.2 Hex
299	Additional Hexapod Problems during Integration & Testing	Top Project	Schedule	Watch	10 A&T
288	Potential ELC Operational Constraints	Top Project	Technical	Watch	8 LV&Svc
301	Loss of Hexapod during On-Orbit Operations	Sub Organization	Technical	Watch	10 A&T
204	Non-Standard Parts Criticality 2 Failure Modes	Residual (On-Orbit)	Technical	Accept	4 Sci
076	ELCA Exception to Mass/CG Requirements (on-orbit)	Residual (Close by)	C, Sc	Accept	2 SE
306	IP TVAC Less than GEVS 12 Vacuum Cycles	Sub Organization	Technical	Accept	2 SE
348	EXPA Residue from Completed Vibration Testing	Sub Organization	Technical	Mitigate	10 A&T
105	Environmental Testing Facility Conflicts with Other Projects	Sub Organization	Schedule	Watch	10 A&T
172	Heritage Hardware Thermal Margins	Sub Organization	Technical	Watch	2 SE
340	Personnel to Support Data Trending	Sub Organization	Sc, T	Watch	10 A&T
276	Instrument Flight Software Latent Defects	Top Project	Schedule	Watch	10 A&T
302	IAM Impedance Requirement Exceedance	Recommend Closure	Schedule	Mitigate	10 A&T
309	Facility Operators for IP TVAC	Sub Organization	Schedule	Watch	10 A&T





Risk Model

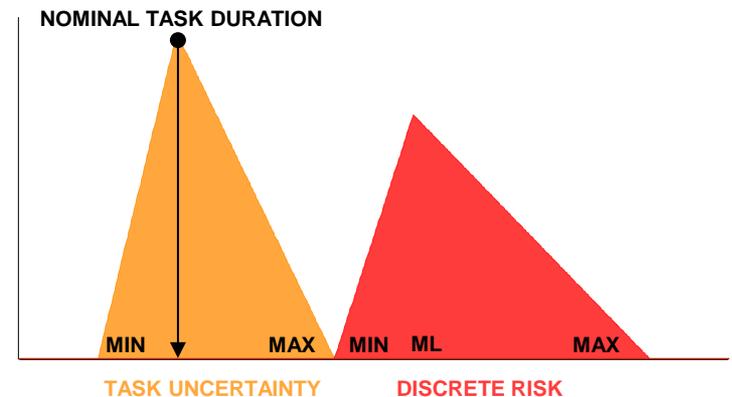


➤ Methodology

- Monte Carlo simulations of project schedule
- Estimates were provided by project SME's as part of developing the Project Management Baseline and Continuous Risk Management process

➤ Project risk model included

- Task Duration Uncertainty
- Discrete Risks
 - Top Project Risks
 - Subsystem Risks
- Generic Risks
 - Additional discrete risks inherent in the activities being performed that were not typically captured in the project risk register





