

Electrical Systems and Low Voltage Systems



- **Jim Beckmann**, Glendale River Hills School District
- **Dale Zabel**, Kettle Moraine School District



What is Integration



Defined by Webster: To coordinate or blend into a functioning whole.

- Combine systems into one backbone, work station and software package.
- Saves money in installation, manpower training and usage.
- Examples include: HVAC controls, keyless entry, security/door monitoring, video, and lighting controls.



Selecting an Integration Vendor



- Furnish and install one software package that will control all devices with one pair of network wires.
- Most integration contractors started in the HVAC controls industry. The contractor must be familiar with all equipment to include video, security, and lighting controls.
- Training and adjustment period after installation. Make part of the bid up front.
- Be comfortable with who you are using, will they be around for a long time.
- Licensing and user rights. \$\$\$\$



Building Equipment

Cameras and Video Support Devices



- Cameras
 - Degree of coverage
 - Night vision or low light capabilities
 - Ease of adjustability
 - Multiple cameras in one fixture
 - Functions (tilt pan zoom)
- Storage
 - Length of time (30,45,60 days)
 - Quality of replay
 - User friendly software



Building Systems

Door monitoring and access control



- Purpose of system = components
 - Monitor doors left open for a specific amount of time
 - Controlled access - card reader
 - External doors - windows
 - Internal doors for restricted area management
 - Fobs or ID cards or both
 - User friendly software
 - Complete building access management
 - Multi purpose ID badges for multiple systems



Building Systems

Communication Devices



- Voice and visual communication
 - PA Systems
 - External and Internal
 - Tied into phone system
 - Clocks / Bell system
 - Individual Devices
 - Digital vs. analog
 - Messaging capabilities
 - Combined system “Singlewire”



Building Systems

Life Safety Equipment and Devices

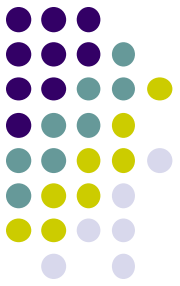


- Proprietary system or components?
 - Owners comfort level
 - Ability to modify system
 - Service contracts
 - Monitoring services
 - Bid out annual inspections
- Additional desired features
 - Ability to use for voice commands
 - Other emergency uses (lockdowns)



Building Systems

HVAC Controls and Software



- Function and capabilities
 - Number and type of units
 - Level of owner's technology abilities
 - User friendly
 - Software licensing and upgrade agreements \$\$\$
 - How many users in the organization
 - Web based and internal connections
 - Open based and the ability to connect to other devices
 - Vendor's reputation and resources to support when needed



Building Systems

Lighting Controls



- How much control?
 - Outdoor
 - Parking and drives
 - Exterior building
 - Playgrounds and other areas
 - Indoor
 - Classrooms
 - Gyms and large areas
 - Hallways
 - Offices
 - Auditorium /stage



Building Systems

Lighting Controls (continued)

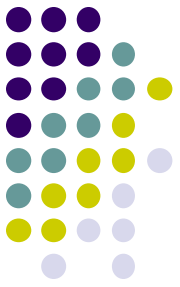


- System flexibility
 - Timers or light sensors
 - Motion detectors
 - Override capabilities
 - Groupings of areas
 - Light levels
 - Daylight harvesting
 - Wireless, Bluetooth
- User friendly software
 - Multiple user options
 - Programming options (simple preset settings)



Building Materials

Receptacles, Switches & Devices



- Residential, Specification, Commercial, Industrial, and Hospital grade.
- Difference between Specification, Commercial and Industrial grade equipment is marketing. Generally speaking: “You get what you pay for”.
- Most manufacturers offer high quality items and lower grade cost effective devices. Be wise!



