ORBITAL ATK

LAUNCH VEHICLE PROTECTION SYSTEM

Team D3

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PROJECT DESCRIPTION

- Orbital ATK is a worldwide leader in aerospace and defense technologies
- Space vehicles are launched primarily from coastal regions with limited to no protection from the environment
- The current protection standard is the application of tarps to critical areas on launch vehicles
- Delays result due to weather effects during final launch preparations
- Design a system to protect launch vehicles during processing from temperature increase from the sun and possible damage from rain/wind

DESIGN RESEARCH

Arctic Oven Tent

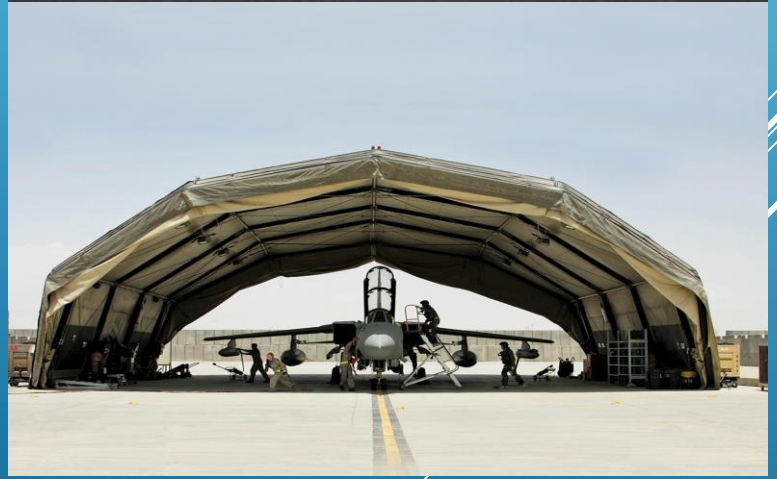
- Pros:
  - Vapex material
  - Limited permeability
  - Lightweight
  - Breathable material
- Cons:
  - Vulnerable to high winds
  - High price point

[1]

DESIGN RESEARCH

Rubb EFASS

- Pros
  - Covers a large surface area
  - Superior solar protection
  - Superior rain protection
  - Rigid Skeleton
  - Allows easy access
- Cons
  - 2-4 day assembly
  - Heavy structural columns



[2]

DESIGN RESEARCH

Losberger RDS

- Pros:
  - Rapid Deployment
  - Inexpensive
  - Enclosure temperature control
  - Maximum protection from sun
- Cons:
  - High Deformation
  - Heavy

[3]

