National Aeronautics and Space Administration

Stratospheric Aerosol and Gas Experiment

SAGE III on ISS

An Earth Science Mission on the International Space Station

Schedule Risk Analysis
A Project Perspective

Lauren Bonine, Project Risk Manager
NASA Langley Research Center
5 N Dryden Street, Hampton, VA 23681-2199 (MS 416)
lauren.bonine@nasa.gov
(757) 864-5634

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

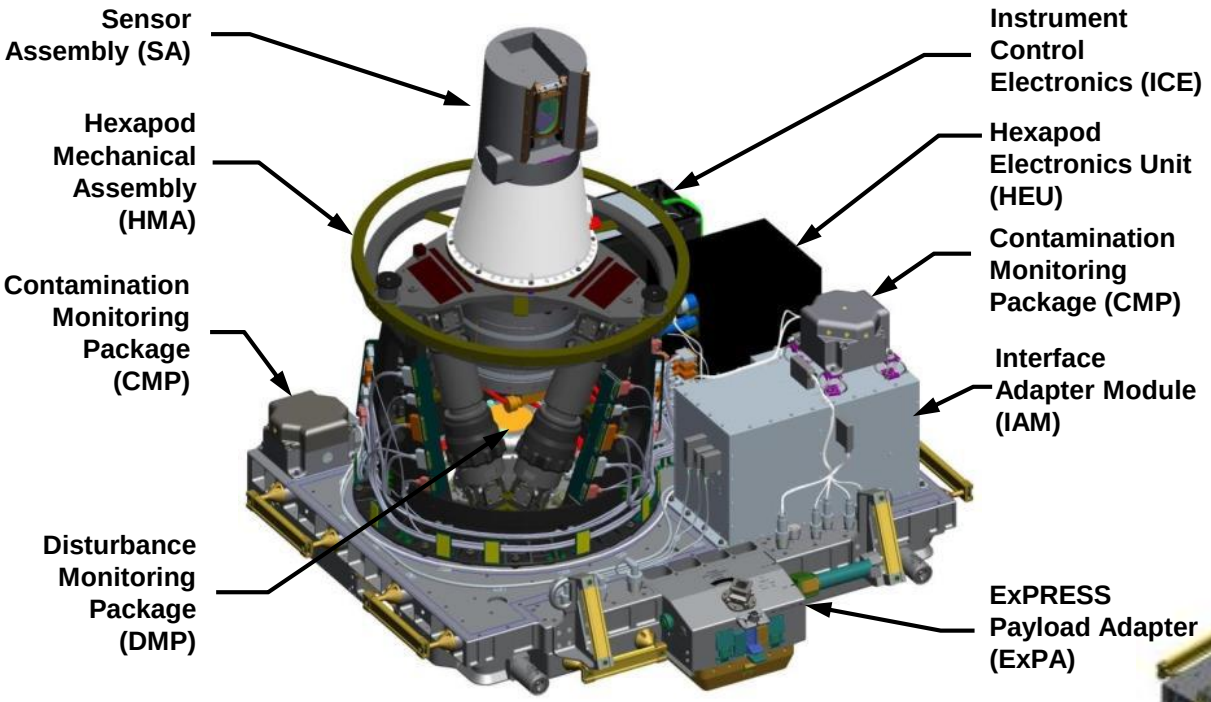
- Space Flight Project managed and led by NASA Langley Research Center
- Partnered with the ISS Program for an instrument pointing system developed under the European Space Agency by Thales Alenia Space Italia
- Planned for launch on SpaceX to the ISS in 2016

SAGE III on ISS Mission

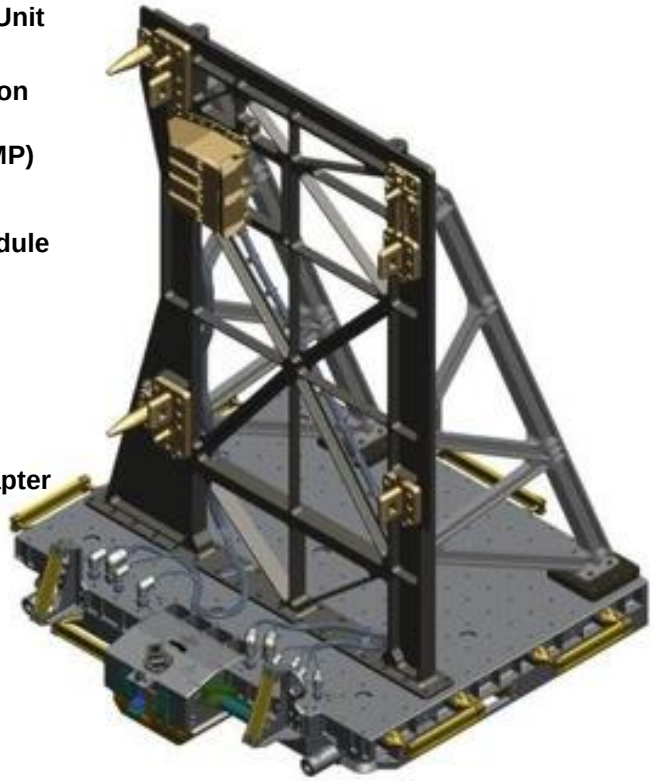
- **Third generation in a family of instruments**
- **Study aerosols, ozone and other trace gases in Earth's upper atmosphere**
- **Supports NASA Strategic Goals**
  - Extend and sustain human activities across the solar system
  - Expand scientific understanding of the Earth and the universe in which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

