clear-vu lighting

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The Safety Case for Low-Voltage Temporary Lighting

How 27.5VDC architecture reduces electrocution risk on active construction sites — and the code regime it replaces.

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FOR
CMs, GCs, ECs, safety officers, electrical foremen, PMs

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EXECUTIVE SUMMARY

Why low-voltage temporary lighting is overdue

In 2021, **75 construction workers were killed by electrocution** in the United States, a 38.9 percent year-over-year jump, with **67.6 percent of those construction electrocutions attributed to direct exposure to electricity** (CPWR Data Bulletin, March 2023). NIOSH reports **61 percent of all U.S. workplace electrocutions occur in construction** (NIOSH Science Bulletin, 2019). Temporary lighting is among the most-handled and most-bypassed electrical systems on any active job site.

The construction industry's persistent reliance on 120V and 277V temporary lighting puts workers in direct contact with line voltage in the wettest, most damaged, most physically abused environments on any job site. Stringer cables get cut by saws, crushed by lifts, submerged in standing water, and re-spliced with electrical tape — yet they carry enough current to kill a worker on contact. OSHA's **"Fatal Four"** lists electrocution alongside falls, struck-by, and caught-in/between as the leading causes of construction fatalities.

FLEX SLS 3.0 reclassifies the temporary lighting hazard profile by running the entire system at **27.5VDC** — well below the 50V shock-hazard threshold recognized by **OSHA 29 CFR 1910.333** and **NFPA 70E**, and within the **IEC 61140 Extra-Low Voltage (ELV)** classification. Body-impedance models in IEC TS 60479-1 show hand-to-hand current at potentials below 30VDC staying well below the ventricular fibrillation threshold — the same physiological basis underlying the OSHA and NFPA 70E 50-volt limit. There is no line voltage exposed anywhere between the supply and the fixture.

The downstream effects are substantial. NEC Article 590 GFCI requirements and OSHA 1926.405 guarding requirements either do not apply or apply trivially — there are no energized parts at a hazardous potential downstream of the supply. The system redeploys from project to project, amortizing capex across multiple builds. This whitepaper documents the safety, code, and operational case, drawing on OSHA, NEC, NFPA, UL, and IEC references and 18 years of field deployment.

27.5 VDC	**680** ft	**68** modules	**0** GFCIs
LOW-VOLTAGE DC BUS	RUN LENGTH PER SUPPLY	PER FPS550 SUPPLY	REQUIRED (NEC ART. 590)

What this paper covers

01	**The Problem**	Why 120V / 277V temporary lighting still defines jobsite electrical risk — and how the code regime layers protection without removing the hazard.
02	**The Reference Frame**	The 50V threshold in OSHA 1910.333 and NFPA 70E, and why operating below it changes the regulatory footprint of the system.
03	**The Solution**	FLEX SLS 3.0 architecture: FPS550 supply, 27.5VDC bus, twist-and-lock T-Connectors, and the FM2A / FM10A / FM30A module family.
04	**Compliance & Benefits**	Side-by-side comparison against line-voltage stringers, productivity gains, and a modeled labor-savings example.

01 · THE PROBLEM

Why temporary lighting has stayed dangerous

Temporary construction lighting is the last category of jobsite electrical infrastructure that still runs at full line voltage. While tools have moved to battery, signaling has moved to low-voltage DC, and communications have moved to PoE, lighting stringers still carry 120V or 277V — daisy-chained across active floors, draped through stairwells, and dropped into wet basements.

Where the hazards come from

- Mechanical damage from saws, drills, lifts, falling materials, and foot traffic
- Water exposure from concrete pours, leaks, and weather penetration on partial enclosures
- Field-spliced repairs using electrical tape rather than proper junction boxes
- Pinch points where stringers cross metal studs, conduit, and rebar
- Bypassed GFCI protection — devices reset, taped shut, or removed when nuisance trips disrupt work

The code response — and its limits

NEC Article 590 (Temporary Installations) requires GFCI protection on all 15A, 20A, and 30A 125V single-phase branch circuits used by personnel on construction sites. **OSHA 29 CFR 1926.405(a)(2)(ii)** adds requirements for guarding of lamps, weatherproof construction in wet locations, and protection of flexible cords from damage.

These requirements are necessary because the underlying voltage is lethal. They do not remove the hazard — they layer protection on top of it. In practice, GFCIs nuisance-trip under inductive loads and capacitive coupling from long stringer runs, prompting workers to bypass them. Guarded lampholders crack. Weatherproof boots tear. The hazard returns whenever the protection fails, and the protection fails routinely.

> **FIELD OBSERVATION**
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> In 18 years of jobsite walkthroughs, we have routinely found GFCIs taped, jumpered, or removed on active construction sites. The code regime fails wherever the protection fails — and the protection fails routinely.

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02 · THE REFERENCE FRAME

What "below the 50V threshold" means

Both **OSHA 29 CFR 1910.333(a)(2)** and **NFPA 70E** recognize **50 volts** as the threshold below which an exposed conductor is not considered a shock or arc-flash hazard. Below that threshold, lock-out / tag-out and shock-PPE requirements do not attach to live-part exposure, provided contact and arc-blast conditions remain limited. This 50V line is the same threshold that exempts doorbells, thermostats, security wiring, intercoms, and Power-over-Ethernet Cat-6 runs from the protective regime that governs line-voltage branch circuits.

