

The Rim Electric Drive - Internal Submarine

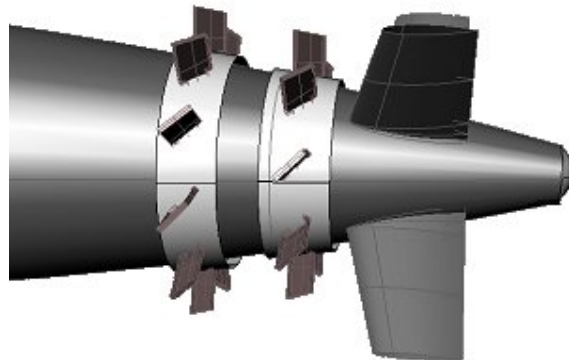
LCDR Dave Kuhn, USN, LCDR Joe Torrez, USN, LT William Fallier, USN

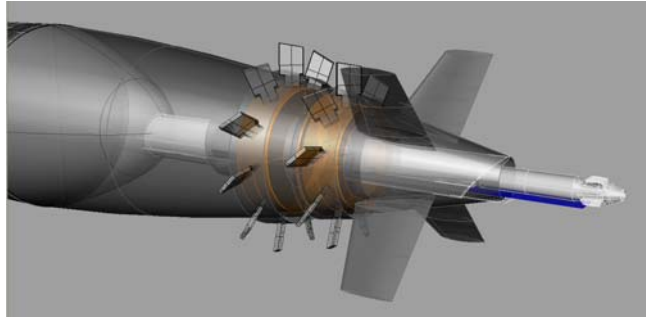


The Rim Electric Drive - Internal (RED-I) submarine will introduce a revolutionary shaftless propulsor on an integrated electric drive “Benchmark” submarine in order to further an ongoing NAVSEA concept study. The goal of the RED-I is to reduce the propulsion system weight and volume while maintaining similar or superior performance. Ultimately, these benefits are used to improve performance, design flexibility and the unmanned underwater vehicle (UUV) interface. The RED-I submarine will preserve the capability to reliably perform its missions unsupported, in far forward areas, for sustained periods of time with a high probability of survival.

The basis for this conversion project was to take a shafted electric drive integrated power system (IPS) benchmark submarine and forward fit a shaftless RED-I propulsor. The objective of the design analysis was to compare the two submarines in terms of cost, speed, and payload. Particular attention was given to weight and general arrangements to determine if the new propulsor provides greater flexibility in design and operation of the submarine. In addition, a basic technology risk assessment was conducted to determine the feasibility and risk in developing this new technology and implementing it in the fleet.

The RED-I motor uses a wet gap permanent magnet motor to turn a ring of propeller blades. Two RED-I motors are mounted in free flood areas in the submarine mud tank, forward of the stern planes. The permanent magnet motor employed is large enough to permit a four feet diameter UUV to internally pass through the RED-I propulsor system in order to deploy from the stern of the submarine.





RED-I Characteristics			
	Weight (LTON)	Surface Draft	29.75
W1	2926.80		
W2+W3	1041.53	KG	16.83
W4	807.21	KM _{envsurf}	18.00
W5	488.67	KM _{nsc}	18.00
W6	452.47	GM _t	1.20
W7	194.74	Trim	-8.76
Condition A-1:	5911.42	KB	18.67
Lead:	1370.54	VCG _{A1}	17.61
Condition A:	7281.96	VCG _{NSC}	16.75
VLI:	418.46	BG _s	1.06
V. Ballast:	89.67		
VL	607.62	Lead	Weight (LTON)
NSC:	7790.09	- Stability Lead	360.91
MBT:	977.51	- Margin Lead	1009.63
Subm Disp:	8767.60	Total Lead	1370.54
Free Floods:	506.35		
Envelope:	9273.95	Installed SHP	25000.00
Reserve Buoyance	0.13	Installed kW	8000.00

Performance Comparison	Threshold (Benchmark)	Goal	RED-I
Max Sustained Speed (submerged) (kt)	25.00	>25	25.05 - 26.02*
Payload / Size			
- Stability Lead (LTON)	452.75	≤ 452.75	242.66
- Margin Lead (LTON)	740.79 (12.2%)	≥ 740.79	994.99 (16.8%)
- Free Flood / BT available (ft ³)	0	≥ 0	0.00
- Unallocated Pressure Hull (ft ³)	0	≥ 0	approx 10,000
Cost (Mdol, FY06)	\$2,677.50	≤ \$2,677.50	\$2,633.50

*The RED-I motor projections predict a final speed improvement of 0-1 knots over the Benchmark