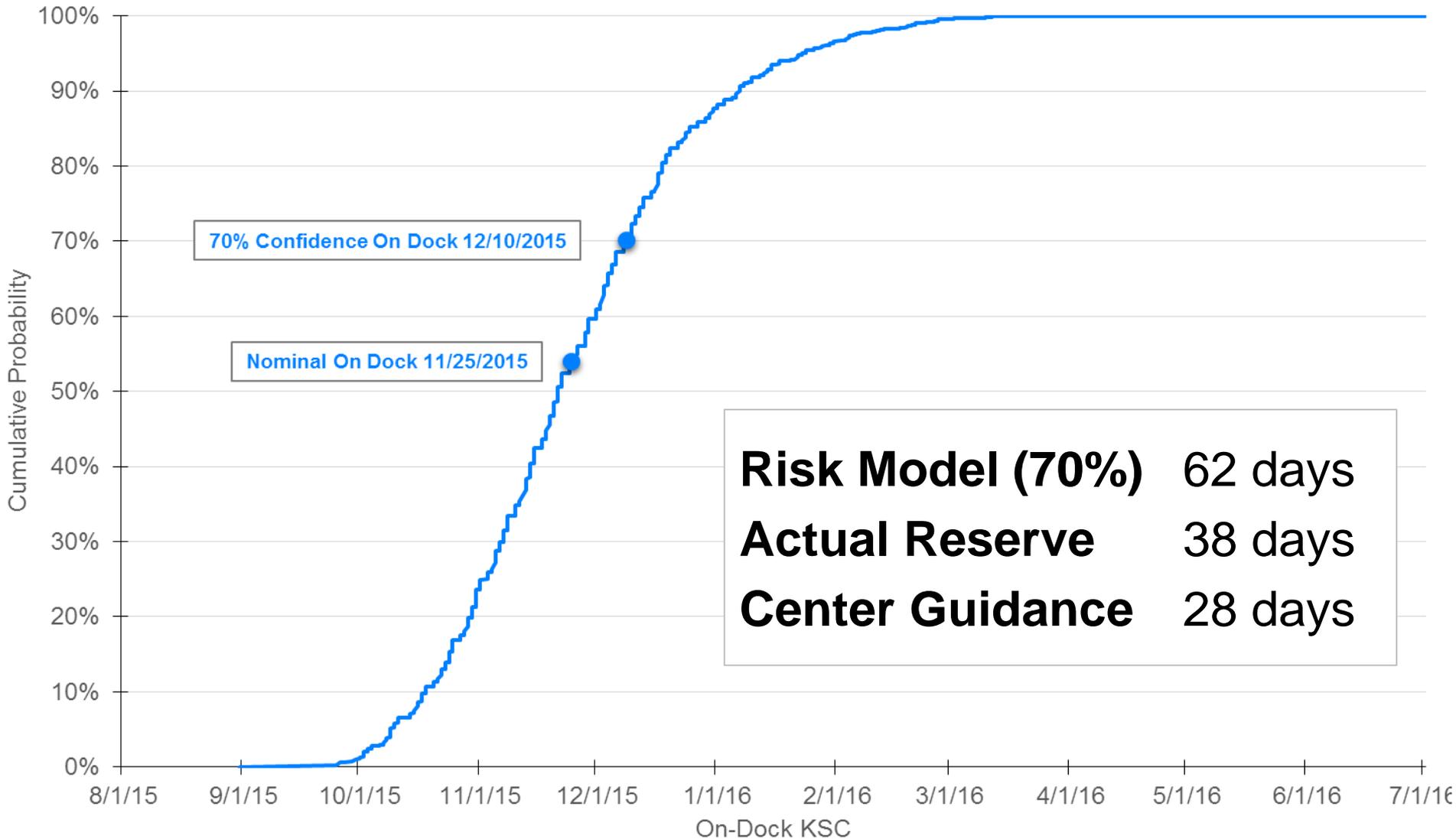
Generic Risks



- **Project identified Generic Risks, or risks common to the development of any spaceflight project**
 - Generic risks were not initially captured as part of the CRM process
- **Sample Generic Risks**
 - Test Anomalies
 - Facility Down-time/Availability
 - Center Closures
 - GSE Development
- **Inclusion of generic risks was necessary for more realistic model results**
- **Other areas for future consideration**
 - Procurement Delays
 - Logistics Coordination
 - Workmanship issues
 - Additional Software Builds



Progressing Towards KDP-D





Model Results & Implications



- **Indicated a need for significantly more schedule reserve than available at the time**
 - Later than planned subsystem deliveries
 - Fixed launch date
- **Based on model results, the project took action to increase schedule reserve**
 - Update Project plan to utilize two shifts Monday through Friday and single shift on Saturdays
- **Required active schedule management approach to meet delivery commitments**



Active Schedule Management



➤ **Schedule Mitigation**

- Added an overlapping shift team for more bench strength
- Added additional workforce and support personnel

➤ **Schedule Contingency**

- Coordinated authorization of work during Center closures
- Identified compressible or descopable tasks which could buy back schedule reserve

➤ **Schedule Recovery**

- Worked additional unplanned shifts to recover schedule
- Re-plan near term schedule tasks to maintain effective progress when issues arise

➤ **Schedule Monitoring**

- Actively monitored schedule reserve available against schedule reserve needed



Schedule Monitoring



➤ Project reserve posture exceeded minimum Center guidance (2 months/year during AI&T)

- Linear reserve burn down was not the best method because of high risk tests late in the schedule

