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Panel Session IV - Protecting the General Public from Launch Hazards

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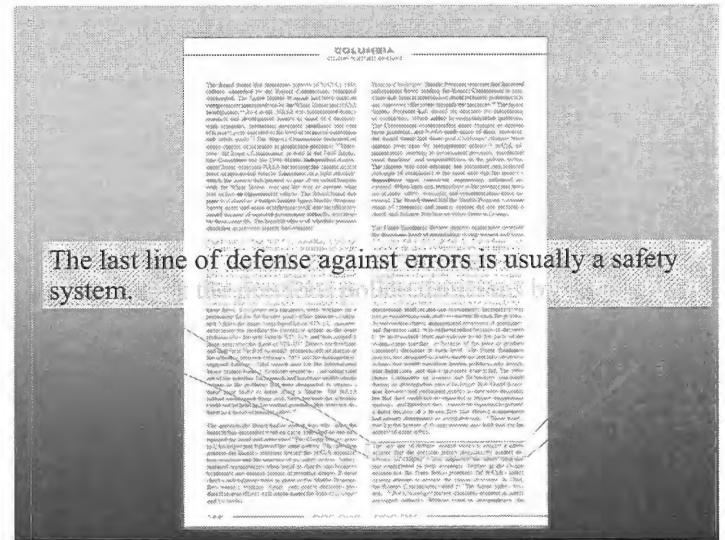
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**Protecting the General Public
From Launch Hazards
is Very Challenging/Expensive
for Many Users**

**Should the Government or an
Industry Group
Ease the Pain?**

45SW/SE
Peter Taddie



Overview

- Flight Termination System – Why?
- Cost Drivers
- ROM Costs for Typical FTS
- Notional Options
- Conclusions
- Recommendation

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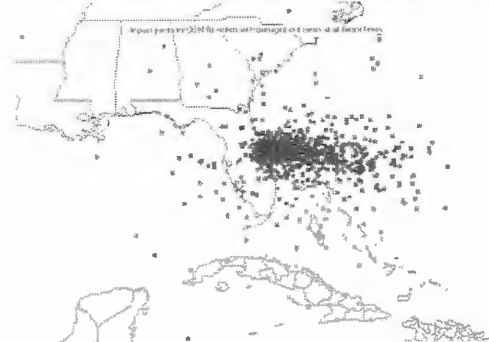


Flight Termination System

WHY?

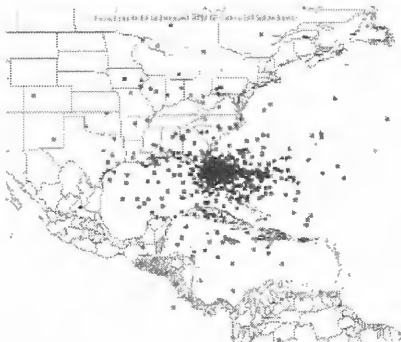
**Random Impact Locations - Free Flying GEM60s
with a Damaged Nozzle Bell**

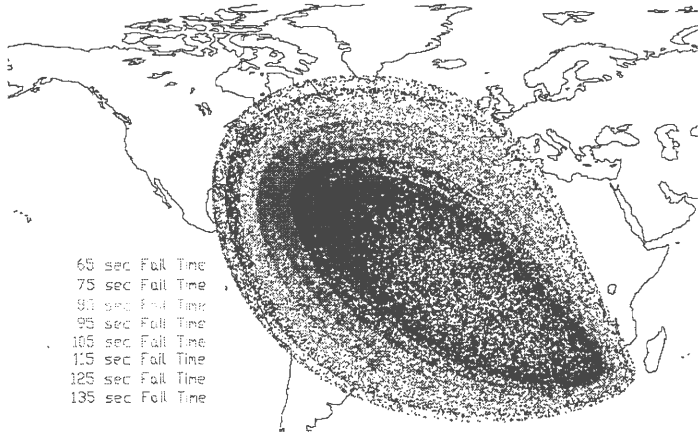
- The potential impact range of GEM60s with a damaged nozzle bell from avionics failures is smaller than for undamaged GEM60s but is still very large
 - 2500 impact points (1000 for each GEM60) are plotted for each of the 22 failure initiation times



**Random (Monte Carlo) Impact Locations -
Undamaged Free Flying GEM60s**

- The potential impact range of the undamaged GEM60s from avionics failures is very large
 - 2000 impact points (1000 for each GEM60) are plotted for each of the 22 failure initiation times