Building Materials

Receptacles & Switches



- “School Grade” Receptacles
 - 20 AMP
 - One piece brass back strap
 - Back and side wire accepted, clamp type with screw
 - Accept #12 wire
 - High impact nylon face plate or stainless steel
- “School Grade” Switches
 - 20 AMP rated
 - “Heavy Duty”



Building Materials

Lighting



- Troffers
 - Depth of fixture
 - Lens thickness
 - Mechanical parts
 - Painting /coating
- Can Lighting
 - Heat dissipation
 - Lamp & lens options
- Emergency
 - Material
 - Battery
 - Self diagnostics
- Exterior Lighting
 - Finish
 - Optics
 - Construction
- Ballast / Driver
 - Manufacturer
 - Quality
- Lamps
 - Manufacturer
 - CRI



Building Materials

Lighting (continued)



- LED conversion options
 - Complete replacement fixtures
 - Bulb replacement kits
 - Internal component replacements
- One for one replacements
 - Measure light levels in areas
 - Dimming options
 - Change layout of fixtures
- Old lamps and fixtures
 - Disposal options
 - Sell on auction or internet site



[This Photo](#) by Unknown Author is licensed under [CC BY-SA](#)



Building Materials

Wire



- Aluminum vs. Copper
- When and where is it appropriate to use aluminum
 - Larger gauge required
 - Check local codes
- MC Cable vs. Conduit
 - Cable allows mobility in the ceiling
 - Installation costs (labor)
 - Local codes may require conduit



What Questions Have Been Asked



- Energy Cost to operate computers, motors, and lighting
- Lightning Protection - is it needed
- Emergency Generators
- Photovoltaic-power from the sun



Energy Costs



- **What does it cost to operate a computer**
 - Dell laptop operating = 32 w @ 10 hours
= 2.2 cents/day
 - Dell desk top, LCD monitor operating = 105 w @ 10 hours =
7.3 cents/day
 - Dell desk top 17" monitor operating = 186 w @ 10 hours = 13
cents/day
 - Apple Mac GS operating = 70 w @ 10 hours
= 4.9 cents/day



Energy Costs



- **What does it cost to leave a computer on overnight @ 7 cents KWH assuming 12 hours/day + 48 hours weekend**
 - Dell laptop sleep mode = 1.2 w @ 432 hrs = 3.6 cents/month
 - Dell desk top, LCD screen monitor sleep mode=71 w @ 432 hrs= \$2.14 cents/month
 - Dell desk top, LCD screen monitor stand by mode=7.7 w @ 432 hrs= 7.2 cents/month ---hibernate load dropped to 7.2 w
 - Dell desk top 17" monitor sleep mode = 120 watts @ 432 hrs = \$3.62/month
 - Dell desk top 17" monitor standby mode = 9.1 watts @ 432 hrs = 27cents/month
 - Apple Mac GS sleep = 3 watts = 9 cents / month



Energy Costs



- Motors and lighting
 - 1 Hp 1 phase cost/hour = .1344 cents/hour = \$3.22/day
 - 1 Hp 3 phase cost /hour = .1043 cents/hour = \$2.50/day
 - 5 Hp 3 phase cost /hour = .4332 cents/hour = \$10.39/day

 - 5 Hp 3 phase, 208 Volts 150' run 3% voltage drop = adds 20 cents cost per day (\$73.00 per year) to operate
go up a wire size (#8)save 6 cents/day = \$22.00 per year