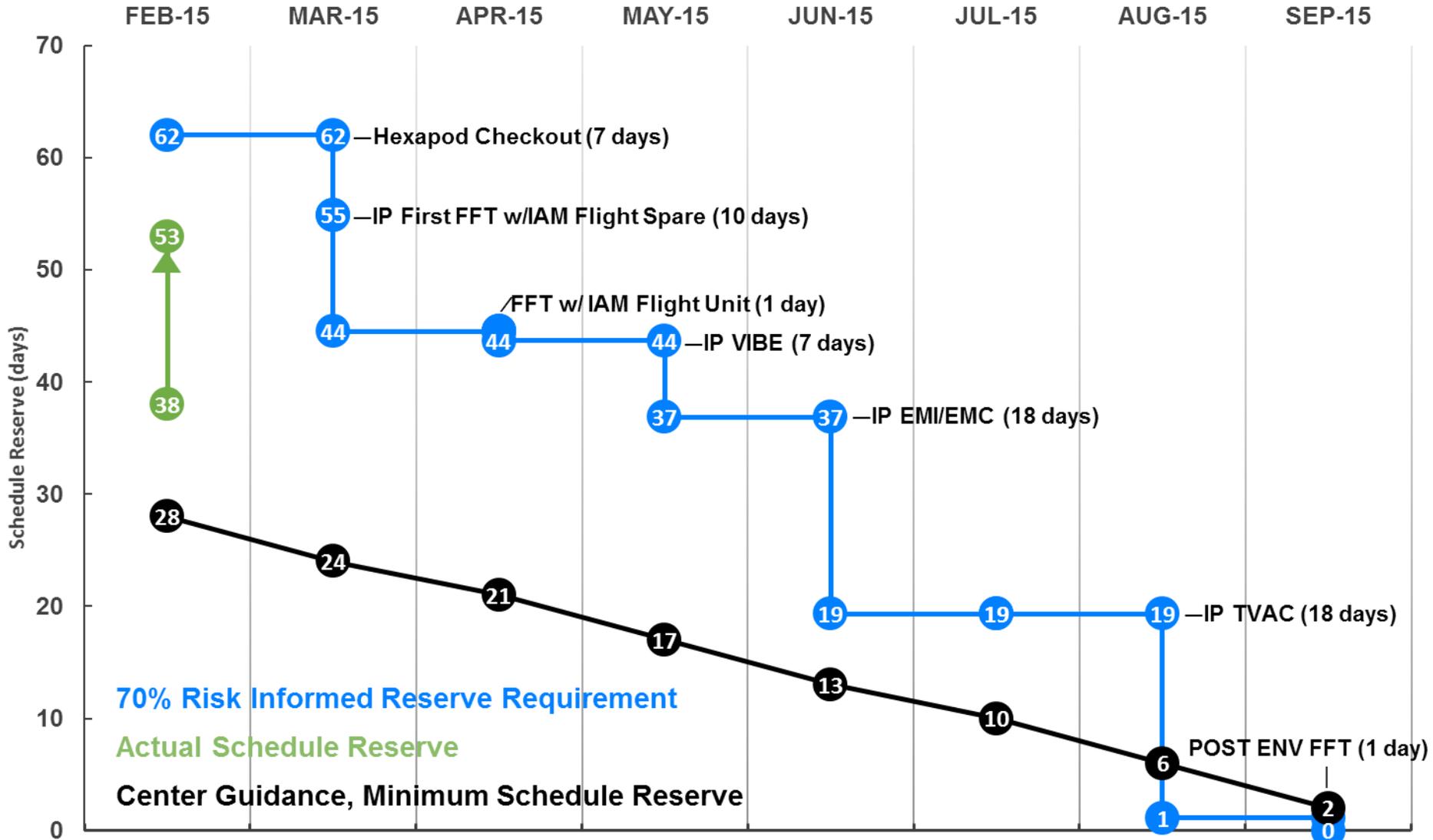
➤ Project Solution

- Develop a methodology to understand the amount of reserve required at each major integration and test activity
- Inform decisions regarding use of schedule reserve

