

# Military Weapon and Communication Systems

## Utilizing Rare Earth Technologies

### (By Function Performed)

*Rare Earth Industry and Technology Association©*

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<b>Military Function Performed</b>	<b>Examples of Systems or Platforms</b>	<b>Enabling Technology / Criticality</b>	<b>Next Best Technology Alternative</b>	<b>Consequences of Reverting to Next Best Technology</b>
Guidance / Control	Guided Missiles  Smart Bombs  Precision / Smart Munitions like Excalibur  Predator Unmanned Aircraft	Extremely small and powerful Rare Earth Permanent Magnet actuators	Electric Induction Actuator	Redesign of system to accommodate much larger actuator system
Propulsion	Advanced Combat Systems Vehicles  More Electric Aircraft	Small, powerful DC Brushless Electric Drive Motors that provide high torque at low speeds	Electric Induction Motors	Redesign of system to accommodate much larger and heavier induction motors and the accompanying sub systems

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	Electric Drives for the Navy	Increasingly important to the Military for Stealth and Fuel Economy		<p>Giving away of position to the enemy</p> <p>Waste of fuel</p> <p>Increased greenhouse gas emissions</p>
Fuel Savings	<p>Military Transport Vehicles (internal combustion engines and hybrids)</p> <p>Vehicles and heavy equipment of all kinds</p>	<p>DC Brushless Electric Assist Motors for steering, braking and cooling to take significant load off the primary drive train</p> <p>Integrated Starter Generators which allows the engine to shut down when idling and start again with instant torque saving fuel in the process</p>	<p>Conventional mechanical systems that draw down energy from the power train</p> <p>Conventional starters and generators</p>	<p>Waste of fuel</p> <p>Increased greenhouse gas emissions</p> <p>Waste of fuel</p> <p>Increased greenhouse gas emissions</p>

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Targeting / Range Finding	Lasers	Rare Earth doped YAG crystals	Previous generation targeting and range finding	Collateral damage  Wasted ammunition
Advanced Displays	Avionics  LCD, CRT, PDP	RE Phosphors	Non-RE phosphors	Limited color capabilities  Analog readouts  Black and White displays
Advanced Lighting	Linear & compact fluorescent lamps	RE Phosphors	Non-RE phosphors based fluorescent lamps  Incandescent lamps  White LEDs	Lower color rendition  Energy consumption more than doubles  LEDs – higher cost

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Communications	<p>Fiber Optics</p> <p>Traveling Wave Tubes (TWT)</p> <p>Lasers</p>	<p>Improved Photonics with trivalent Rare Earth doped materials</p> <p>Improvements in amplification and signal gain</p> <p>Microwave amplification in satellite communications</p> <p>Line-of-sight communications links</p>	Previous generation technologies	<p>Inferior (slower) communications capabilities</p> <p>Less bandwidth and slower data transfer</p>
Surveillance / Counter-Surveillance	<p>Sonar</p> <p>Night Vision Goggles</p>	<p>Terfenol – D (Tb) used to generate acoustic waves</p> <p>Improvements in amplification, signal gain and energy resolution</p> <p>RE permanent magnets</p>	Previous generation technologies	<p>Inferior intelligence</p> <p>Giving away of position to the enemy</p>

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	<p>Radar</p> <p>Electronic Counter Measures (ECM)</p>	<p>within the Radar's TWT to focus microwave energy. YIG and YGG used in phase shifters, tuners, and filters</p> <p>Radar jamming devices such as the Tail Warning Function system which uses Y, Gd and Sm</p>		
Nuclear Threat Detection	Advanced Scintillation Detector for Gamma Rays	Lanthanum bromide crystals improve energy resolution / specificity, shorter decay times, fast response and high light output	Sodium Iodide crystal detector	Greater incidence of false positives
Soldier Health & Triage	Medical Imaging Devices	Scintillators for Computed Tomography (CT) and Positron Imaging Tomography (PET)	Non-RE scintillators	<p>Lower image quality</p> <p>Higher radiation dose</p>

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Energy Storage	<p>Nickel Metal Hydride Batteries</p> <p>RE doped ceramic capacitors</p>	<p>Commercially proven technology</p> <p>High energy density for directed energy weapons</p>	<p>Li Ion Batteries</p> <p>Inferior capacitors</p>	<p>Still under development</p> <p>System redesign</p>
Superalloys and Other Specialty Metal Alloys	<p>Thermal Barrier Coatings (TBC's) for Jet Engines</p> <p>Magnesium Castings Alloys</p> <p>Superalloys (Haynes, Brightray, Incotherm, Udimet, etc.)</p> <p>High Strength Steels</p>	<p>Y stabilized Zr</p> <p>Mischmetal</p> <p>La, Y / Mischmetal</p> <p>Various from Mischmetal</p>	<p>Non-TBC based engine design</p> <p>Inferior alloys</p>	<p>Lower efficiency engines</p> <p>Weapon system redesign and possible failure</p>