FLEX SLS 3.0 operates the entire downstream bus at **27.5VDC** — roughly 45 percent of that 50V threshold. The fixtures, cables, and connectors a worker touches on the floor never carry a voltage that OSHA or NFPA 70E classify as a shock hazard. Line voltage is contained inside the listed FPS550 power supply enclosure; nothing downstream of that enclosure is at hazardous potential.

03 · THE SOLUTION

The FLEX SLS 3.0 architecture

FLEX SLS 3.0 is listed to UL 2108 (Low Voltage Lighting Systems). It is a centralized low-voltage DC lighting system: a single power supply converts site line voltage to 27.5VDC inside an enclosure; every cable, connector, and module downstream operates well below the 50V shock-hazard threshold defined by OSHA 1910.333 and NFPA 70E.

FM2A MODULE
27.5VDC, twist-and-lock T-Connector

System backbone

- **FPS550 power supply** — 550W at 27.5VDC, overload / over-voltage / over-temperature protected
- Up to **68 modules** across **680 feet** of low-voltage bus per supply
- **Twist-and-lock T-Connectors** — no splicing, no junction boxes, no conduit
- **Secondary surge suppression up to 3kV** built into the supply at the line-side input
- **Operating temperature −30°C to +50°C ambient** — safe near combustible materials, safe for incidental contact

Module family

Module	Wattage	Lumens	Application
FM2A	6 W	1,000 lm	Corridors, stairwells, finish work (10 ft spacing meets OSHA 5 fc)
FM10A	21 W	3,000 lm	Open floors, work zones, layout areas (20 ft spacing)
FM30A	50 W	6,000 lm	Excavation, structural, exterior staging (30 ft spacing)

DC arc-flash and fire-load considerations

Unlike AC, a DC arc does not self-extinguish at a zero-crossing. FLEX SLS 3.0 addresses this at the architecture level: the FPS550 supply provides **internal current limiting**, **overload / over-voltage / over-temperature protection** on the secondary side, and **3kV secondary surge suppression**. Twist-and-lock T-Connectors make and break under no-load conditions when modules are added or removed in sequence, eliminating hot-disconnect arcing in normal use. Combined with the 27.5VDC bus and current limiting, the system stays below the conditions required to sustain an open-air DC arc — a materially lower arc-flash and fire-load profile than a 120V or 277V stringer.

Why the topology matters on a real job site

The traditional alternative — line-voltage stringers — ties up an electrician every time fixtures are moved, plus GFCI testing on a daily cadence and lock-out / tag-out any time a circuit is de-energized for relocation. FLEX SLS 3.0 collapses all three of those touchpoints. The line-side install — mounting the FPS550 supply and tying it into the panel — remains a licensed-electrician job. Everything downstream is a low-voltage DC plug-together: T-Connectors twist on the same way as a weatherproof network connector, the bus stays live, and the work continues without re-permitting the move. Because modules are rated for repeated handling and redeployment across projects, the same fixtures travel from project to project — a capex profile closer to scaffolding than to consumable stringer cable.

04 · COMPLIANCE & BENEFITS

Operational benefits & compliance summary

Code & compliance snapshot

Requirement	Line-Voltage Stringers	FLEX SLS 3.0
NEC GFCI requirement (Art. 590)	Required on all 125V branch circuits	**Not applicable — bus is 27.5VDC, not a 125V branch circuit**
Lock-Out / Tag-Out for relocation	Required (OSHA 1910.147 / 1926.417)	**Not required — below 50V threshold (OSHA 1910.333)**
OSHA 1926.405 guarding & weatherproofing	Required; often bypassed in the field	**Inherently safe — no exposed line voltage**
OSHA Fatal Four — electrocution exposure	Direct exposure to 120V / 277V	**Materially reduced — 27.5VDC bus, below 50V threshold**
Electrician scope of work	Every fixture move requires a licensed electrician	**Licensed install at the supply; downstream is low-voltage DC**

Productivity gains

- **Modules reconfigure as low-voltage DC** — relocations no longer queue behind electrician availability for every fixture move
- **No daily GFCI testing routine, no lock-out / tag-out for moves** — fewer documentation entries, fewer nuisance shutdowns, faster relocations
- **Modules redeploy across projects** — capex amortizes across multiple builds instead of being consumed per job
- **Lower jobsite electrical load** — high-efficiency LEDs at 27.5VDC reduce branch-circuit draw versus equivalent stringer wattage

Modeled labor savings — illustrative example

Commercial electrician loaded rates in the U.S. run roughly **$75 to $150/hr** (Buildforce, U.S. commercial electrician rate survey). A planning model for a 40-story high-rise: **20 relocations/week × 1 hour/move × $110/hr × 50 weeks ≈ $110,000** of licensed-electrician time freed for higher-skill line-side work, with modules redeploying to the next project instead of being consumed as stringer cable. Illustrative, not a guarantee — actual savings depend on job size, move cadence, and local labor rates.

Bottom line

Battery tools and PoE jobsite systems crossed the low-voltage line years ago. Temporary construction lighting is the last major jobsite electrical system still run, by default, on line voltage — not because the hazard has been justified, but because no listed architecture replaced it. Running the work-area bus at 27.5VDC — below the 50V shock-hazard threshold recognized by OSHA 1910.333 and NFPA 70E — materially reduces the hazard, lifts the code burden that grew up around it, and returns the hours spent testing and re-permitting stringers. FLEX SLS 3.0 is the production implementation of that crossing.

Specifying temporary lighting? Our engineering team will scope FLEX SLS 3.0 and provide a fixed quote, drawing package, and AHJ submittal support. Contact **516-941-3737** · sales@clearvulighting.com.