SAGE III on ISS Flight Hardware

SAGE III on ISS consists of two payloads

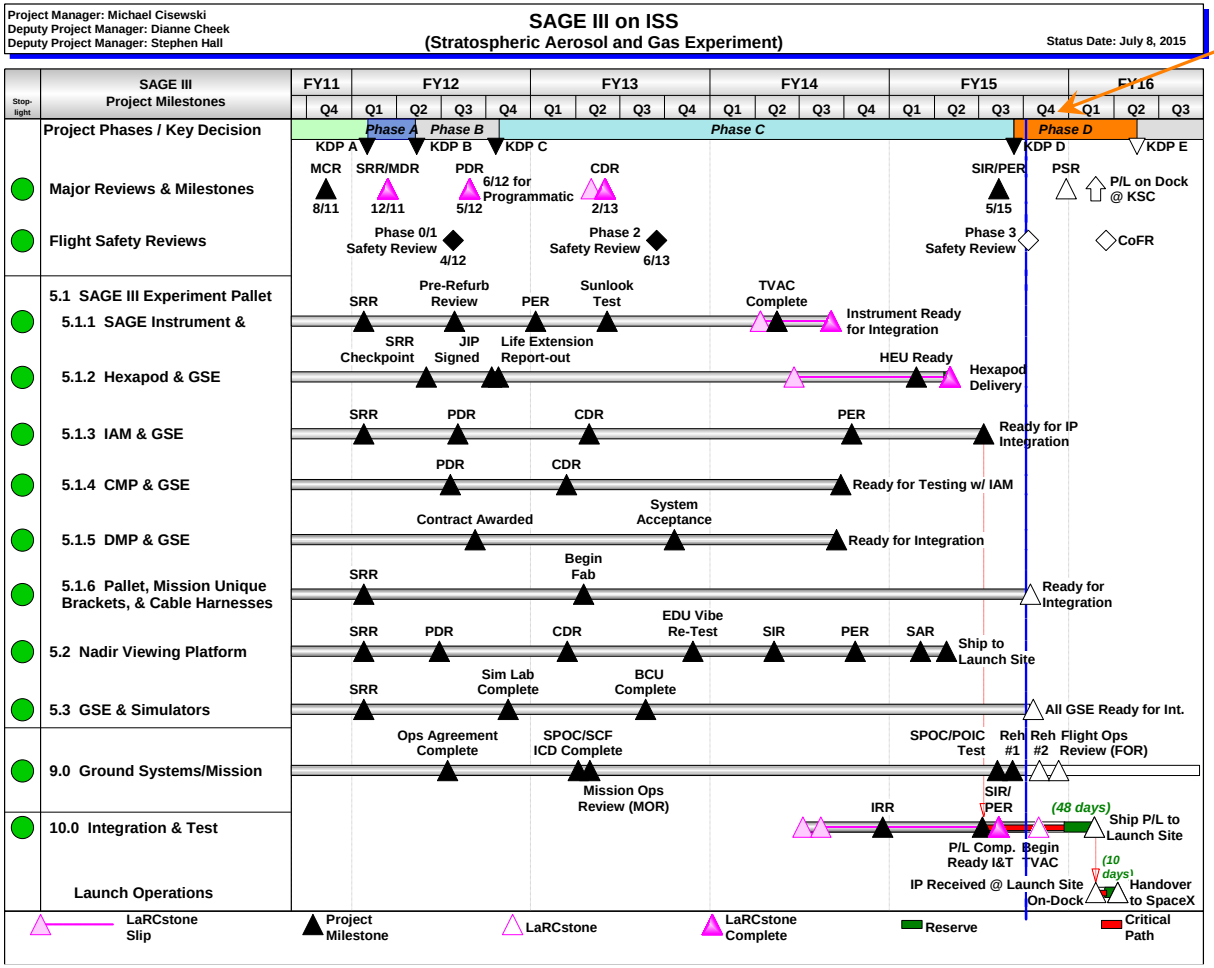


Instrument Payload (IP)



Nadir Viewing Platform (NVP)

