Safety & Reliability Assessment of Side-Mount Crew Option

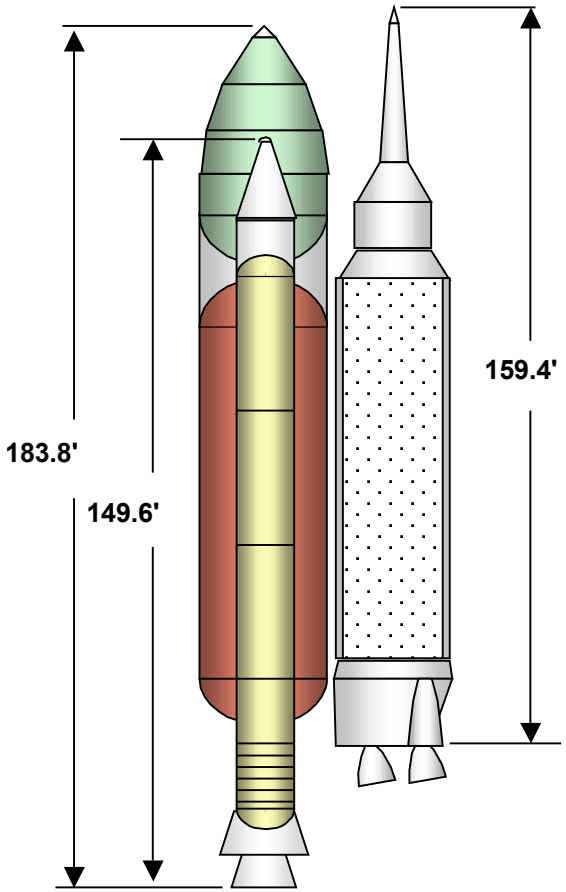
Gaspare Maggio & Tony Hall

Information Systems Laboratories

Technology Risk Management Operation

May 28, 2009

Vehicle Configuration & Performance Assumptions



Boost Stage	
Engine	2 x RSRB
Burn Time (s)	124
Booster Type	4 segment
Propellant Type	PBAN
Sea-Level Thrust (lbf - ea)	3,139,106
Sea-Level Isp (s)	268.8
Main Stage	
Engine	3 x SSME Blk II
Burn Time (s)	510
Propellant Mass (lbm)	1,588,636
Percent Off-Loaded	0%
Percent Residual	2%
Powerlevel (%)	104.5%
Sea-Level Thrust (lbf per engine)	375,181
Sea-Level Isp (s)	365.2
Vacuum Thrust (lbf per engine)	469,449
Vacuum Isp (s)	452.1

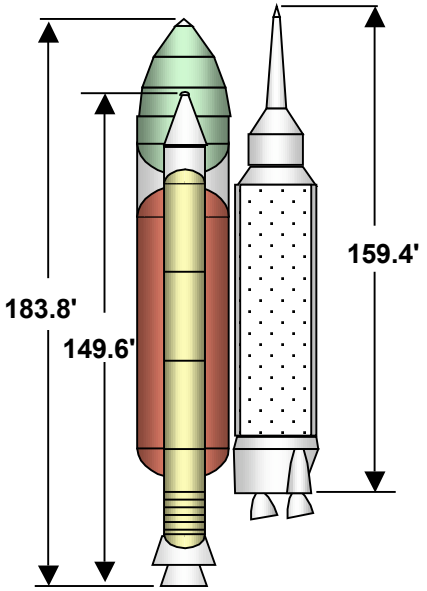
Safety & Reliability Assessment Ground Rules & Assumptions

