Advanced Topside Lighting System

2020 ELECTRICAL PANEL PROJECT 2019-477-002

Project Review
2021 NSRP All Panel Meeting

March 23, 2021

Data Category B: GOVERNMENT PURPOSE RIGHTS
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ADVANCED TOPSIDE LIGHTING SYSTEM

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  ○ Cinema Laser Projectors - Adaptation to Lighting
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PROBLEM(s) STATEMENT

• Corrosion: #1 problem.
• High Maintenance.
• Large Size / Weight / RCS.
• EMI / RFI.
• Multiple control panels required.
• No “One size Fits All” solution.

SOLUTION

• Utilize Commercially available advanced solid-state based lighting systems.

BENEFITS / ROI

1. Extend reliable service lifetime.
2. Reduce TOC.
3. Small size/weight – Reduced RCS.
4. Blueprint for multiple ships’ classes.
5. Parts commonality and interchangeability.
ADVANCED TOPSIDE LIGHTING SYSTEM

TEAM:
RSL Fiber Systems | Signal Mate, PSU EOC, Austal, NNS, Ingalls, NAVSEA 05Z33

TASKS:
1. Identify, catalog and prioritize issues.
2. Define optimal requirements.
3. Identify and evaluate new lighting devices.
   ▪ Reliability.
   ▪ Compliance to 72 COLREGS.
   ▪ Control system requirements.
4. Define blueprint for optimal configuration.
5. Estimate costs and timelines for qualification of a complete system.
6. **Add-On:** Identify mature products using advanced lighting technologies and adapt them for ready implementation on naval combatants.
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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:
   - Lighting system blueprint;
   - Methods to verify compliance to COLREGS;
   - Estimates for ROI, qualification costs, and timelines.

TECHNOLOGY TRANSFER

• Briefing at the NSRP Electrical Panel meetings;
• Virtual presentations at SNAME 2020 and NSRP Day at NAVSEA.
• ManTech proposal planned for submission in 2021.
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KEY FINDINGS

1. Water gets into everything – especially when parts are opened for maintenance → reduce/eliminate maintenance. Hermetically seal topside equipment.

2. All metals corrode – even 316 stainless steel → Reduce use of metals topside.

3. All electrical parts exposed to the weather corrode → place electrical parts internal to the ship.

4. Smaller and lighter is better → ease of installation, low RCS, low topside weight.

5. Damage is inevitable → Ease of field repairs and modular constructions.

Other Issues / Concerns

6. Damage due to location.

7. Effect of EMI/RFI on LED lights.


9. NVIS Compatibility.

10. Legacy control panels incompatible with LED upgrades.
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SYSTEM OUTLINE

1) Solid state sources – LEDs and Laser Diodes:
   • High reliability.
   • Long life.
   • Mature technologies.

2) Laser based fiber optic remote source lighting:
   • Eliminate topside metallic parts.
   • Reduce size & weight.
   • Drastically reduce cost of the RSL technology.

3) LED Luminaires:
   • Accessible locations.
   • Self monitoring.

4) Lights controlled by:
   • Integrated bridge system for New Constructions.
   • Legacy control panels for In-Service upgrades.

<table>
<thead>
<tr>
<th>CHARACTERISTIC</th>
<th>2016</th>
<th>2020</th>
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<tbody>
<tr>
<td>LED Module Cost</td>
<td>100%</td>
<td>55.3%</td>
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<tr>
<td>LED Module Output</td>
<td>100%</td>
<td>250%</td>
</tr>
</tbody>
</table>
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COLREGS COMPLIANCE

CONSIDERATIONS

• Incandescent:
  - 100% intensity to 0 (failure).
  - Control panel detects open circuit.
• LED & Laser Diodes:
  - Slow decay in intensity to end of life.
  - Affected by drive current / environment / temperature.
  - May fall below COLREGS requirements before stated hours.
    o No open circuit to be detected by Control panel.

SOLUTION

• Monitor intensity.
• Trigger “Open” circuit if below COLREGS.
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LASER ILLUMINATION

Adapt RGB Laser modules from Digital Cinema Projectors:

• Mature, multi-source supply chain.
• Optimized for reliable, extended operating lifetimes.
  ▪ Over 50 Billion RGB laser device hours logged.
  ▪ 20 years device/10 years commercial system reliability data.
  ▪ Up to 50,000 hours (> 22 years - Navigation Lights).
• Designed for Human Visual System (HVS) perception.
• Active Safety systems developed.

Topside Lighting Applications:

• Modular, scalable with “common platform”.
  ▪ COLREGS Compliance:
    o Single Color
    o RGB controllable white (or any color).
    o Continuous monitoring → Intensity & Chromaticity.
  ▪ M85045 4 channel fiber cable (same construction / larger fiber sizes).
    o Supports RGB/NIR illumination, monitoring, de-icing and future applications.

30,000 lm Laser Cinema Projector
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SYSTEM ARCHITECTURE

CONSIDERATIONS

• Redundancy.
• Safety – Crew and Hardware.
• Ease of installation.
• Flexible / reconfigurable / upgradable.

SOLUTION

• Multiple, localized DC networks with redundant AC/DC power supplies.
• Compatible with LED and laser diode sources.
• UPS providing (TBD) hrs of back-up.
• < 30 VDC power distribution.
• Emergency laser shut off if system integrity compromised.
• RGB laser illuminators configurable to multiple lighting functions (masthead, sidelights, task...).
ADVANCED TOPSIDE LIGHTING SYSTEM

RETURN ON INVESTMENT
Expedited ROI, expedited qualification cycle, and lower costs by leveraging Laser Cinema systems.

NAVIGATION AND SIGNALING [16 LIGHTS]

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>ESTIMATED (FINAL REPORT)</th>
<th>REVISED (WITH CINEMA LASER)</th>
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<tbody>
<tr>
<td>ROI from Installation</td>
<td>≤ 3 Years</td>
<td>&lt; 3 Years</td>
</tr>
<tr>
<td>TOC Savings in 5 Years</td>
<td>25%</td>
<td>30%</td>
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<tr>
<td>Annual Savings: Full U.S. Fleet</td>
<td>~ $ 6.5 Million</td>
<td>~ $ 6.5 Million</td>
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<tr>
<td>Qualification Testing Cost</td>
<td>$ 1.1 Million</td>
<td>$ 700K - $ 800K</td>
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<tr>
<td>Qualification Testing Time</td>
<td>14 Months</td>
<td>≤ 12 Months</td>
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Questions?
Please Contact

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