Current Project Status

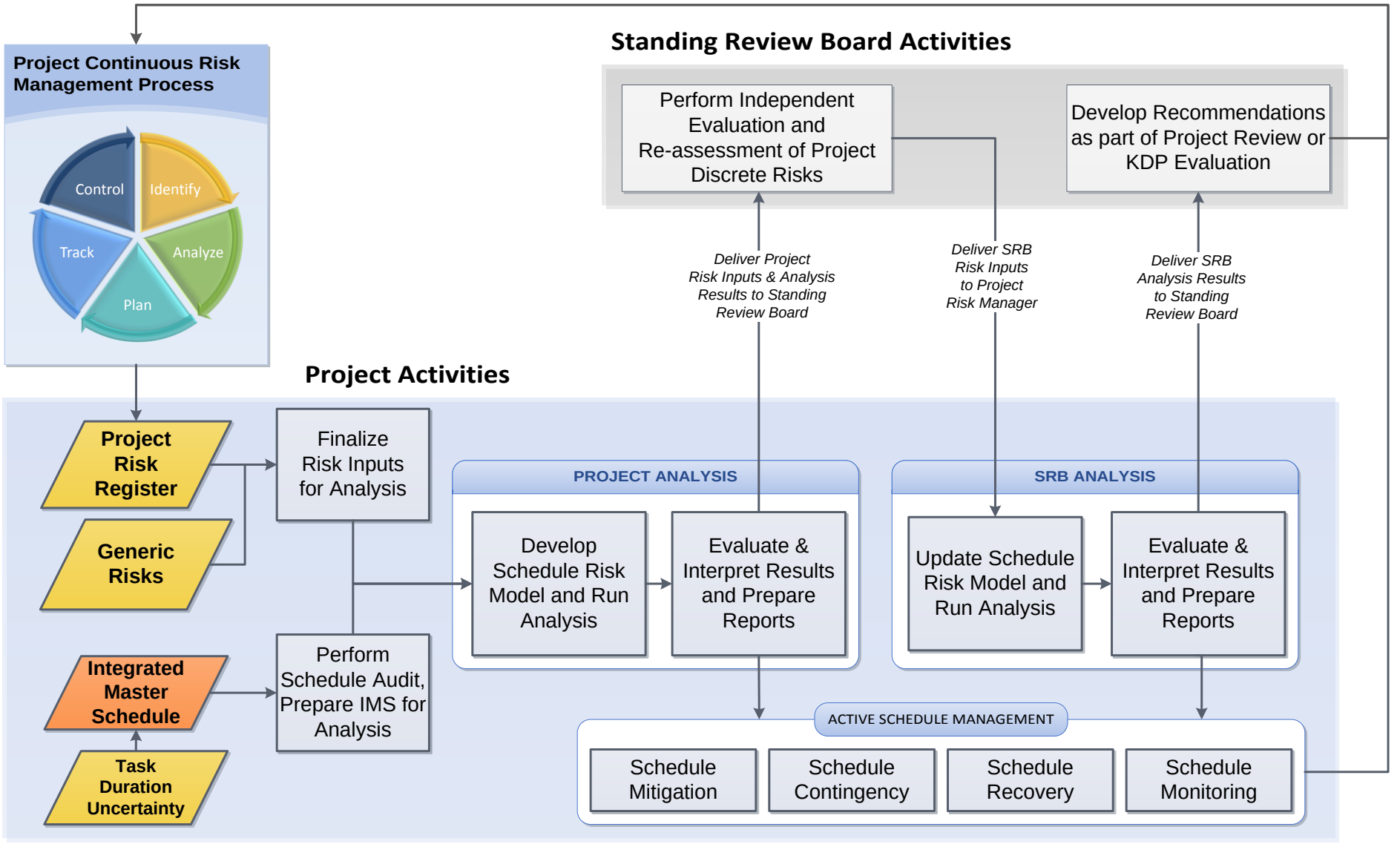


Currently in Phase D

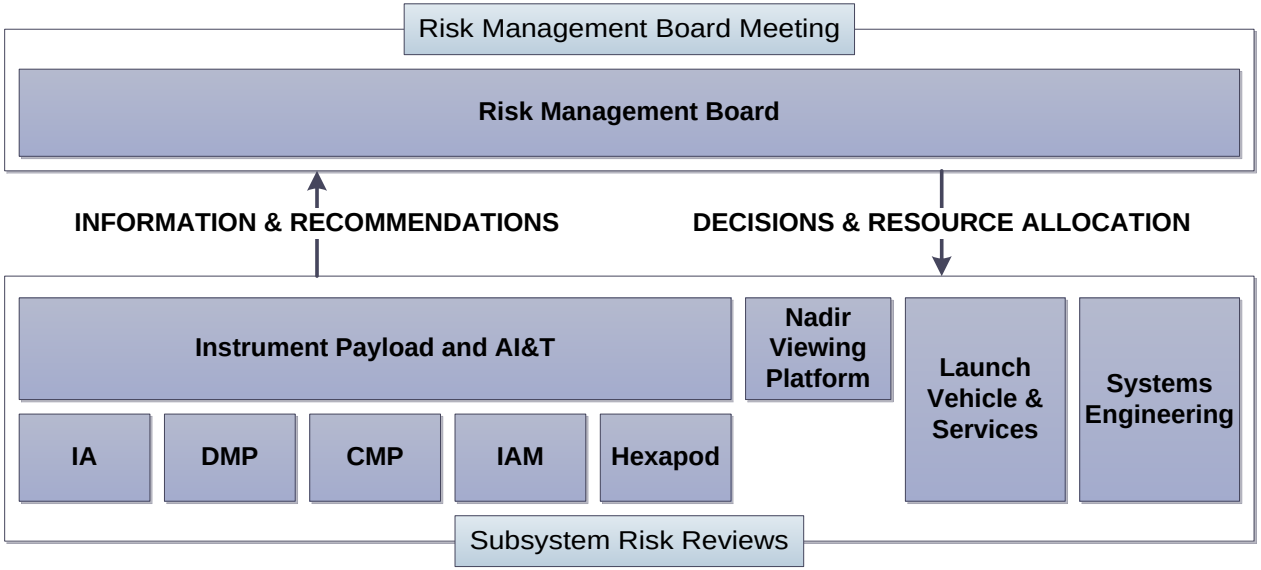
Instrument Payload in Thermal Vacuum Testing