CUSTOMER NEEDS

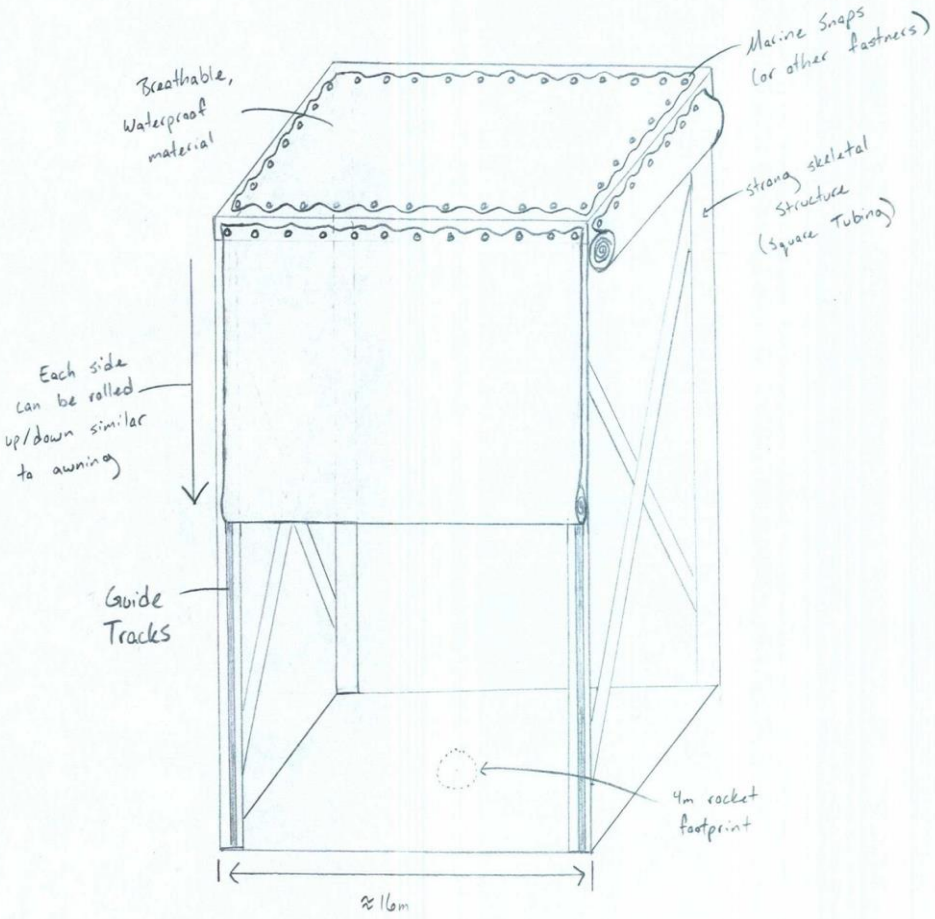
- Enclosure must perform in wind speeds up to 50 mph
- Enclosure can not come in contact with launch vehicle
- Enclosure prevents transmission of water to the launch vehicle
- Launch vehicle temperature must be maintained within specified range (Solar Protection)
- Enclosure must be reuseable
- Safety of Orbital ATK employees and launch vehicles are top priority

ENGINEERING REQUIREMENTS

- Bearing Stress
- Tensile Strength of material
- Enclosure Deflection
- Permeability
- Heat Flux through enclosure material
- UV Degradation
- Usage Quantities
- Factors of Safety in Design

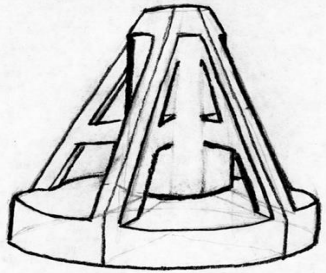
DESIGNS CONSIDERED

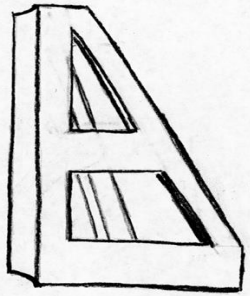
- Pros:
  - Strong, yet cheap
  - Simple geometry for ease of construction
  - Adjustable sides allow for easy access
- Cons:
  - Not fully sealed
  - Possibility for mechanical failure
  - Top heavy when all sides are rolled up
  - Top does not allow for water run off

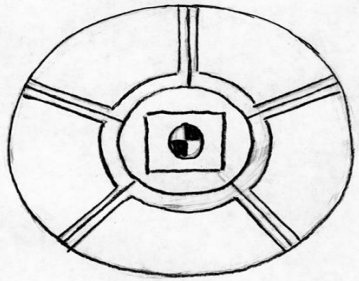


DESIGNS CONSIDERED

- Pros:
  - Geometrically stable
  - Simple deployment
  - Open-ended material selection
- Cons:
  - Lots of material
  - Exposed areas
  - Not fully sealed



