

FAR-UVC PPE SAFETY MODULE

v1.9 — Open-Grid Ambient-Flow Specification

Solar-assisted | Starlink-connected | AI-supervised | Hardwired-safe | Rapid-deployment

This specification defines a highly practical, low-maintenance Far-UVC PPE decontamination system optimized for rapid deployment in austere outbreak environments. By embracing natural ambient cross-winds through fully open side flanks and using a modest mini-split AC unit for thermodynamic displacement, v1.9 achieves excellent performance with minimal mechanical complexity.

KEY DESIGN PRINCIPLES

- **Mechanical Simplicity:** Minimal moving parts. Open-flank architecture eliminates complex sealing, dampers, and pressurized zones.
- **Thermodynamic Efficiency:** A modest mini-split AC unit provides targeted cold air displacement rather than trying to condition an entire sealed volume.
- **Natural Cooling:** Lamps are mounted on an open steel mesh grid, allowing ambient cross-breezes to cool the fixtures naturally.
- **Hardwired Safety:** Lamp activation is controlled exclusively by photoelectric break-beam sensors and an industrial timer — completely independent of software.
- **Identified Accountability:** Full integration with xAI Grok and Starlink for real-time identified telemetry, coaching, and intervention capability.

STRUCTURAL DESIGN — OPEN-FLANK CONFIGURATION

The system uses a standard 12-foot or 20-foot ISO shipping container with the long side walls fully opened during operation. This allows massive natural cross-breezes to flow through the module, providing ventilation, lamp cooling, and ozone dilution at zero energy cost.

Inside, a freestanding open steel mesh or slotted strut grid is installed a few inches off the walls. The high-output 222 nm KrCl lamps are mounted on this grid so air can circulate freely around the fixtures, maintaining optimal operating temperatures without dedicated cooling loops.

CLIMATE & AIR MANAGEMENT — THERMODYNAMIC DISPLACEMENT

A compact, off-the-shelf mini-split AC unit (~\$600) is mounted on the ceiling above the center stance. It delivers a focused stream of cold air downward. Because cold air is dense, it sinks, absorbs heat from the lamps and worker, and is carried outward by natural cross-breezes through the open side flanks. This efficiently manages heat and trace ozone while providing immediate cooling relief to the clinician inside the protective suit.

HARDWIRED SAFETY LAYER — PHOTOELECTRIC OPTICAL VEIL

Lamp firing is governed by a simple, deterministic hardwired circuit:

- Dual industrial infrared photoelectric break-beam sensors (garage-door style) at shin and waist height.
- Both beams must be interrupted simultaneously.
- Entry and exit doors must be confirmed closed.
- A rugged solid-state industrial timer then executes the fixed 15–30 second exposure cycle.
- The entire permissive loop operates independently of any software or network connection.

INTELLIGENCE & ACCOUNTABILITY LAYER

xAI Grok Edge Supervisor: Local edge compute with rugged cameras performs worker identification, real-time voice coaching for starfish posture, PPE integrity screening, posture compliance scoring, and immediate local + remote alerting.

SpaceX Starlink: Integrated terminal streams fully identified operational data (worker identity, delivered dose, compliance score, system status) back to central command in real time.

v1.9 COMPONENT MATRIX

Layer	Component	Primary Function
Enclosure	12–20 ft ISO with Open Side Flanks	Natural cross-wind ventilation & rapid deployment
Lamp Grid	Open Steel Mesh / Slotted Strut Framework	Maximum natural convective cooling of lamps
Climate	Compact Mini-Split AC Unit (Ceiling Mounted)	Thermodynamic cold air displacement & worker relief
UV Array	High-Output Filtered 222 nm KrCl Lamps	Multi-angle photon cage for rapid surface decontamination

Safety Trigger	Dual Photoelectric Break-Beam Veil + Industrial Timer	Hardwired, frictionless permissive logic (software-independent)
Intelligence	xAI Grok Edge Node + Camera Array	Identification, real-time coaching, PPE screening, scoring
Communications	SpaceX Starlink Terminal	Identified real-time telemetry and safety alerts
Power	Tesla Powerwall 3 + Solar Array	Resilient off-grid power with automatic load management

Table 1: v1.9 component matrix — optimized for simplicity, reliability, and rapid field deployment.

v1.9 represents the optimal balance between performance and field practicality. By leveraging natural ventilation and targeted thermodynamic cooling instead of complex sealed systems, it delivers reliable far-UVC surface decontamination with minimal mechanical risk, low maintenance, and maximum speed to the front line.

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