Nadir Viewing Platform Delivered to Launch Site

Schedule Risk Analysis Process



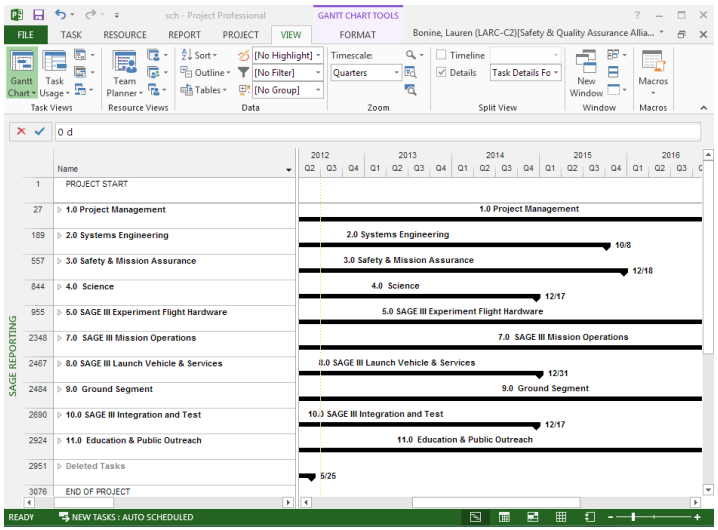
Continuous Risk Management

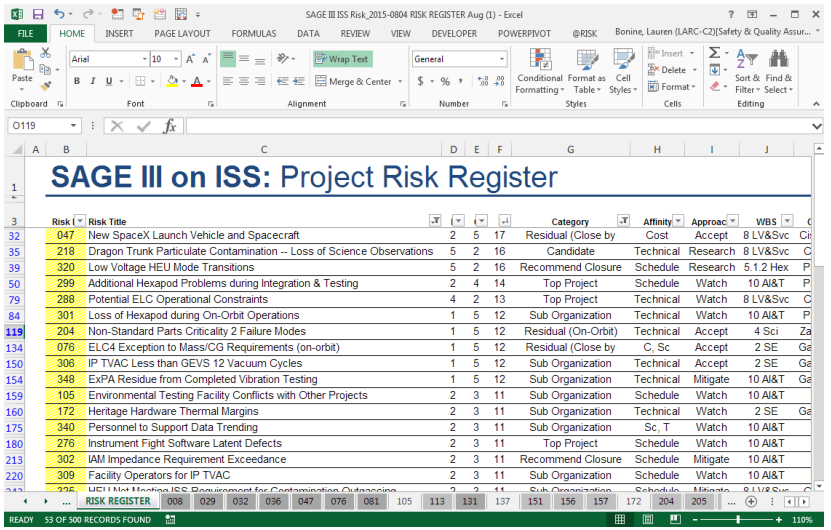


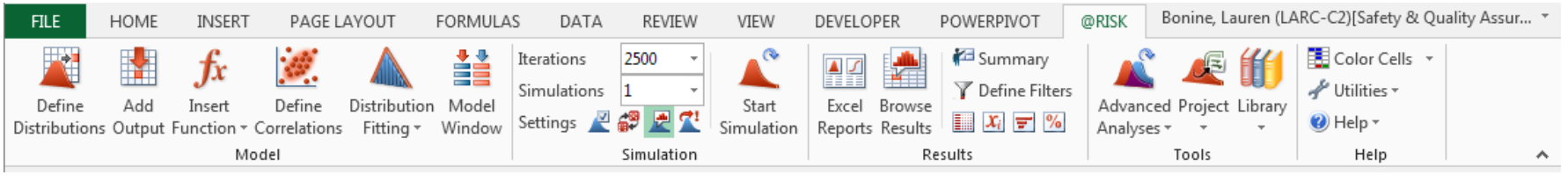
- **Implemented at Top Project and subsystem levels**
- **Subsystem leads and subject matter experts are the primary source of risk identification and analysis inputs**
- **The RMB oversees the CRM process, makes decisions and allocates resources for risk management activities**