- **Scope of assessment is from lift-off (T+0) to MECO**
- **Reliability Assessment**
  - No margin assumed for integration/development issues given similarity to current Space Shuttle configuration
- **Safety Assessment**
  - LAS jettison occurs 30 seconds after booster MECO
  - Orion is assumed to have a blast overpressure tolerance of 1440 psf
  - Launch Abort System (LAS) is assumed to be designed to abort with an acceleration of 10 Gs and burning for 2 seconds
  - There is about a 40% mean likelihood of an uncontained failure of an RSRB propagating to the ET
  - There is a 75% mean likelihood of an uncontained failure of an SSME propagating to the ET
  - The g's that the crew is exposed to during a nominal ascent trajectory is not considered in the safety assessment of the configuration s for modeling simplification purposes

Loss of Mission Results

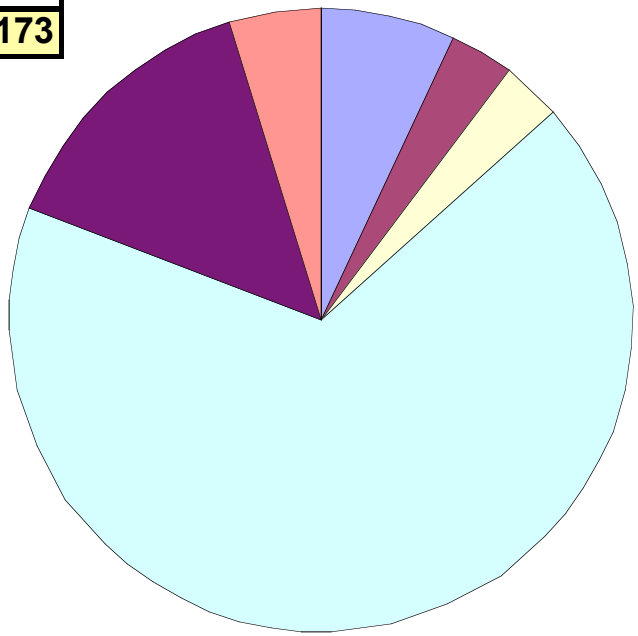
RSRB Boosters	
Contained Failure (Booster)	1 in 2,463
Uncontained Failure (Booster)	1 in 5,293
Separation (Booster)	1 in 5,587
Total	1 in 1,292
SSME Mainstage	
Contained Failure (Mainstage)	1 in 257
Uncontained Failure (Mainstage)	1 in 1,193
Other (Mainstage)	1 in 3,627
Total	1 in 200
Vehicle Total	**1 in 173**

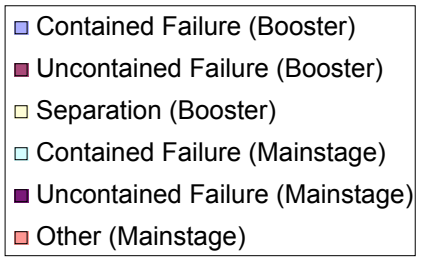
Strap-On	2 x RSRB
Core	3 x SSME Blk II
Tankage	Shuttle-Type External Tank



"Other" categories include:

