Lightweight Multi-Role Missile
Integrated SAFU & Lethal Payload
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Lightweight multi-role missile:

- low cost/low mass/multi-purpose
- Precision strike/light platforms.
- Defeat of Land, Sea & Air targets
- Anti-FIAC (Fast Inshore Attack Craft)

Family of weapons:

- Expansion into future variants
- Multiple Platforms
- UAV capable
**Fuzing System Challenge**

**Lightweight Multi-Role Missile**
- Requirement for a novel integrated SAFU
- For both warhead & second stage rocket motor

**Integrate the Lethal Payload**
- Warhead & SAU as a single unit
- Compact design - small space envelope
- Integrated safety & arming unit and second stage rocket motor ignition safety
- Combine the qualification - Reduce Development Time & Cost
**ISAU - Key functions**

**Energetic Interface to both rocket motor & warhead**
- Detonator and Through Bulkhead Igniter

**Prevents unintentional arming**
- Second stage Rocket Motor & Warhead

**Autonomous ignition of the second stage rocket motor**
- After achieving safe distance from the launch platform

**Arming the warhead**
- Missile has achieved warhead safe separation

**Initiate the warhead**
- Receipt of the trigger
Warhead & Rocket Motor

- **Safety and design issues**
  - Integration of the two different safety functions within the same physical package
  - Common safety environmental inputs
- **Benefits of integrated design**
  - Reduction of time and cost of qualification

Different safety standards

- **SAU – STANAG 4187 (Mil-Std-1316)**
  - Safety functionality should not be mixed
  - Shared safety environments
    - Power
    - First Motion (IOM)
    - Bore Rider
- **MISAU – STANAG 4368 (Mil-Std-1901A)**
  - Latest version closer to warhead safety standards
    - Shuttered primary energetics
    - In line firing levels greater than 500 Volts

Integration of both standards

- Ensure all safety requirements met
Integrated safety sequence

- **For autonomous weapon functions**
  - Second stage rocket motor and warhead

- **Safety 1**
  - Instant of move (IOM) + Arming power

- **Safety 2**
  - First stage rocket motor
    - Borerider (Set back, spin & tube exit)
  - Two independent electronic timers

**Second stage rocket motor fires**

- **Safety 3**
  - Second stage rocket motor
    - Accelerometer circuit (Acceleration + Time)
  - Two independent electronic timers

**Warhead armed**

- **Target Detection**
  - Impact trigger
  - Proximity trigger

**Warhead fires**
Initial ISAU Safety Functions

- Power supply on
- ISAU monitors the Instant of Movement (IOM) and Bore Rider (BR) validation circuits
- First Stage Rocket Motor Fires
- IOM circuit detects tape break and switches power on to timer and control circuitry.
- Circuitry detects BR closure
- Timers one and two triggered from BR
- Parallel Timers one and two complete sequence

Rocket Motor Functions

- Rocket Interface Circuit power is switched on
- Rocket Static Switch 1, 2 and Rocket Dynamic signal is switched on
- Rocket interface circuit fires igniter
- Second Stage Rocket Fires
Warhead Arming Functions

- Velocity Sensing Accelerometer Circuit acquires velocity within time window
- Parallel Timers one and two complete sequence
- Warhead Static Switch 1, 2 and Warhead Dynamic signal is switched on
- Warhead Charging Circuit power is switched on.
- HV Capacitor starts charging
- ISAU transits to Armed
- Trigger pulse initiates detonation
Independent parallel timers for the Rocket Firing circuit
- Different technology
- Triggered by Environmental inputs (IOM & BR)

Independent parallel timers for the Warhead Arming circuit
- Different technology
- Triggered by Environmental inputs (IOM & BR)

Physical implementation
- **Rocket Motor timers**
  - Physically separated
  - Implemented on separate boards
- **Warhead Arming timers**
  - Physically separated
  - Implemented on separate boards
Rocket Motor Inhibit function
- Prevent second stage rocket motor firing if Timer not elapsed.

Impact Detection function
- Prevents second stage rocket ignition if an impact is detected (e.g. the ground)

Min safe second stage rocket ignition distance
- Rocket Timers not to expire before minimum Safe Distance when the missile is travelling at lowest velocity.

Minimum safe arming distance
- Warhead Arming Timers, not to expire before missile has travelled beyond safe separation threshold
- Environment 3 - Missile Velocity verification from second stage rocket motor prior to expiry of Warhead Arming Timer.
- If the Velocity verification occurs after the timer expires then the Arming process shall be inhibited.
B Model Bore Rider Assembly

- Designed to meet STANAG 4187
  - No stored energy tending to arm
- Designed to use 3 available environments
  - Launch Shock
  - Roll rate
  - Tail pick-up - Cover plate removal
- Mechanical latch
  - Ensures contact if spin rate drops below threshold
- LS Dyna modelling
- Catapult testing performed
Low risk & low cost design development
Pull through from current product and research activities

- Integrated in single assembly
- Simplified “snap together” construction
- Easy to manufacture
Lethal Payload Assembly

- Rubber Ring
- Fragmentation body & canister
- ISAU PEC Assemblies
- Liner
- Trigger Interface
- Shaped Charge
- Stemming
- Detonator
- Bore rider
- Rocket motor interface
- Main charge
Lethal Payload System Modules

ISAU

Flexi Assembly
ISAU to GPU

SK14

Ignition Safety &
Arming Unit

Rubber fitting band

Warhead

Lethal Payload
Safety

- Compliance to STANAG 4187 & 4368

- Mixed functionality and safety environments
  - Work with the national safety board to address early
  - Good partitioning of functionality
    - Ignition circuits separated from Initiation circuit
  - Design now provisionally accepted by UK DOSG

One Stop Shop for Fuzing Systems
ADVANTAGES

- **Single integrated unit**
  - Simplified ESAU design for both warhead & rocket motor ignition
  - Reduced volume, easier to integrate/mount in weapon
  - Reduced complexity – greater reliability
    - Shared safety 1
    - Shared safety 2
    - Shared power supply

- **Single integrated development & qualification programme**
  - Reduced cost of management and common activities
  - Single qualification programme

- **Integrated lethal Payload**
  - Integrated approach of warhead and ISAU
  - Common qualification activities

**One Stop Shop for Fuzing Systems**
Further integration of the lethal package

- Lethal Package defined as Warhead/SAU/MISAU
  - Similar to Hard Target Fuze
  - Onboard sensor and trigger processing
    - Accelerometer, Processing and intelligent algorithms for Hard Target Fuze
    - Laser or RF detection with processing and algorithms for Prox Fuze

Integration of Safety Standards

- STANAGS 4187 (Mil-Std-1316) & 4368 (Mil-Std-1901A)
  - Create a single common standard for weapon energetics safety
LMM Trials Video

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