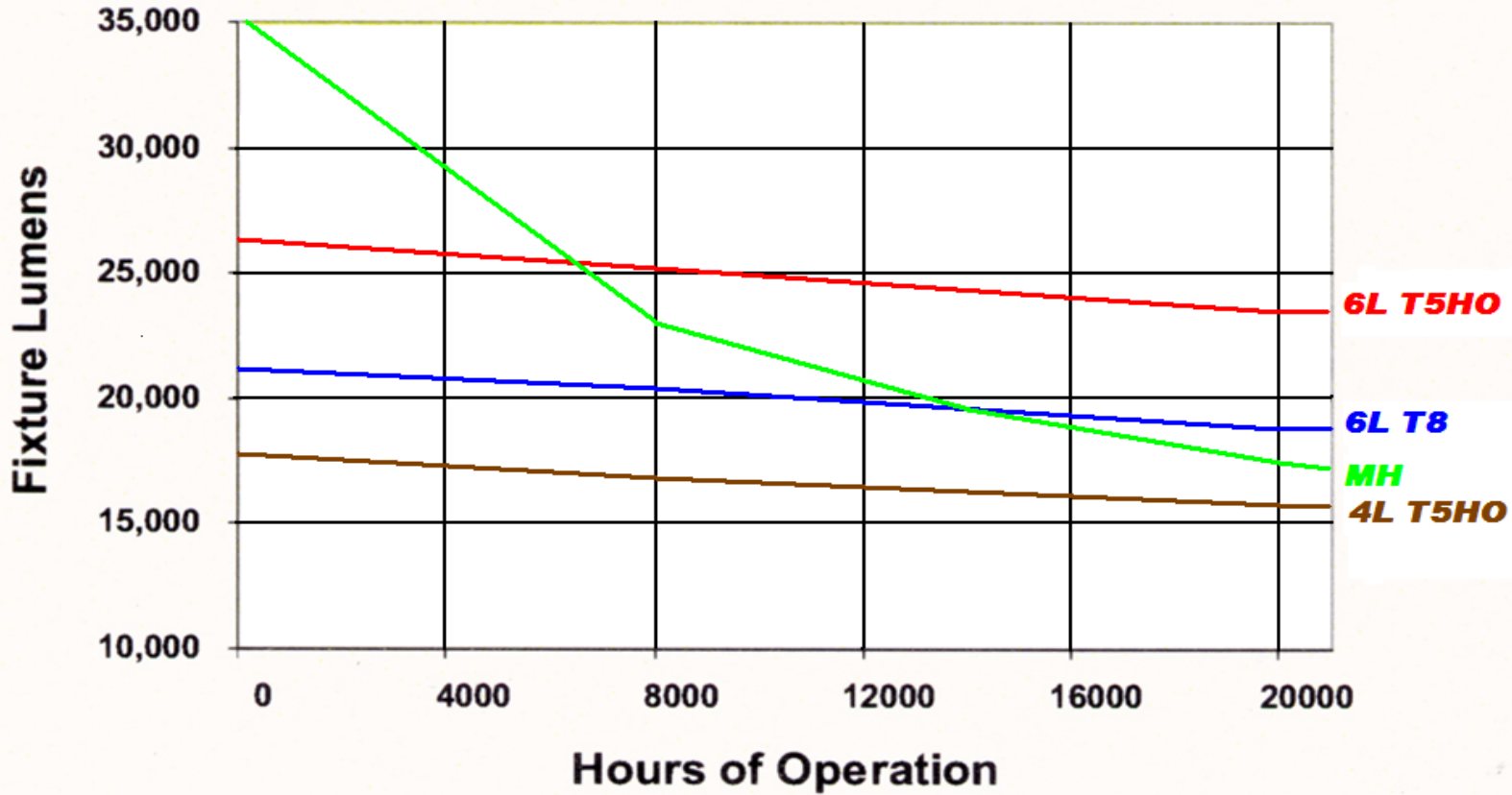
 - 5 Hp 3 phase, 480 Volts 150' run .37% voltage drop = adds 3.5 cents (\$12.77 per year) cost per day to operate

