

# A Small Company Approach to Space Mission Assurance

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# Who We Are

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- Small, woman-owned business with focus on high reliability electronics and aerospace systems
  - Major customers include large prime contractors, Government, small satellite manufactures, large electronics suppliers
  - Focus on higher reliability components and tailored reliability to meet mission requirements
  - Flexibility and experience with mission assurance levels ranging from commercial to high-reliability
  
- Incorporated in August, 2013
  - Positive growth since inception
  - Highly qualified staff – each individual has broad engineering skillset
  - Extensive internal investment in new product development
  
- Located in Reston, VA
  - Over 2000 square-feet of development and manufacture/test space
  - Expertise in power and analog design, digital design, firmware programming, mechanical and thermal design, design for manufacture and test.
  - Close relationships with large space avionics providers for flight hardware manufacturing and application of advanced manufacturing processes



# What is Mission Assurance?

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*“... application of proven scientific, engineering, quality, and program management principles toward the goal of achieving mission success.”*

- excerpt from [www.aerospace.org](http://www.aerospace.org), Mission Assurance

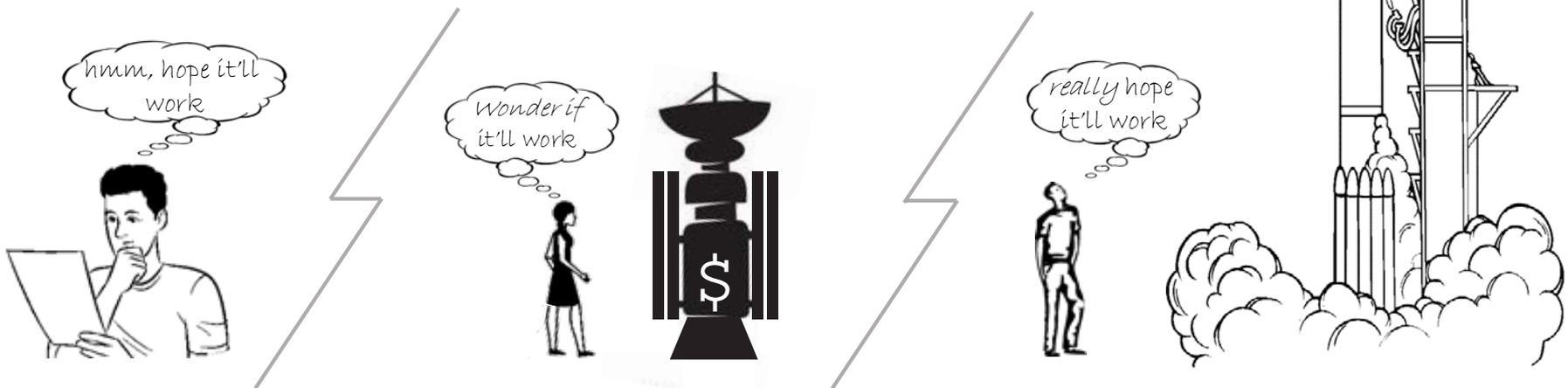
- Design / Architecture
- Part, Material, & Process
- Verification



# Why do we need Mission Assurance?

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- Launch/space environments have wide range of conditions
- Hard to fix things after launch
- Space stuff is expensive
- Hard to sell space hardware without it





# Mission Assurance Challenges

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- More Assurance = More \$\$\$
- How much assurance is enough?
  - Cost of failure vs. Value of success
  - Challenge of environment
- Mission Assurance needs to be mission specific
  - Environment – mechanical, thermal, radiation, EMI/EMC
  - Life – 3 month vs. 20 years
  - Value - \$50k Cubesat vs. \$1B rover



# Small Company vs. Large Company Mission Assurance

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## Large Company

- Proprietary internal processes and procedures
- Large number of specialists
- Internal subject matter experts
- Reliance on large number of company-wide policies and procedures