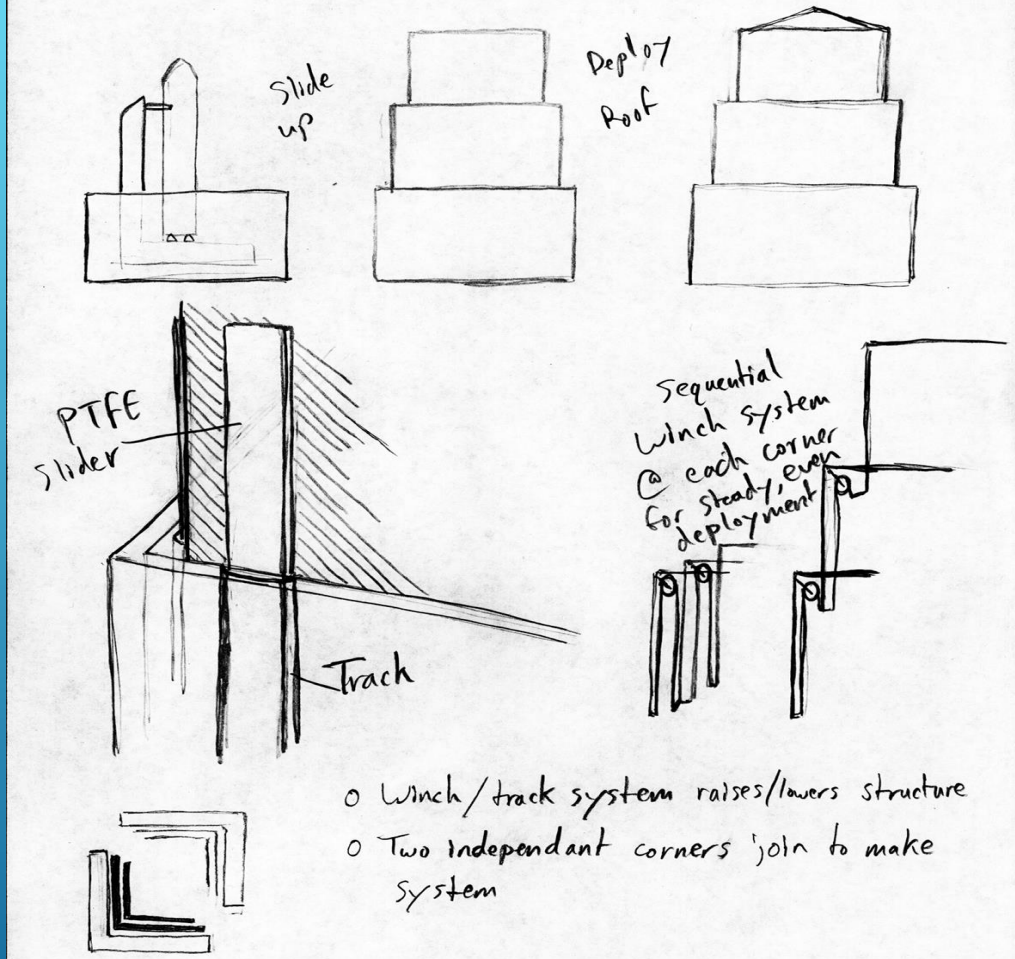




- Pieces fit together to form complete shell.
- Central tube protects L.V.
- Buttresses from top to edge of wide base for support.
- Cutouts in buttresses to allow air flow/minimize force from wind load.
- Made from rigid foam, plastic or inflatable

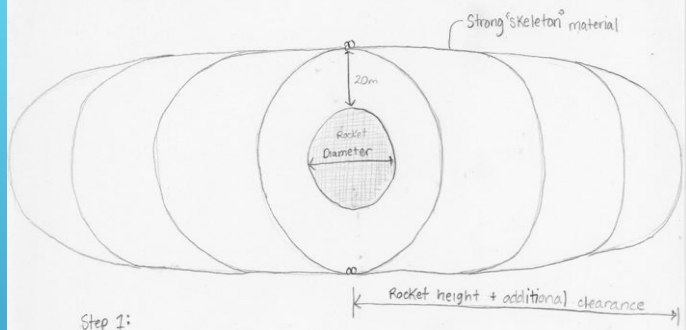
DESIGNS CONSIDERED

- Pros:
  - Roof
  - Adjustable final height
  - Compact storage
  - Easy assembly and disassembly
- Cons:
  - Mechanically complicated
  - Not sealed
  - Possible mechanical failure
  - Component wear