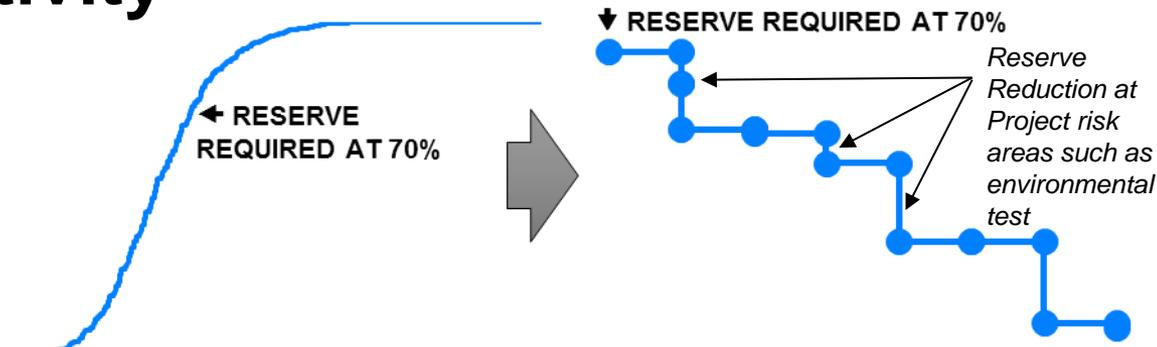




Risk Informed Reserve Burn Down



- **Sum the mean observed impact of all risks adjusting for parallel risk impacts**
- **Determine the scale factor of the mean observed impact to the reserve required at 70%**
- **Scale mean observed impacts at each major integration activity by the 70% scale factor to determine the estimated reserve required for each activity**





Benefits



- **Provides an estimate of reserve to be maintained as the project executed integration and testing activities**
- **Informs decisions**
 - Adding shifts or adjust staffing plans
 - Descope or compress downward tasks
 - Considered as part of risk trade for tactical decisions
 - Capitalize on opportunities
- **Serves as a management baseline to assess progress**
- **Excellent communication tool for project stakeholders**



