

Eliminate All Pyro Devices

Space Propulsion Technology
Assessment Workshop

April 2001

Current Baseline

Eliminate All Pyro Devices

- This is both a subset and a superset of the Simplified Mating Operations technology
- The pyro devices are on critical (T-0) umbilicals as discussed in the Simplified Mating Operations briefing
- They are also used for the staging events
 - Solid motor ground hold-downs
 - Fore and aft external tank attachments
 - Fore and aft solid motor attachments
- Pyro has been used until recently on external tank to ensure tank break up during an accident for range safety
 - Range safety could easily require same on new vehicles

Potential Solutions

Eliminate All Pyro Devices

- Replace all umbilical and staging pyro devices with mechanical or electro/mechanical devices
 - Umbilicals - See Simplified Mating Operations
 - Staging
 - Design new T-o hold down system
 - Design new thrust augmentation separation system
 - Design new system for stage and/or element separations
- Design and show that vehicle and/or staged elements will break up in an accident

Technologies to Implement Solutions (TRLs)

Eliminate All Pyro Devices

- Umbilicals
 - Mechanical/electrical disconnect design (2/3)
 - Examples, springs or shape memory alloys, pneumatic collets (3)
 - Electromagnetic coupling (3/4)
 - Both the umbilical and the vehicle mating site designed together for load transfer
- Staging
 - T-0
 - Currently four bolts per SRB
 - 28 inches by 3-1/2 inches
 - Soft Release - Bolts that fail predictably have been used on Saturn (6)
 - Pivotal Clamp (3)
 - Ball Lock assembly (3)
 - Removable Pin (3)
 - EHAs (5)
 - Electro magnetic coupling (3)

Technologies to Implement Solutions (TRLs) (Cont'd)



Eliminate All Pyro Devices




- Staging (cont'd)
 - Thrust augmentation, staging, and other element separation
 - Nominally part of shut down sequence
 - Memory shape materials (3)
 - Ball Lock assemblies (3)
 - Removable pins (3)
 - EMAs, EHAs

Cost to Mature Technology

Eliminate All Pyro Devices

- There would probably be an added cost to the development program for an unmanned test flight if the program did not already have such a flight

\$100K	
\$500K	
\$1M	
\$5M	
\$10M	
\$30M	
\$50M	
\$100M	
\$500M	

6 Mo	
1 Yr	
18 Mo	
2 Yr	
3 Yr	
4 Yr	
5 Yr	
5 Yr+	