Project Analysis Tools

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







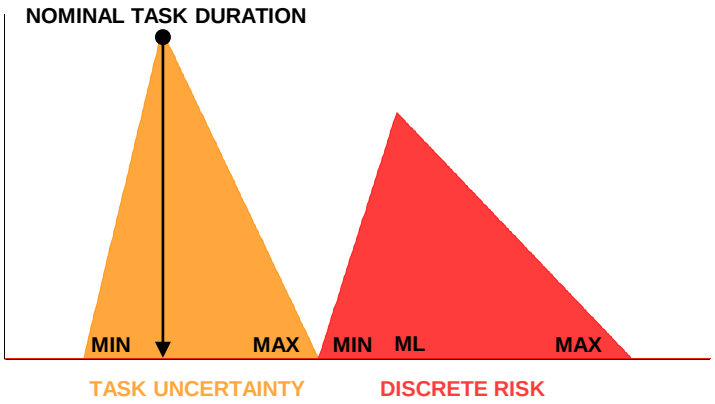
Risk Model

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

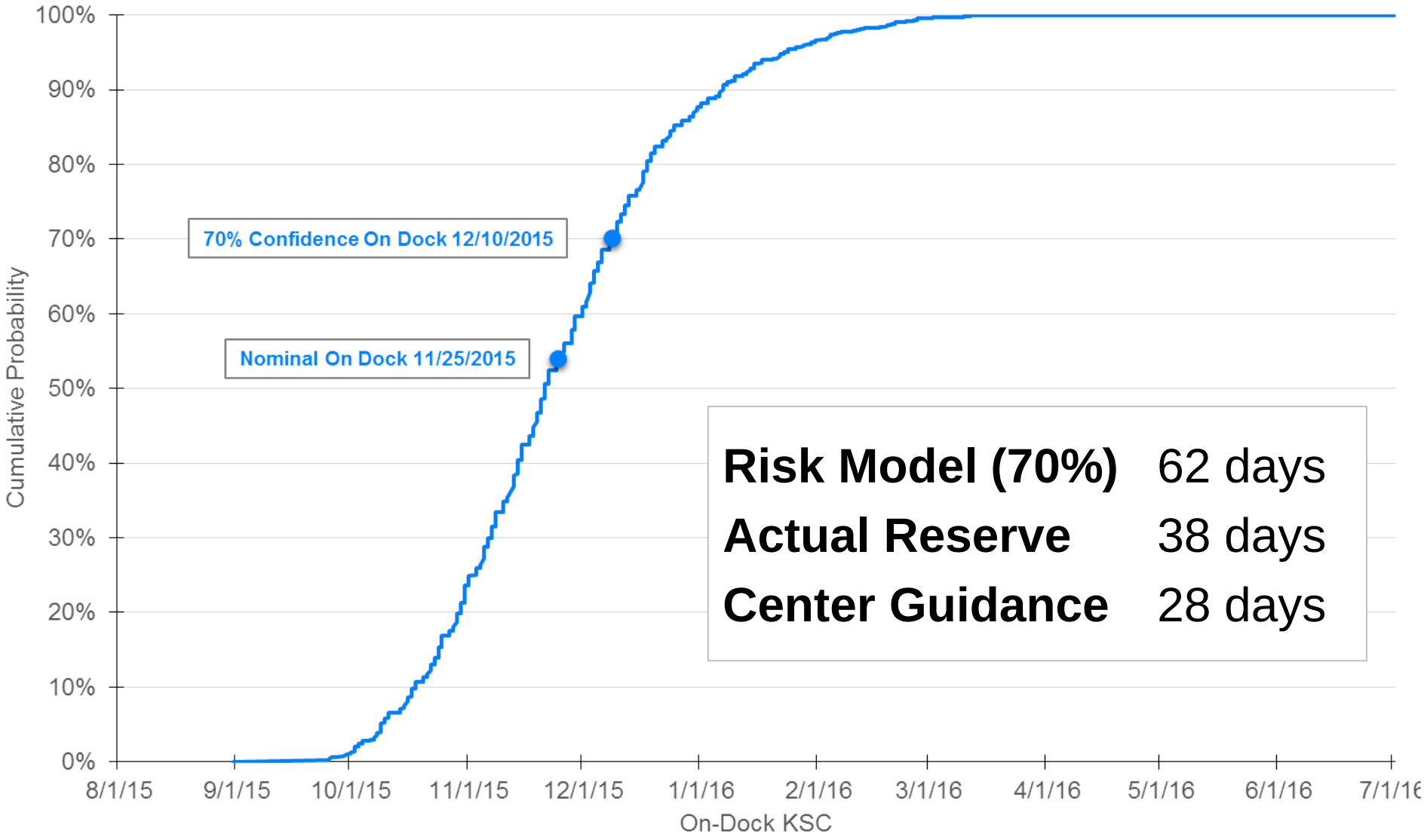
- Task Duration Uncertainty
- Discrete Risks
  - Top Project Risks
  - Subsystem Risks
- Generic Risks
  - Additional discrete risks inherent in the activities being performed that were not typically captured in the project risk register



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



Risk Model (70%)	62 days
Actual Reserve	38 days
Center Guidance	28 days

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

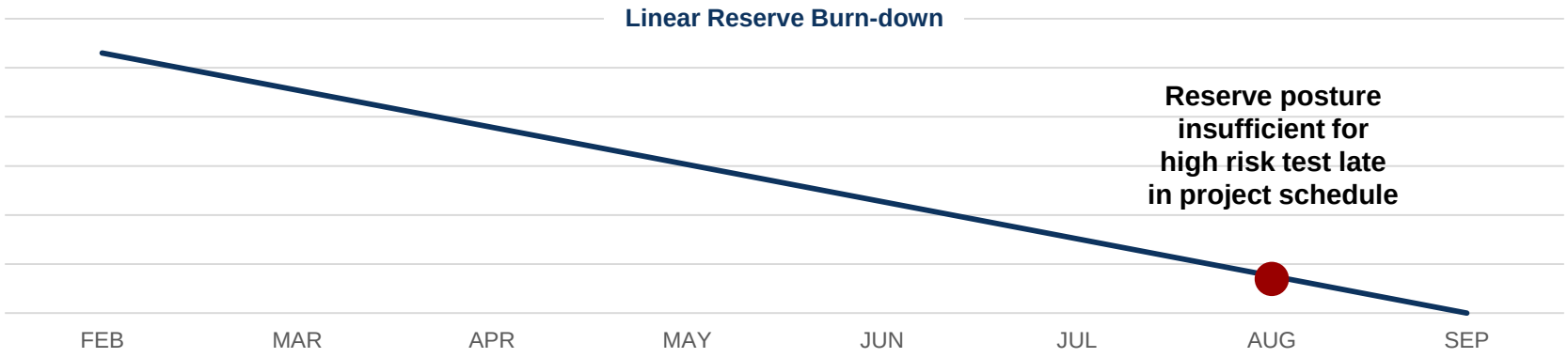
- Worked additional unplanned shifts to recover schedule
- Re-plan near term schedule tasks to maintain effective progress when issues arise