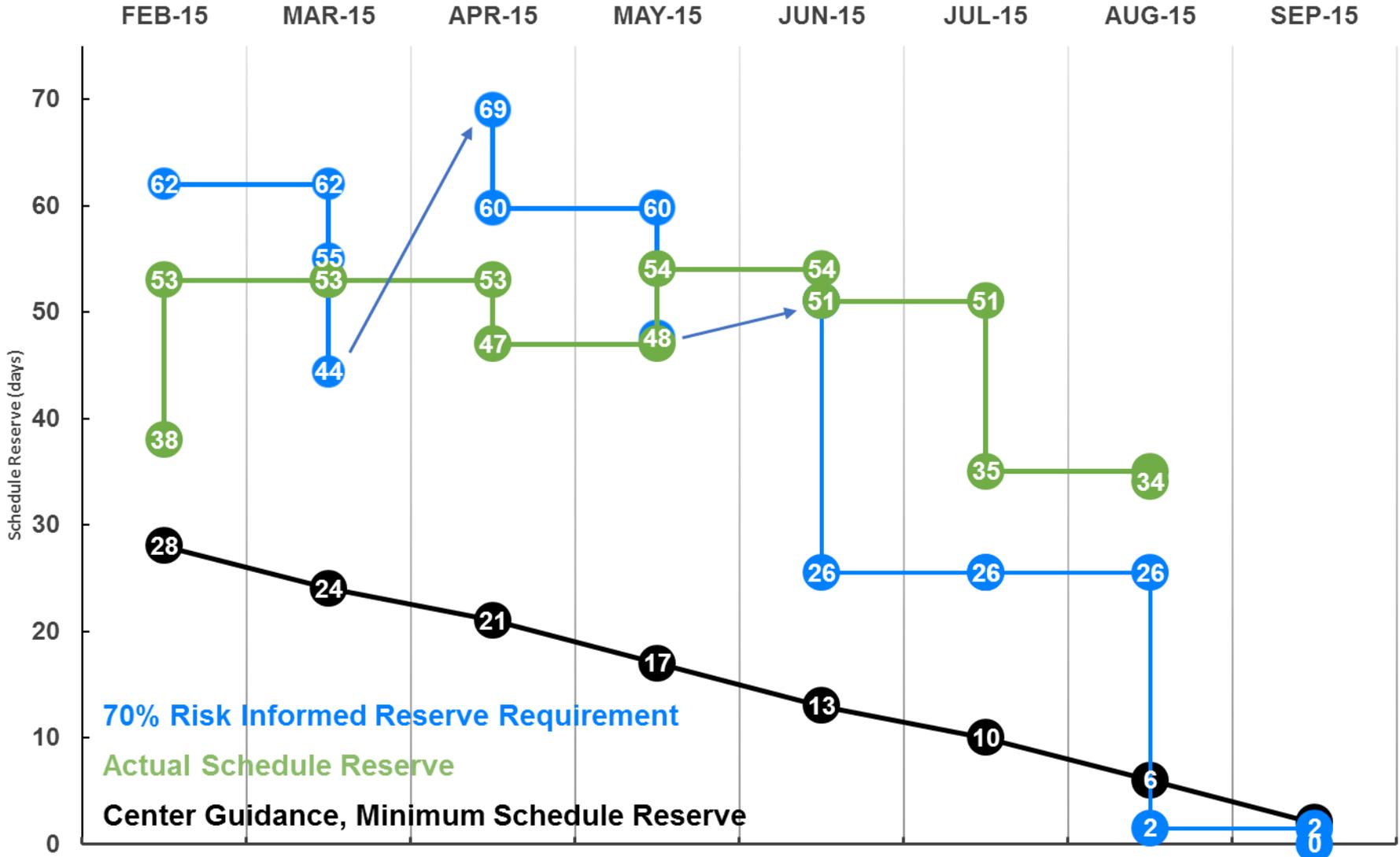
Challenges



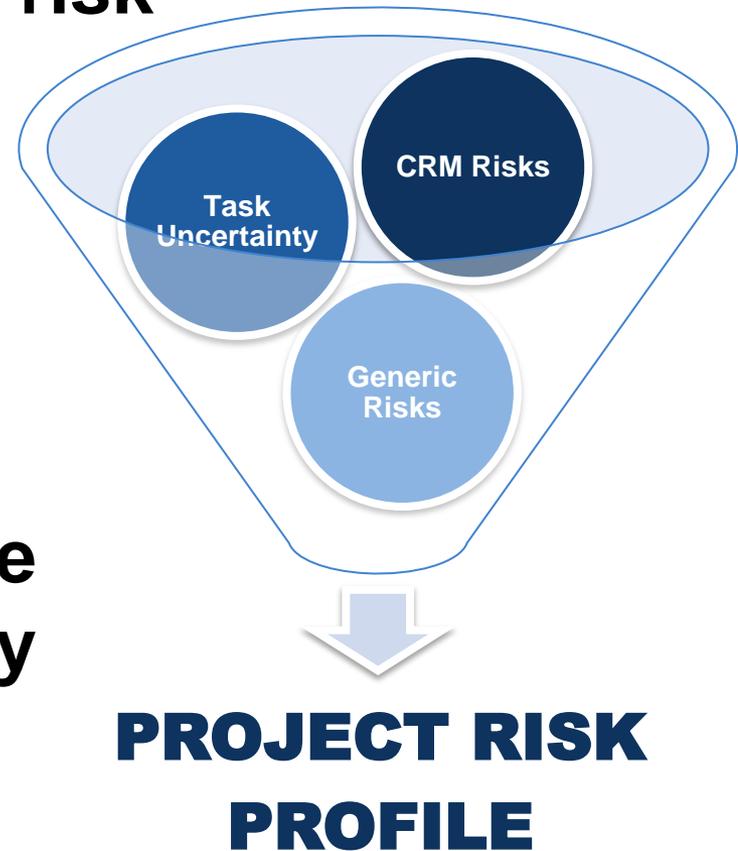
- **Scaling reserve requirements to 70% level was challenging when iterating analysis over time**
 - Reserve does not scale consistently from one analysis to the next even in areas where risk inputs were unchanged
 - Risks not closed as planned needed to be carried forward causing downward reserve requirements to be adjusted
- **Initial rollout – new view of reserve burn down for project stakeholders**
 - Stakeholder reception has been positive



Risk Informed Reserve Burn Down vs. Project Execution



- **Discrete risks managed as part of the CRM process did not provide a complete story for potential project schedule risk**
- **Risk informed reserve Burn down was a good management tool to aid in decision making**
- **Center guidelines for minimum schedule reserve may not always adequately support project needs**





Next Steps



- **Refine schedule reserve burn down methodology**
- **Document execution of common Flight Project tasks such as environmental tests**
 - Scope of task
 - Planned vs. actual task duration (and reason for variances)
- **Document issues experienced resulting in schedule reserve use or other schedule impacts**
 - Aid future project planning and risk management
 - Improve future risk models
- **Potential area for CADRe or other systematic data capture**



Navigation and Space Administration



Questions?