FTS Cost

Cost Drivers



- Flight Termination System **must** function reliably when vehicle is breaking-up
 - Single Fault Tolerant
 - Highly reliable piece parts
 - Extensive development, qualification and acceptance testing

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Typical Launch Vehicle Flight Termination System Costs (ROM)
 Note: Does not include FTS Needs Analysis, system design, integration, or vehicle testing

| Component | Quantity (Typical) | Recurring Cost Per Unit Including ATP | Development and Qualification Testing <small>Note 1</small> | Delta Qualification Testing <small>Note 2</small> | Margin/Gap Testing | Lot Acceptance Testing <small>Note 3</small> | Age Surveillance Testing <small>Note 4</small> |
|---------------------------|--------------------|---------------------------------------|--|--|--------------------|---|---|
| Antenna | 2 | \$10K - \$14K | TBD | TBD | NA | NA | NA |
| RF Coax Cable | AR | \$100 - \$200 | TBD | TBD | NA | NA | NA |
| RF Power Divider | 1 | \$5K - \$7K | TBD | TBD | NA | NA | NA |
| Secure Destruct Receiver | 2 | \$60K - \$100K | \$1M - \$3M | \$70K - \$100K | NA | NA | NA |
| Non-Secure Receiver | 2 | \$10K - \$100K | \$0.5M - \$3M | \$70K - \$100K | NA | NA | NA |
| Battery | 8 | \$8K - \$10K | \$0.5M - \$1M | \$70K - \$100K | NA | NA | NA |
| ADS Logic Box | 8 | \$40K - \$75K | \$1M - \$3M | \$70K - \$100K | NA | NA | NA |
| S+A with EED | 2 | \$10K - \$25K | \$250K - \$1M | \$70K - \$100K | \$250K | \$70K-\$100K | \$70K-\$100K |
| S+A Interrupter | 8 | \$10K - \$25K | \$250K - \$1M | \$70K - \$100K | NA | NA | NA |
| Lanyard Pull Initiator | 8 | \$2K - \$4K | \$250K - \$1M | \$70K - \$100K | \$250K | \$70K-\$100K | \$70K-\$100K |
| Explosive Transfer System | AR | \$0.5K - \$1K | \$250K - \$1M | \$70K - \$100K | \$250K | \$70K-\$100K | \$70K-\$100K |
| Shaped Charge | AR | \$2K - \$4K | \$250K - \$1M | \$70K - \$100K | \$250K | \$70K-\$100K | \$70K-\$100K |

Note 1: New Design Note 2: Existing Design - Heat Environment Note 3: Does Not Include Component Costs

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Options

Option 1

- Government or Industry Group contract with various manufacturing vendors to develop, qualify, and build a variety of unique, cutting-edge technology FTS components (e.g., space based, autonomous) IAW Government requirements
- User (DOD, NASA, Commercial) Responsibility
 - Design Flight Termination System IAW government requirements
 - If desired, purchase unique FTS components from government/industry group and perform delta qual/acceptance testing IAW government requirements
 - Develop, qualify, build, and test remaining FTS components as required, IAW government requirements
 - Perform FTS integration/testing on vehicle IAW government requirements

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Options (cont.)

Option 2

- Government or Industry Group contract with various manufacturing vendors to develop and qualify a variety of unique, cutting-edge technology FTS components (e.g., space based, autonomous) IAW Government requirements
- User Responsibility
 - Design Flight Termination System IAW government requirements
 - If desired, purchase unique FTS components from pre-qualified manufacturing vendors and perform delta qual/acceptance testing IAW government requirements
 - Develop, qualify, build, and test remaining FTS components as required, IAW government requirements
 - Perform FTS integration/testing on vehicle IAW government requirements

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Options (cont.)

Option 3

- Government or Industry Group purchases "rights" to qualification data for legacy FTS components and makes it available to all

Options 4 - 10

- Permutations and combinations of above options and others not yet offered

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Conclusions

- Significant cost reduction for users (while maintaining high FTS reliability) can only be accomplished by solutions that are very much out-of-the-box
- Concept is radical and has risks for all involved (Gov't/Users)
 - Safety
 - Political
 - Contractual
 - Technical
 - Legal
 - Mission Assurance
- Cost/Benefit for each player is unknown at this time



Recommendation

- Government (federal or state) should fund a feasibility assessment with following objectives:
 - Survey all ranges and range users (DoD, NASA, Commercial) and determine level of interest in government or industry group developing, qualifying, and possibly fabricating high end FTS components
 - If level of interest is high enough perform cost/benefit analysis for all reasonable/rational options and all users