Advanced Topside Lighting System

Project Update 1

May 2020



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PROBLEM(s) STATEMENT

- Corrosion: No. 1 maintenance problem.
- Lighting: Top 20 Maintenance Burden.
- Electrical Interference with topside Intelligence, Surveillance, and Reconnaissance (ISR) equipment.
- Weight, RCS, Size...
- Multiple control panels to operate topside lighting equipment.
- Different vessel configurations no "One size Fits All" solution .

SOLUTION

 Apply <u>commercially available</u> advanced lighting technologies to mitigate / eliminate issues with topside lighting and define the <u>optimal topside</u> <u>lighting system configuration</u> based on the type of vessel and the location of the lighting devices.

BENEFITS / ROI

- 1. Reduce TOC of topside lighting;
- 2. Provide a **topside lighting system blueprint** for multiple ships' classes;
- 3. Provide a flexible system configuration with **parts commonality and interchangeability**.



INTERIOR LIGHT ENGINE (ILLUMINATOR)

PROJECT TEAM

RSL Fiber Systems (Lead) Signal Mate NAVSEA 05Z33 Penn State ARL – EOC Austal USA HII - Ingalls Shipbuilding HII - Newport News Shipbuilding

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ADVANCED TOPSIDE LIGHTING SYSTEM NSRP PANEL PROJECT TASKS

- **Task 1:** Evaluate topside lights on multiple ships' classes.
- Task 2: Identify and "catalog" the issues based on the ship's class and installation location of the lights.
- Task 3: Define the optimal functional requirements for the specific lights.
- **Task 4:** Identify advanced lighting devices and technologies to provide the best solution to the requirements.
- **Task 5:** Identify how the advanced lighting technologies will comply to USCG 72 COLREGS and to DOD-HDBK-289(SH).
- **Task 6:** Define the requirements for the lights to be controlled by a variety of control systems using industry standard communication protocols.
- **Task 7:** Outline the blueprint for a lighting system utilizing advanced lighting technologies, adapted to multiple ships.
- **Task 8:** Estimate the costs, level of effort, and timelines to qualify the system and its components to the applicable MIL and COLREGS requirements for use on U.S. Naval vessels.

NSRP PANEL PROJECT DELIVERABLES

1.	Kick-Off / Project plan and schedule;	(2/6/2020)
2.	Report 1 with outline of issues with topside lighting;	(3/31/2020)
3.	Report 2 with functional requirements for lighting;	(6/30/2020)
4.	Report 3 with new lighting devices and technologies;	(8/31/2020)
5.	Final report with:	(12/18/2020)
	 Outline of a lighting system blueprint, adaptable to m 	ultiple ships' class

- Outline of a lighting system blueprint, adaptable to multiple ships' classes and to different control systems;

- Methods to verify compliance to COLREGS via intensity and chromaticity monitoring;

- Estimates for the cost, level of effort, and timelines required to qualify this advanced topside lighting system and its components.

TECHNOLOGY TRANSFER

- Briefing at the NSRP Electrical Panel meetings;
- Tabletop display at SNAME 2020 and NSRP Day at NAVSEA;
- White Paper submitted to present findings to date at ASNE TSS in Arlington, VA (August 5 6, 2020).

ADVANCED TOPSIDE LIGHTING SYSTEM Baseline Technology – Remote Source Lighting (RSL)



LIGHT ENGINE

- Remote Light Source (Illuminator) within ship's structure.
- Fiber optic cable carries light to the luminaires up to 900 ft (275 meters).
- Non-electric, non-metallic luminaires diffuse and/or shape the light as needed.
- + Proven technology in US Fleet since 2004
- No EMI, Reduced Maintenance, reduced lifetime cycle cost, Low RCS
- Long distances from illuminator to luminaires (275m / 900ft)
- MIL-SPEC Qualified/ 72 COLREGS Compliant
- High fiber cable cost
- LED: Poor fiber coupling efficiency
- Metal Halide: Short source life (2,000-4,000 hrs)
- High hardware cost when compared to legacy