Schedule Monitoring

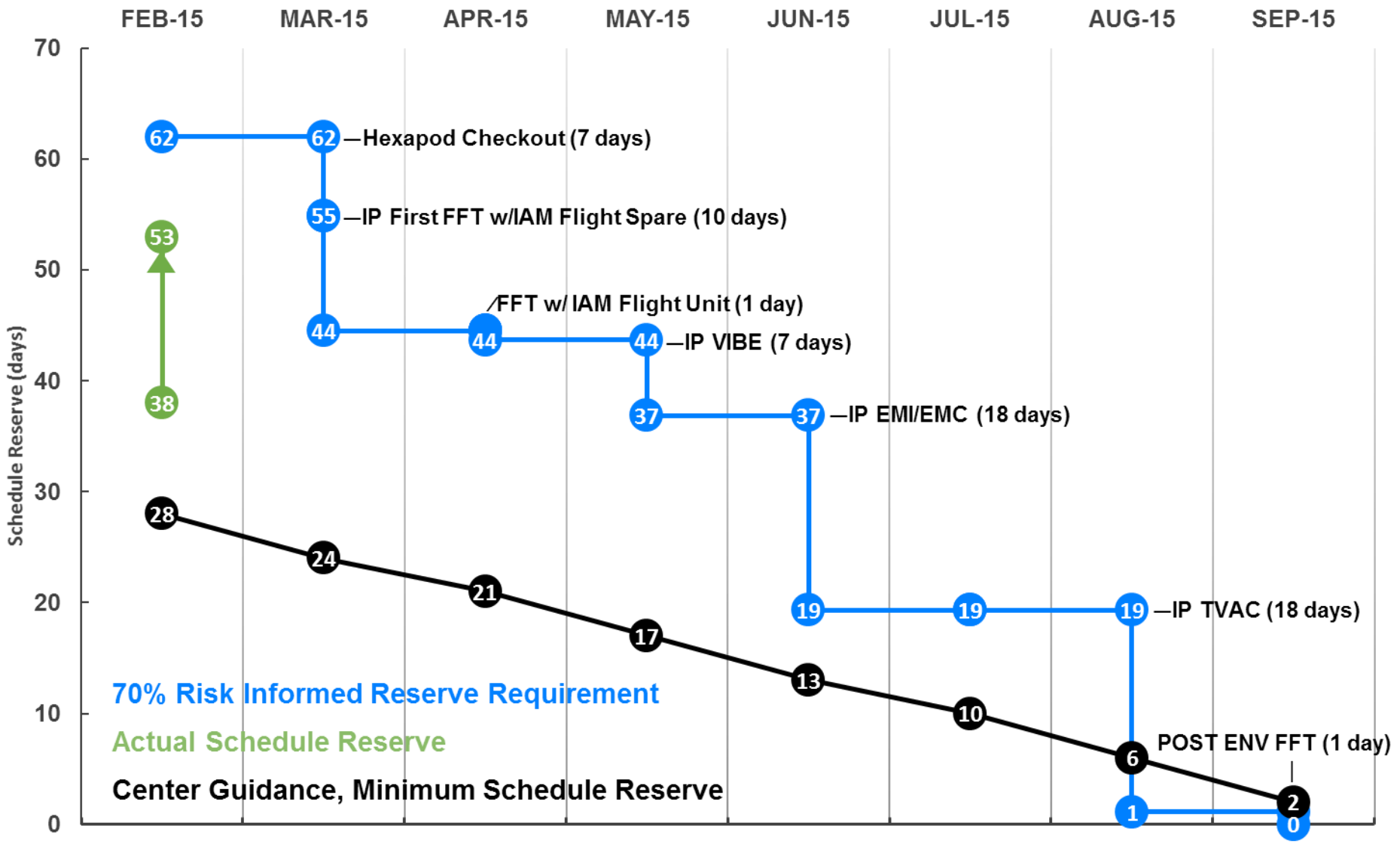
- Actively monitored schedule reserve available against schedule reserve needed