## Small Company

- Use industry/external standards
- Small number of generalists
- External subject matter experts
  - NASA
  - Consultants
  - Customer resources
  - Partners (eg. manufacturers)
- Reliance on few company-wide policies and procedures; individuals to follow industry best practices



# Hi-Rel vs. Commercial Mission Assurance Plan

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## Hi-Rel

- Customer typically flows subcontractor mission assurance plan
- Develop plan to meet requirements using external processes/procedures
  - IPC, NASA, DoD, ESA, or customer-supplied

## Commercial (Lo-Rel)

- No formal flowed mission assurance plan
  - Work with customer to understand mission risk tolerance and environment
- Generate baseline mission assurance approach using tailored processes/procedures
  - Often limited by project budget/schedule
  - Often start with same standards as Hi-rel, then reduce scope



# Hi-Rel vs. Commercial Mission Assurance Derived Requirements

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## Hi-Rel

- Flow mission assurance requirements into design derived requirements
  - Reliability (MTBF)
  - Redundancy
  - Failure modes

## Commercial (Lo-Rel)

- Fewer Mission Assurance derived requirements
  - Reliability (MTBF) is usually not quantitatively analyzed
  - Redundancy is usually not required
  - Failure modes usually only need to meet safety requirements (eg. battery)



# Hi-Rel vs. Commercial Mission Analysis

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## Hi-Rel

- Perform Analysis
  - Reliability
  - FMEA
  - WCA
  - EEE Stress
  - Solder Joint Reliability
  - Structural
  - Thermal analyses

## Commercial (Lo-Rel)

- Design with extra margin in nominal condition to reduce risk in worst-case conditions
- Perform abridged analysis on critical circuits
  - EEE Stress
  - WCA
- Thermal and mechanical performance verified by test
  - Standard practices and heuristics used to reduce risk



# Hi-Rel vs. Commercial Parts, Materials, Processes

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## Hi-Rel

- Parts, Materials, and Processes (PMP) Plan flowed by customer
- Develop approach to meet requirements
  - Select baseline families of parts (eg. JANS transistors, Class V, Mil 55342, CWR29, etc.)
  - Identify non-standard parts requiring additional screening
  - Generate SCDs for procuring non-standard parts

## Commercial (Lo-Rel)

- No flowed PMP Requirements
  - Cost/Schedule often major consideration
- Generate Part, Materials, Processes Plan
  - Identify required radiation level based on orbit, mission duration
  - Select SEE requirements (SEL, SEFI levels, etc.)
- Select baseline families of parts (eg. automotive grade passives, etc.)
- Utilize proprietary list of radiation tolerant commercial devices
  - Strategically select new devices for testing/evaluation



# Hi-Rel vs. Commercial Verification

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## Hi-Rel

- Develop Verification Plan
  - Customer may define verification methods for each requirement in contract documents
- Significant overlap between test and analysis
  - Analysis performed for BOL ambient, BOL temperature, and EOL conditions
  - Test used to validate analysis
- Environmental testing typically performed at box level

## Commercial (Lo-Rel)

- Develop Verification Plan
  - Methods generally not defined by contract
  - Cost/schedule are a significant factor in verification plan
- Less overlap between test/analysis
  - Favor testing – most representative of actual conditions
  - Analysis focused on things that are difficult to test or will change significantly over life
    - Eg. radiation effects/degradation
- Environmental testing may be qualification unit only or performed at spacecraft level
  - Less stringent overall requirements lessen schedule impact of late-flow surprises



# Summary

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- Overall mission assurance philosophy is similar between small and large companies
- Mission Assurance needs to be right-sized for the mission
- Cost-constrained missions need more creative application of traditional mission assurance guidelines to balance risk and cost
  - Large push for this in emerging LEO Smallsat markets
  - Seeing some GEO/Interplanetary missions with higher risk tolerance
- Small business approach needs to leverage industry standards and knowledge
  - Leverages industry-wide expertise
  - Reduces need for large number of internal subject matter experts