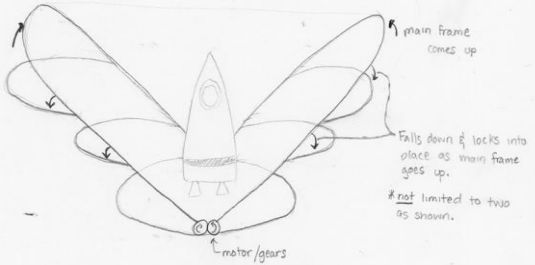


DESIGNS CONSIDERED

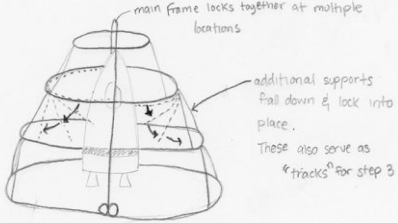
- Pros:
  - Lightweight
  - Low cost
  - Easy to assemble
- Cons:
  - Mechanically complicated
  - Potential mechanical failure



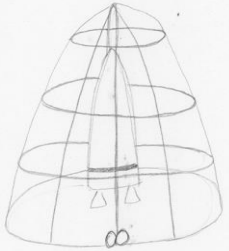
Step 1:



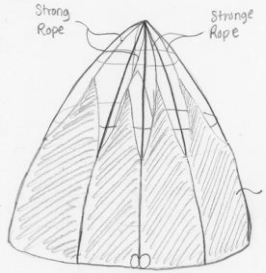
Step 2:



Completed step 2:

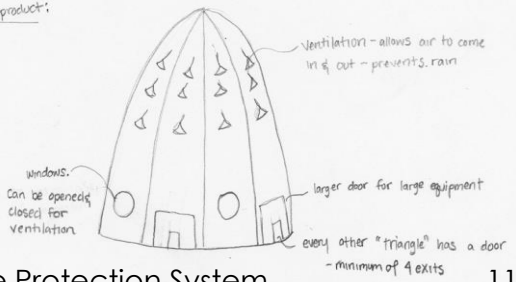


Step 3:



* weather proof material is roped up tracks to enclose the launch vehicle

Finished product:



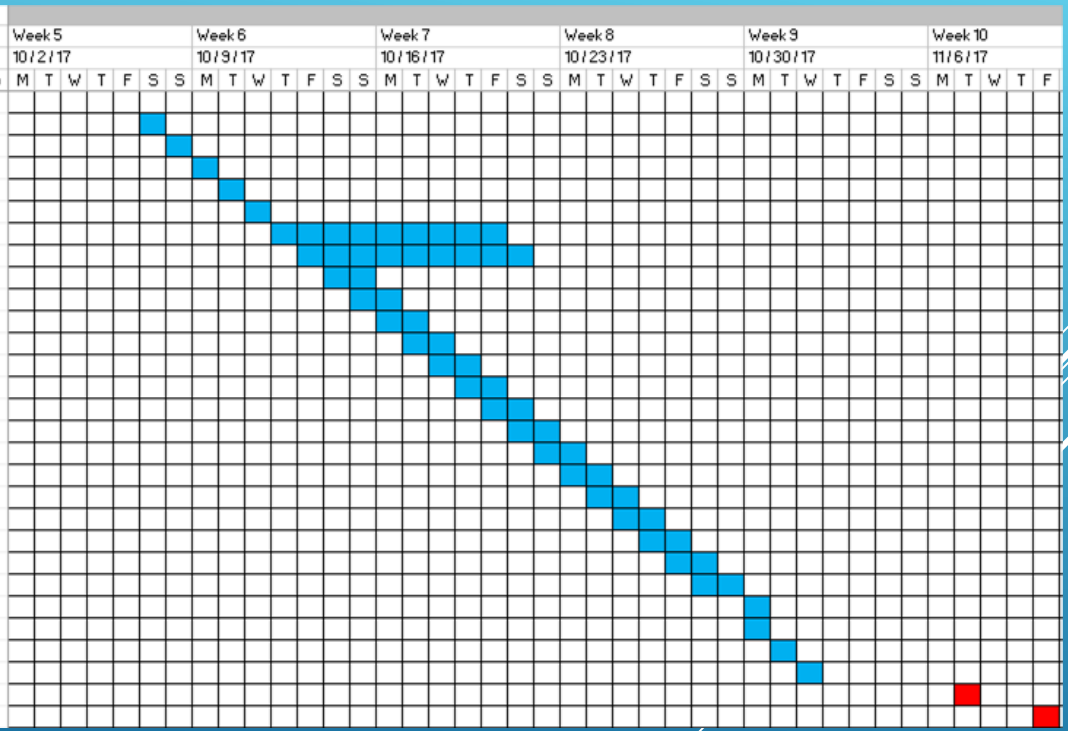
BUDGET

- Further budget implications will be determined as the project continues.

Current Budget Allocation	
Transportation	$300
Prototyping	$3,700
Testing	$1,000
Total	$5,000

SCHEDULE

			Project Start Date:	9/5/2017 (Tuesday)		
			Display Week:	1		
	Task	Lead	cessor	Start	End	Don
3	**Phase Two – Final**					
3.01	Introduction Write Up			Sat 10/07/17	Sat 10/07/17	0%
3.02	Project Description			Sun 10/08/17	Sun 10/08/17	0%
3.03	Original System Write Up*			Mon 10/09/17	Mon 10/09/17	0%
3.04	Requirements Write Up			Tue 10/10/17	Tue 10/10/17	0%
3.05	Engineering Requirements Write Up			Wed 10/11/17	Wed 10/11/17	0%
3.06	Testing Procedures			Thu 10/12/17	Fri 10/20/17	0%
3.07	Testing Procedures Write Up			Fri 10/13/17	Sat 10/21/17	0%
3.08	House of Quality Write Up			Sat 10/14/17	Sun 10/15/17	0%
3.09	Existing Designs Write Up			Sun 10/15/17	Mon 10/16/17	0%
3.10	Design Research Write Up			Mon 10/16/17	Tue 10/17/17	0%
3.11	System Level Write Up			Tue 10/17/17	Wed 10/18/17	0%
3.12	Existing Design I Write Up			Wed 10/18/17	Thu 10/19/17	0%
3.13	Existing Design II Write Up			Thu 10/19/17	Fri 10/20/17	0%
3.14	Existing Design III Write Up			Fri 10/20/17	Sat 10/21/17	0%
3.15	Functional Decomposition Write Up			Sat 10/21/17	Sun 10/22/17	0%
3.16	Black Box Model Write Up			Sun 10/22/17	Mon 10/23/17	0%
3.17	Functional Model Write Up			Mon 10/23/17	Tue 10/24/17	0%
3.18	Subsystem Level Write Up			Tue 10/24/17	Wed 10/25/17	0%
3.19	Subsystem I Write Up			Wed 10/25/17	Thu 10/26/17	0%
3.20	Subsystem II Write Up			Thu 10/26/17	Fri 10/27/17	0%
3.21	Subsystem III Write Up			Fri 10/27/17	Sat 10/28/17	0%
3.22	Designs Considered Write Up			Sat 10/28/17	Sun 10/29/17	0%
3.33	Design Selected Write Up			Mon 10/30/17	Mon 10/30/17	0%
3.34	Up			Mon 10/30/17	Mon 10/30/17	0%
3.35	Design Description Write Up			Tue 10/31/17	Tue 10/31/17	0%
3.36	Proposed Design Write Up			Wed 11/01/17	Wed 11/01/17	0%
3.37	Final Proposal Presentation			Tue 11/07/17	Tue 11/07/17	0%
3.38	Final Proposal Submittal			Fri 11/10/17	Fri 11/10/17	0%



REFERENCES

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[2] (2014, Oct). CAE Aviation [Online]. Available: http://www.rubbuk.com/projects/aviation/cae-aviation.htm

[3] (2017). Large-Span TMM Inflatable Shelter [Online]. Available: http://www.losberger.com/us/en_US/products/rapid-deployment-systems-us/inflatable-shelters/large-span-tmm-inflatable-shelters/