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

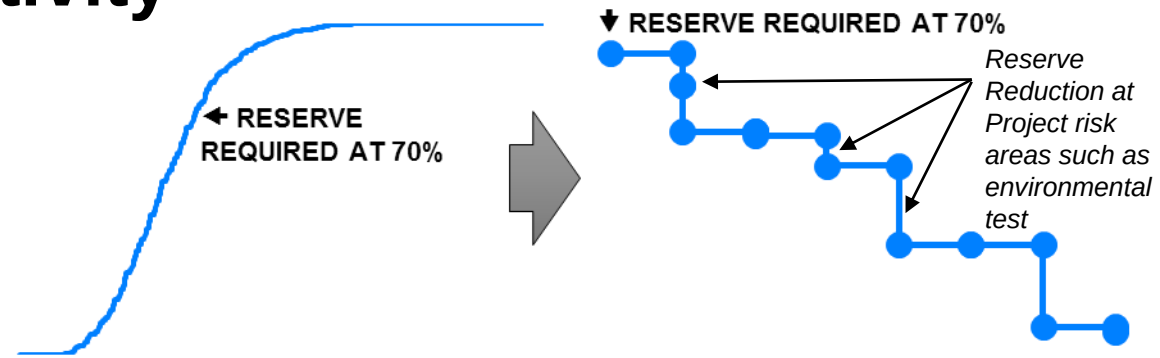


Risk Informed Reserve Burn Down



Methodology

- 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



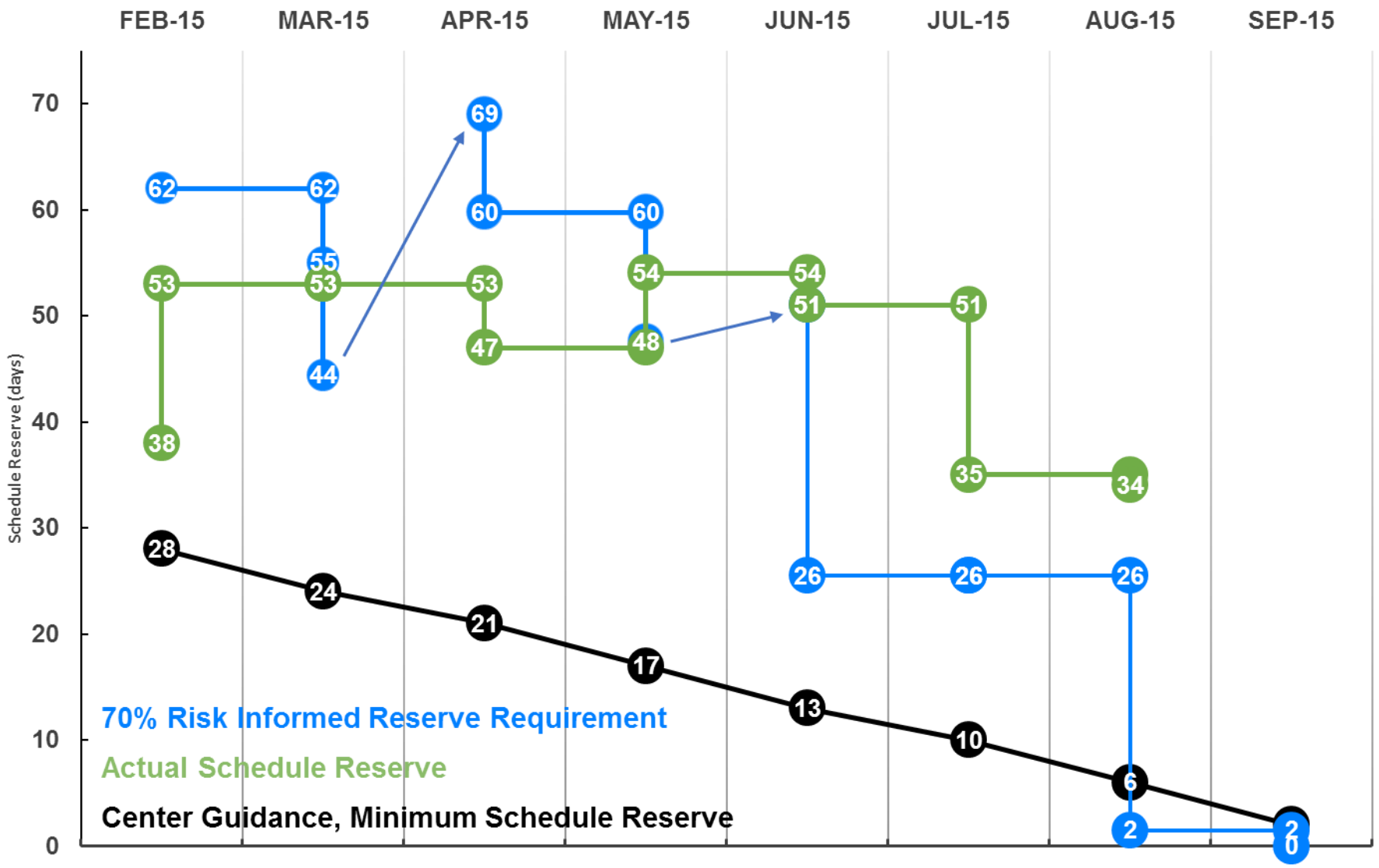
Benefits

- **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

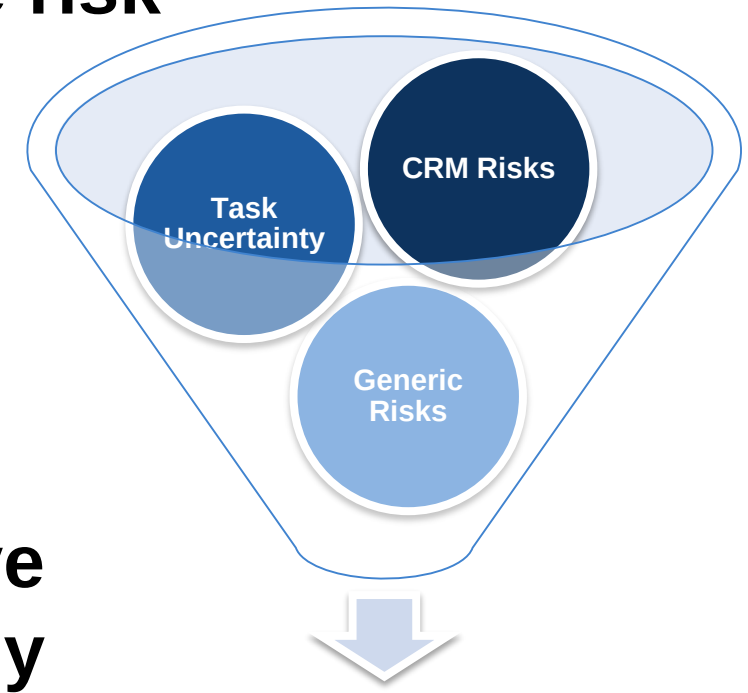
- **Scaling reserve requirements to 70% level was challenging when iterating analysis over time**