 - 2 lamp night light T-8 lamps elec. ballast = .43 cents/hour = \$0.10/day

 - Are night lights required?—no but EM lights are



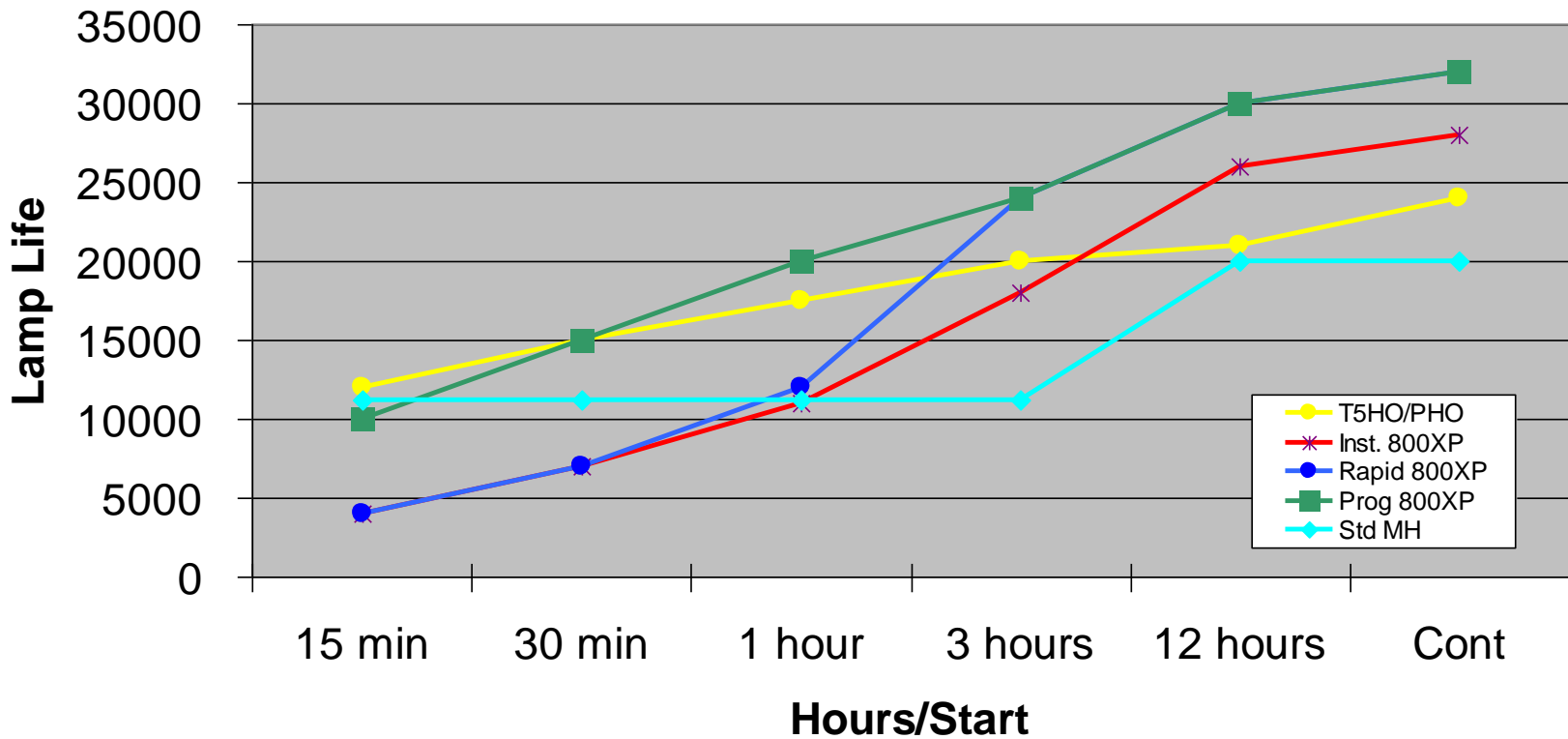
Light Output vs. Hours of Operation



Occupancy Sensor Control



T8, T5HO, MH Lamp Life



Emergency Generators



- IBC requires higher lighting levels in places of assembly and corridors than the old code.
- Adding non life safety load to life safety panelboards not allowed per code.
- Generator must be at least 20' from service transformer.
- Generator must be in a 2 hour rated room.
- Fuel type natural gas, diesel or gasoline.
- NEC 700 dictates requirements for testing and keeping records of testing-NFPA 110.
- If battery units are used in lieu of generator then testing every month required.



