GUIDELINES AND SUGGESTIONS FOR BALLOON GONDOLA DESIGN

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HUGO FRANCO
DESIGN REQUIREMENTS

● STRUCTURAL INTEGRITY
  ➢ Primarily to survive termination event
    ➢ Safety
    ➢ Mission assurance
  ➢ Has been sufficient for landing – Although not a CSBF requirement

● LAUNCHABILITY
  ➢ Important to prevent damage
  ➢ Allows for less than ideal launch conditions

● STAGING/PICKUP
  ➢ Must be able to fit inside existing high bays
  ➢ Allows for hoist pickup and roll out to launch vehicle

● RECOVERY
  ➢ Some existing recovery limitations – Particularly Antarctica
  ➢ Crucial to stay within limitations for critical components
**STRUCTURAL REQUIREMENTS**

- **10G Vertical – 5 G Side Load**
  - Based on ultimate load of the material (not yield)
  - Intended to prevent freefall of components

- **Rotator**
  - Critical Component
    - Single point failure
    - Watch for concentration factors

- **Suspension Lines (Where Applicable)**
  - Great historical data for steel cables
  - Have used synthetic systems before to save weight – Kevlar, Spectra
    - UV a concern, one time use perhaps

- **Structural Members**
  - Mostly made of Aluminum or other lite tough metals
  - Have flown Carbon Fiber/metal hybrids
    - Still learning to test and approve for certification
LAUNCHABILITY

● PAYLOAD MUST BE ABLE TO SURVIVE LAUNCH
  ➢ These are dynamic launches
    ➢ Damage to antennae, solar panels or other protruding objects
    ➢ Sensitive equipment can be damaged
    ➢ Latching mechanisms

● MINIMUM DESIRED DISTANCES FROM LAUNCH VEHICLE
  ➢ “20 degree rule” – Assures minimum desired clearance Launch Vehicle
  ➢ 6 ft. of ground clearance – Avoids contact with ground
  ➢ 5 ft. of clearance from front end of vehicle – Avoids contact with front end of vehicle during launch

● OTHER OBSERVATIONS
  ➢ Width/Length of payload – High MOI
  ➢ Wide sections near the boom (higher)
    ➢ Risk of contact with boom and damage
**STAGING/GONDOLA PICKUP**

- **FACILITIES LIMITATIONS**
  - Height/Width of payload
    - Allow for weighing the payload inside the building (Antarctica)
    - Allow for ease of roll in/and out of building

- **CART/WHEELS**
  - Allows people to work underneath
  - Ideally allows for ballast hoppers and solar panels to stay attached for roll out.
    - Huge time saver
  - Must be big enough for easy rollout
  - Must allow rotation of payload for vehicle pickup
**RECOVERY**

- **GONDOLA DISASSEMBLY**
  - Critical components to stay within a certain allowable size and weight
    - Limited by recovery vehicle
      - Helo
      - Twin Otter and Bassler (Antarctica)
      - Land Vehicles
  - Easy/Quick Disassembly
    - Allows for quicker recovery - Antarctica
    - Data vaults and other critical components accessible
      - Trade off between access and protection
COMMON PITFALLS AND RECOMMENDATIONS

- **WAITING TOO LONG TO CONTACT CSBF**
  - The sooner the better on gondola design
  - Pointing systems are critical and expensive components
    - The sooner we see the design the better
  - Placing CSBF equipment in appropriate location
    - Thermal considerations
    - Antenna placement

- **PROVIDING ANALYSIS FOR MAXIMUM WEIGHT**
  - Final weights are usually higher than predicted
    - Avoids rerunning the analysis if overweight

- **PROTECTIVE CAGE FOR SIP**

- **NO APPROPRIATE CASTERS/TIRES**
  - Hard to maneuver