  - Reserve does not scale consistently from one analysis to the next even in areas where risk inputs were unchanged
  - Risks not closed as planned needed to be carried forward causing downward reserve 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



Lessons Learned

- 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



PROJECT RISK PROFILE

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**

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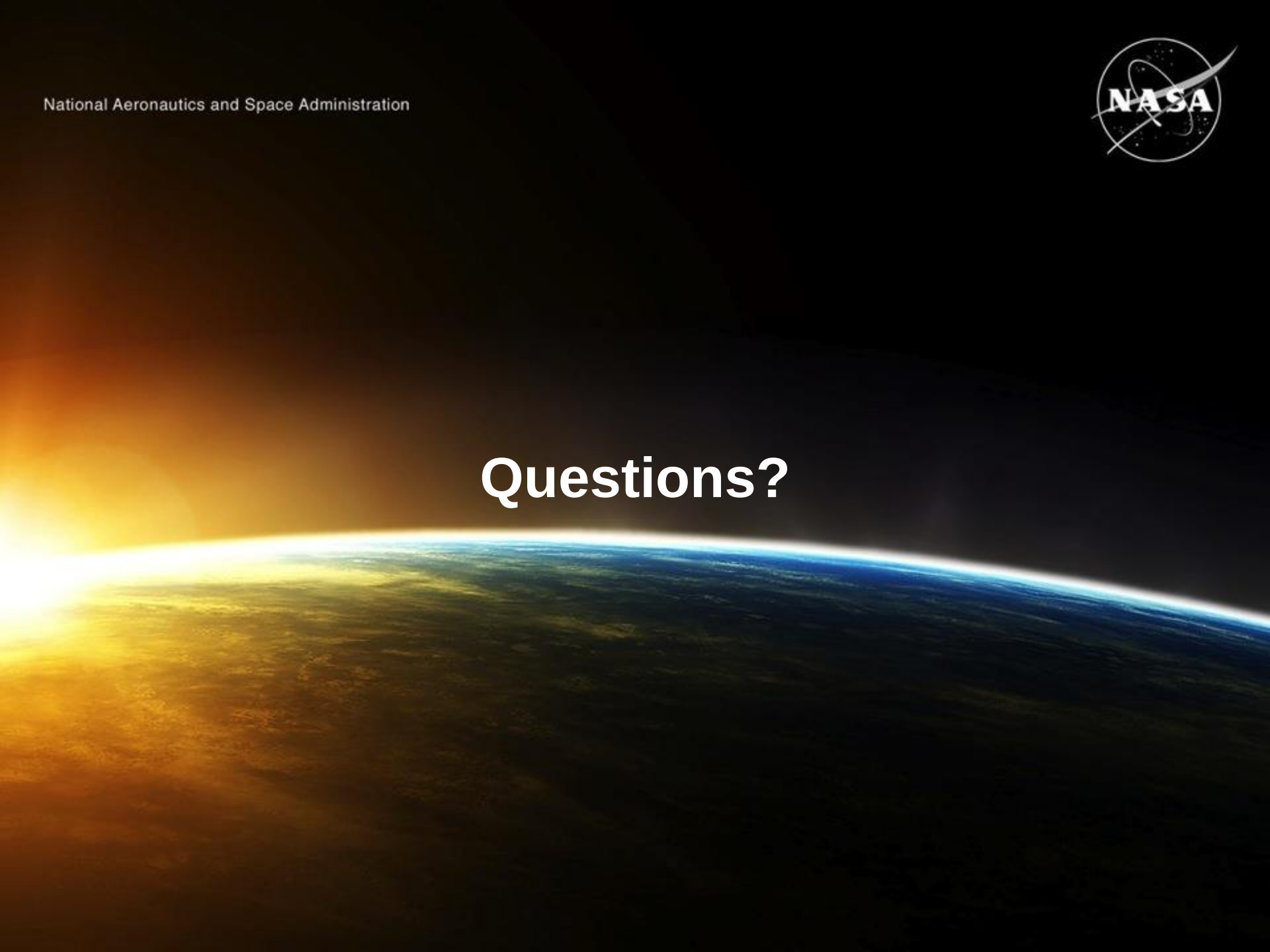

Questions?