Lightning/Surge Suppression



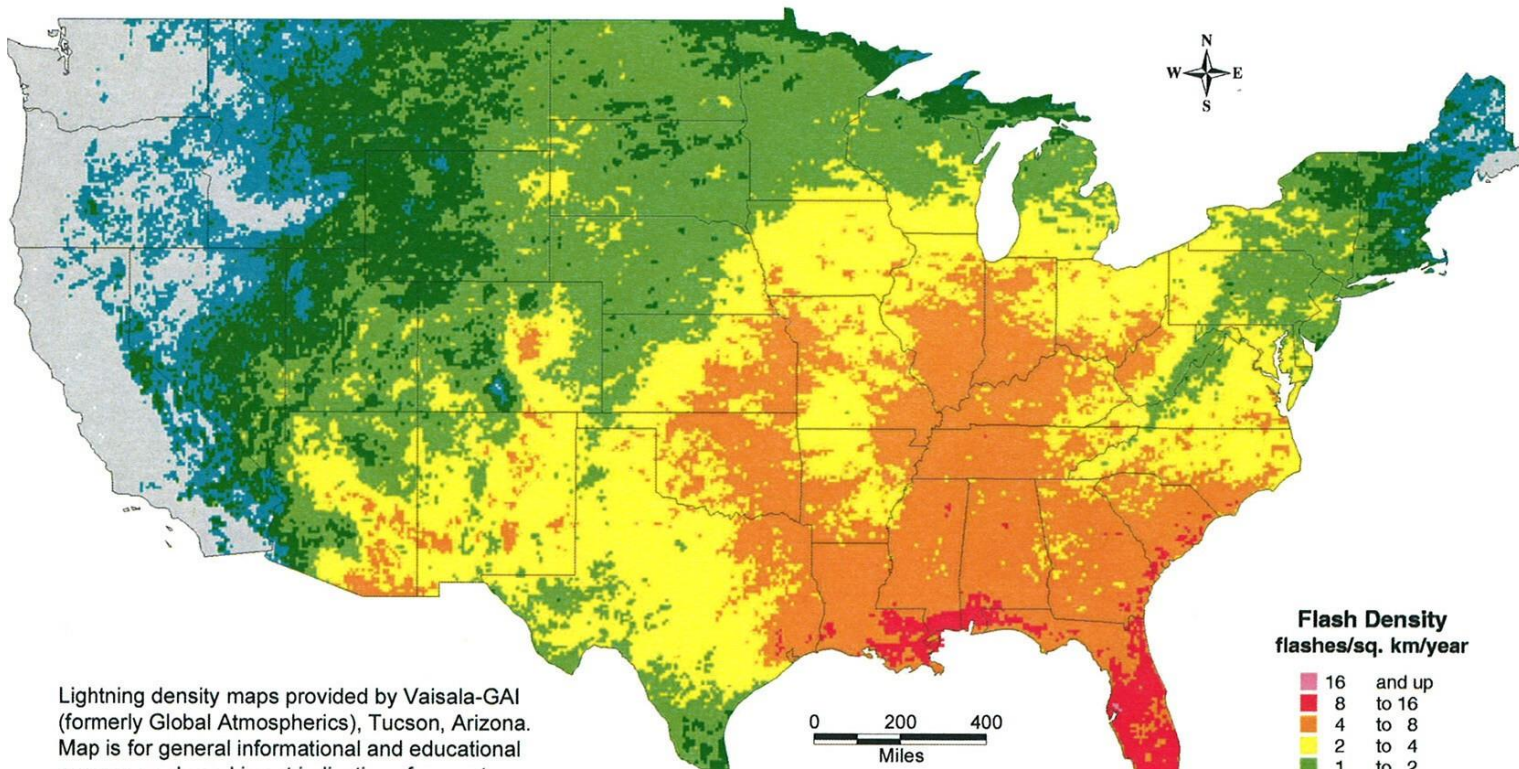
- Any structure of any material has the same probability of getting struck- metal is not more likely than wood.
- The probability of being struck increases based on height
- The basic principle of lightning protection is to provide a direct, easy path for the lightning bolt to enter or leave the earth without passing through a non-metallic or non-conducting part of the structure or other object.
- Building wide surge protection wired in at the main panel



Flash Density



5-year Flash Density Map — U.S.
(1996–2000)



Lightning density maps provided by Vaisala-GAI
(formerly Global Atmospheric), Tucson, Arizona.
Map is for general informational and educational



Photovoltaic



- Cost is going down
- One KW requires about 80 SF roof
- Focus on Energy
- WE Energies has increased the size of system you can install
- Roof mount versus ground installation
- Combining projects for maximum payback - LED lighting conversion and adding solar cells



Questions??

Thank You!

