HPS TO LED LIGHTING RETROFIT EXPERIENCE

I-70 from SR 267 to I-465
I-465 & I-70 Interchange
PROJECT BACKGROUND

• Original I-70 Fast Track project:
  • More than 600 luminaires on nearly 500 poles
  • Full-Cutoff luminaires
  • Type II, III, & IV distributions
  • Effective Mounting Heights (EMH’s) varying from 22’ to 40’
  • 250 Watt HPS Roadway luminaires
  • 150 Watt HPS Underpass luminaires

• Original I-465 West Leg project:
  • Twin luminaire poles on Median Barrier oriented parallel to direction of travel
  • Low EMH poles
  • 400 Watt HPS Roadway luminaires
PROJECT PURPOSE

- HPS to LED Retrofit
- Maintain INDOT Illuminance Design Criteria
  - Avg. Illuminance $\geq 0.8$ fc
  - Avg/Min. Uniformity Ratio $\leq 4.0:1$
- Minimize change to pole location(s), Mounting Heights (MH’s), and Mast Arm length
- Evaluate Luminaires from various manufacturers submitting for INDOT approval
PHOTOMETRIC MODELING

- Classification of Luminaire Types:
  - High mast – N/A for this project
  - High Lumen (400W HPS Equivalents)
  - Low Lumen (250W HPS Equivalents @ 40’ MH)
  - Low Lumen-Low MH (250W HPS Equivalents @ 25’-30’ MH’s)
  - Underpass
- Luminaires from INDOT “Approval Pending” list:
  - Classification Types 2, 3, & 4 applicable to the project
  - Modeled 4 manufacturers (Eaton, GE, American Electric, and Philips) for Classification Types 2, 3, & 4 with consistent 4000K CCT
  - Modeled 1 manufacturer (GE) for Underpass Classification Type
PHOTOMETRIC MODELING ALTERNATIVES

- Alternative 1 → Direct 1:1 replacement of HPS with Manufacturer recommended LED equivalent
- Alternative 2 → Direct 1:1 replacement + Reduction of poles
- Alternative 3 → Direct 1:1 replacement + “supplements” to achieve INDOT Illumination Design Criteria
- Alternative 4 → Equal Lumen package comparison
ALTERNATIVE 1 (DIRECT 1:1)

- Low Average Illuminance values (Typ. 0.5 fc – 0.7 fc) for majority of calculation zones for 3 of 4 manufacturers
- Low Minimum Illuminance values (0.0 fc or 0.1 fc) for numerous calculation zones
ALTERNATIVE 2 (DIRECT 1:1 & REDUCE POLES)

• Given that Alternative 1 did NOT produce satisfactory Illumination results... a reduction in the number of poles was not a viable possibility
• Alternative 2 dismissed
ALTERNATIVE 3 (DIRECT 1:1 + SUPPLEMENTS)

- Median Barrier Luminaires oriented parallel to direction of travel DID NOT WORK
  - Solution → Rotate poles/luminaires 90 degrees
- Proposed LED luminaires don’t have as much back light as Existing HPS luminaires
  - Solution → Add 2\textsuperscript{nd} luminaire & arm to Existing poles... converting them from Singles to Twins
- Gap in Illuminance coverage between original projects
  - Solution → Add new poles/luminaires
- Increase Lumen output for manufacturer luminaires as needed to achieve design criteria
ALTERNATIVE 4 (EQUAL LUMEN PACKAGE)

- **Basis:** Manufacturer that “most closely achieved the INDOT Design Criteria” based on Manufacturer recommended HPS equivalent
- **Research & Obtain manufacturer .ies files of approximate equal initial lumens**
- **400W & 250W HPS equivalent @ 40’ MH → approx. 27,000 initial lumens**
- **250W HPS equivalent @ 30’ MH → approx. 16,000 initial lumens**
RESULTS SUMMARY

- All Manufacturer recommended HPS equivalent luminaires under-performed
- Increasing Initial Lumens improved Avg. Illuminance performance
- Avg/Min. Uniformity Ratio a problem due to low Minimum values
- Need to analyze photometric modeling to assure criteria
- Still may be some deficiencies
- Some criteria relaxation may be the practical solution
- Provided INDOT with some basis for a large scale LED retrofit project
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Questions?

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