Concept Proposal: Automated Lighting Truss Lift System

Objective

Safely raise and lower a 40-ft lighting truss (about 25 ft) to set height using two professional dual-speed chain motors, with redundant position feedback and independent mechanical load supports when parked.

1. Lifting System

* Two dual-speed, stage-rated chain hoists (professional rigging motors, e.g. CM Lodestar, GIS, Stagemaker).
* Rated capacity to cover the full load with safety factor.
* Each hoist has a spring-applied, electrically-released brake (primary holding device).
* Two fixed-length catch/parking chains that the bar rests on in the raised and lowered positions for passive support if a brake or hoist fails.

1. Position Feedback

* Two industrial encoder-based draw-wire sensors (absolute type preferred).
* One installed vertically on each side, measuring actual truss height.
* Resolution around 1 mm or better, linearity about 0.05–0.1% full scale.
* Feeds directly into the PLC as position feedback.
* PLC compares left/right encoder readings to detect skew and stop motion if mismatch exceeds threshold.

1. Controls and Safety

* Contactor arrangement:
  + KMAIN = master safety contactor, controlled by safety relay
  + KSLOW and KHIGH = interlocked pair for speed selection
  + KUP and KDN = interlocked pair for direction
  + KBRK = brake coil, sequenced to release before motion and set after stop
* Safety chain (hard-wired, not PLC dependent):
  + E-Stop switches
  + Ultimate top limit switch
  + Phase sequence/loss relay
  + Motor overload relays (one per hoist)
  + All NC contacts in series feeding KMAIN coil
* PLC functions:
  + Monitor normal top/bottom limits for permissives
  + Read draw-wire encoders for position and skew
  + Apply soft limits
  + Current monitoring (non-safety) for diagnostics, slack detection, trending
  + Manage brake coil timing and speed-change dead time
  + Operator interface via HMI (status, alarms, commands)

1. Safety Considerations

* Primary holding: internal brakes of the chain motors
* Secondary holding: fixed chains at end positions
* Redundancy: independent limit switches and E-Stops outside PLC logic
* Skew monitoring: PLC stops if encoder readings differ beyond allowed tolerance
* Load monitoring (optional): add load cells for extra overload/slack detection
* Maintenance: regular brake inspections, encoder cable checks, hoist servicing per manufacturer

1. Operator Interface

* Industrial touchscreen HMI (e.g. AutomationDirect CM5 series)
* Raise/lower commands, encoder position display, limit settings, alarm display
* Physical E-Stops wired to safety relay
* Manual reset button required after any fault trip

1. Open Items for PE Review

* Electrical engineer: confirm contactor wiring scheme, approve safety chain design, verify PLC I/O compatibility, confirm overload relay sizing.
* Mechanical engineer: confirm hoist sizing vs load and duty cycle, approve truss interface and catch chain design, review encoder mounting and cable routing, verify compliance with rigging standards.