LPD 17 Class

- Signaling and Nav lights
- 5 Systems per ship
- 13 Ships + 13 LPD 17 F II
- Metal Halide and LED illuminators



Italian FREMM

- Signaling and Nav Light
- 5 Systems per ship
- 10 ships
- LED illuminators



DDG 1000

- All Topside and Boatbay lighting
- 28 systems per ship
- 3 ships
- Metal halide illuminators



SOLUTION → **Visible Diode Lasers**

Laser Prototype System - Navigation Lights Luminaire

- High Brightness (W/mm²str) couple into 1F cable
- Small size
- 30,000+ hours life
- Red + Green + Blue = Infinite color options
- Extensive use for HD projection



✓ Lower system cost

- ✓ Commonality of parts
- \checkmark High reliability
- ✓ Commercially available



With 700 Lumens RGB Laser

	Luminous Intensity (Candela)		
Hz Angle (deg)	White (RGB)	Red	Green
-80	200.08	82.63	109.91
-40	171.44	68.95	93.90
-20	159.63	64.51	85.68
0	144.79	60.05	75.88
20	137.09	57.91	70.01
40	132.26	57.93	65.31
80	129.57	61.00	60.18

Masthead: 6 NM visibility, 94 Candela Sidelights, Task Lights: 3 NM visibility, 12 Candela

Note: Output is uneven due to misalignment of SMA connector into luminaire designed for larger 37F cable connector.

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ADVANCED TOPSIDE LIGHTING SYSTEM Baseline Technology – LED Navigation Lights



Photo Courtesy of LopoLight

- Masthead: 6 NM visibility
- Sidelights, Task, Stern: 3 NM visibility
- + UL-1104 / COLREGS Certified
- + IP 67 rating
- Proven technology used for commercial vessels and pleasure boats.
- Some LED luminaires monitor output intensity.
- Not MIL-spec qualified.
- Not all LED luminaires monitor intensity for COLREGS compliance, only monitor hours of operation.
- Still require electrical cables to luminaire.



Photos Courtesy of Signal Mate

TASK 1 FINDINGS

Common Issues

- 1. Corrosion major cause of lighting failure and high maintenance costs;
- 2. <u>Water egress</u> into enclosures causes premature failure of lighting devices;
- 3. <u>Grounding</u> is difficult and time consuming;
- 4. Many lighting fixtures are <u>heavy and difficult to install</u>/remove;
- 5. The <u>different failure modes</u> of incandescent and solid state light sources must be taken into consideration when making upgrades.

Other Issues

- 6. Damage of lights due to location.
- 7. Effect of EMI/RFI on LED lights.
- 8. De-Icing.
- 9. Legacy control panels incompatible with LED upgrades.





Photos Courtesy of Austal USA

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TASK 1 FINDINGS

Other Considerations

- Low radar cross section of interest for all ships' classes.
- Lights fully embedded in the ship's structure → protect from damage and provide low radar cross section.
- Reduction of topside weight and weight of light fixtures.
- Longest cable runs to the lighting devices: ~150 ft.
- Ideally, all signal and navigation lights would be controlled via integrated control panel(s) / control screen(s).





NEXT STEPS

Task 2 – Catalog issues based on lighting installation.

Task 3 – Define the optimal requirements.

Begin identification of optimal control panel(s) configuration.

Report 2 – Due June 30, 2020.

FOLLOW-ON

- Baseline for an NSRP Research Announcement or ONR ManTech to <u>adapt and qualify systems</u> to U.S. Navy vessels' requirements.
- Qualified systems will be suited for ITAR compliance and export to NATO navies.
- Systems will be suited for use in demanding industrial and marine applications (oil tankers, oil platforms, refineries, LNG facilities...)

Questions?