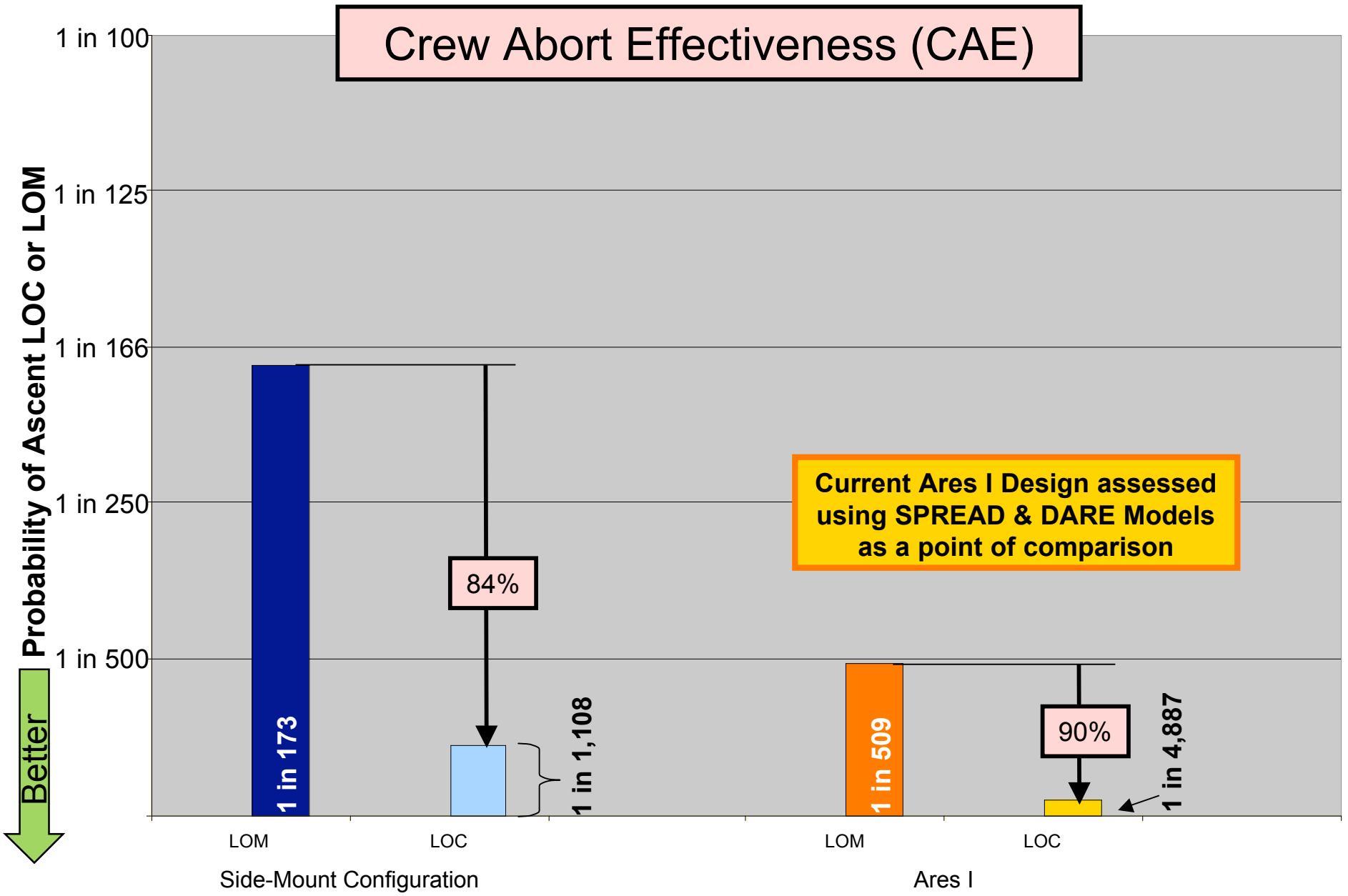
MPS, APU, TVC, TCS, Separation





Launch Vehicle LOC and LOM Comparison During Ascent

All results generated by using SPREAD and DARE Models



Ares I Reasons for Higher Reliability and Safety

Applicable to results generated using SPREAD and DARE models

Reliability

- **Smaller Vehicle**
  - The payload capability of the Ares I is approximately one-third that of the Side-Mount configuration. To achieve the higher payload capability, the Side-Mount vehicle must use more engines and more solid boosters, which drives overall reliability down.

Safety

In the event of an uncontained First Stage failure on Ares I:

- **More Favorable Vehicle Geometry**
  - The in-line configuration of the Ares I provides better initial separation distance between the Orion and the centers of the potential blast loads. The Side-Mount vehicle places the Orion laterally next to the external tank and SRBs, placing it closer to both blast loads.

Launch Vehicle LOC and LOM Comparison During Ascent

Side-Mount results generated by using SPREAD and DARE Models