ENSIGN BICKFORD AEROSPACE

N93-20140

LASER DIODE ORDNANCE DESIGN

for the

NASA AEROSPACE PYROTECHNIC SYSTEMS WORKSHOP

JUNE 9 & 10, 1992

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LASER DIODE ORDNANCE DESIGN

INTRODUCTION:

- Technologies are now available to optimize vehicle ordnance performance, weight, safety, reliability and cost

- Maximum benefits achieved only through comprehensive ordnance to vehicle integration - Technology vs Requirements

- Laser Diode Ordnance provides one solution to meet the requirements for multiple aerospace applications

LASER DIODE ORDNANCE DESIGN

CHARACTERISTICS:

- Simple Electronic Controls and Safing
  - Adapts to multiple control and sequencing options
  - Hardened to stringent environments
  - Can be miniaturized

- Low Voltage System
  - No high voltage components
  - Prompt timing

- Inert Fiber Optics
  - Safe from electrical interference
  - Low light power for reduced impact on connector interface

- Insensitive Initiators
  - Secondary explosives
  - Fiber interface for electrical safety

LASER DIODE ORDNANCE DESIGN

SYSTEM DESCRIPTION:

- Laser Firing Unit, Fiber Optic Cables and Initiators
  - Receives Command Control Signals and Power
  - Routing of Single or Multiple Fiber Cables
  - Explosive or Pyrotechnic Initiators

Issues:

- Centralized vs Distributed Design
  - Number of Firing Units and Optical Connectors
- System vs. Component requirements
  - System Reliability vs Component Margins
- Requirements Definition - Specification Intents
  - Barriers or Inhibits
  - BIT or Testability

LASER DIODE ORDNANCE DESIGN

LASER FIRING UNIT:

- Single or Multiple Laser Diode Outputs
  - Single Quantum Well Laser Diode, 850 nanometer wavelength
  - 2.5 watt output with 200 micron fiber
- Single Discrete Commands, 28 VDC power
- Single Fault Tolerant
- Independent and Verifiable Inhibits
- Weight and Volume, 1.5 lbs, 40 cubic inches for up to 6 outputs

Issues:

- Electrical and Mechanical Interface
- Laser Power
- Safing Design
- Built In-Test

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FIBER OPTIC CABLES:

- Hard Clad or Glass-on-Glass Fibers
  - Diameters range from 100 microns to 400 microns
  - MIL-C-38999 connectors
  - Bend Radius - 0.5 inch for 200 micron fiber
  - Proof test up to 500,000 psi

Issues:

- Cable and Connectors Requirements
- Connector Losses
  - Contamination Characterization

LASER DIODE ORDNANCE DESIGN

INITIATORS:

- Performance Duplicates Existing Devices (Detonators & Squibs)
  - Insensitive Explosives or Pyrotechnics
  - Hermetic (< 1 X 10^{-6} cc/sec He leak rate)
  - Fiber or Window Seal
  - Dichroic Coating

Issues

- Acceptable Explosive Materials
- No-Fire Levels
- Inadvertent Events and Levels
- BIT Level

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CONCLUSIONS:

- Launch vehicles, Satellites, Tactical Missiles, Strategic Missiles and Aircraft Ordnance Systems can be optimized for specific requirements

- Laser Diode Ordnance is a low risk solution for multiple applications

- Vehicle specifications for ordnance must be flexible to alternative technologies to achieve "Best Fit" design