Risk Balance

A Key Tool for Mission Operations Assurance

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RISK – THE CONTINUING THREAT
What is Mission Success?

MEETING LEVEL 1 REQUIREMENTS
WITHIN COST AND SCHEDULE
WITH ACCEPTABLE RISK AND
DOING IT SAFELY!
What is Risk?

Risk is the likelihood of an undesirable event/outcome occurring **AND** the severity of the consequences of the occurrence. Risks are classified in the broad areas of implementation and mission risk.

- **Implementation risk** addresses cost, schedule, technical and/or programmatic threats.

- **Mission risk** addresses the mission success criteria.

- **Likelihood** is characterized by two major parameters – conditions and window of vulnerability.

- **Consequence** is characterized as either mission impact or implementation impact, and by the set of possible outcomes should the risk item occur.
Where do Risks Come From?

Experience indicates that risks are derived from several root causes:

• Unsettled definition of mission Level 1 requirements, priorities and full/minimum success criteria
• Incomplete understanding of the driving mission/system requirements, including the impact of mission time-critical activities
• Lack of sufficient margins (technical and programmatic)
• Unsubstantiated assumptions (which are usually optimistic)
• Incomplete identification of key risks and mitigation options
• Unsubstantiated optimism of the capabilities of the project team and/or its contractors/partners
• **Unknown Unknowns**
The Risk Iceberg
RISK TRADES, A BALANCING ACT
Approach

• To provide an independent Mission Assurance assessment of the Project Options for dealing with the approaching conditions/event.

• Review the Key areas/events to identify major risk Items: (such as)
  – Spacecraft safing history, especially during critical times
  – Maintaining redundant/backup capability
  – Swapping from a nominally performing subsystem
  – Flight Software changes
  – Hardware vulnerability
  – Schedule/resource impacts
  – First time in-flight event

• Recommend an option based on the risk drivers
UNDER COVER OF DARKNESS?
Major Risk Drivers for Entry Decision

- From an earth hazard avoidance, nighttime entry has the spacecraft targeted to the earth at E-13 days vs E-30 days for the daytime case.
- **Ground impact hazard assessment** shows a hazard track across 2 for the nighttime entry vs a longer hazard track across Canada and multiple states for the daytime entry.
- The nighttime entry conditions maintain more SRC design margin than the daytime.
- **Ground station coverage** provides dual site coverage for SRC release for the nighttime entry, but not for daytime entry
- **SRC processing time** would be less with a daytime entry for the anomalous hard landing case were the capsule is breached.
Minor Risk Drivers for Entry Decision

- **Backup orbit duration** for the nighttime entry is shorter by 2 years, and both enable a backup orbit with manageable Delta-V.
- **SRC release downlink data rate** is higher for nighttime entry than daytime entry - doable at either data rate.
- **STRATCOM Tracking** resources are more robust for the nighttime entry (visual, IR and radar) than for the daytime entry (radar only).
# Daytime Vs Nighttime Entry Options

<table>
<thead>
<tr>
<th>Risk Drivers and Rankings</th>
<th>Rank</th>
<th>Risk Trade Cases</th>
<th></th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Nighttime</td>
<td>Daytime</td>
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<tr>
<td></td>
<td></td>
<td>Human Safety</td>
<td>Mission Success</td>
</tr>
<tr>
<td>Earth Hazard Avoidance</td>
<td>Major</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Ground Impact Hazard Assessment</td>
<td>Major</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>SRC Design Margin</td>
<td>Major</td>
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<td>✓</td>
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<tr>
<td>Ground Station Coverage</td>
<td>Major</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>SRC Processing Time - Anomalous</td>
<td>Major</td>
<td>✓</td>
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<tr>
<td>Backup Orbit Duration</td>
<td>Minor</td>
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<tr>
<td>SRC Release Downlink Data Rate</td>
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✓: Lower Risk Option
CAN YOU HEAR ME NOW?
## TWTA Options

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<td>Minor</td>
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<td>Hardware vulnerability</td>
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<tr>
<td>Schedule/Resource Impacts</td>
<td>Major</td>
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<td>In-flight First Time Event</td>
<td>Minor</td>
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✓: Lower Risk Option
Major Risk Drivers for Instrument Turn-on Decision

- **High voltage arcing** within the instrument could result in an under-voltage trip since the spacecraft is only single fault tolerant with the instrument on.

- **Dendrite growth within the capacitors** of the instrument and any appreciable time spent with a power bus rail shorted-to-chassis condition will result in the bus voltages becoming further imbalanced.

- **RTG-3 case voltage drifts** (existing soft short) leading to an uncorrectable power load that consumes wattage that could otherwise be utilized by the instrument and engineering loads.

- **Power System complexity** combined with aging effects raises the possibility of losing RTG-3 causing a deep under voltage which would cause a power-on-reset placing the spacecraft in extended sun search with propellant being expelled for up to 45 min.
**Instrument Turn-on Options**

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Thanks

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