MEP ENGINEERING SERVICES

The Buildings That Power Projects Depend On

Electrical-led mechanical, electrical and plumbing design for control buildings, e-houses, switchgear and battery rooms, and commercial and institutional facilities — by the firm that designed the electrical system inside them.

A control building is not a building with switchgear in it. It is a piece of substation equipment that people occasionally stand inside.

The heat load comes from relay panels and station service losses. The ventilation rate is set by battery gassing, not comfort. The cable entries are simultaneously a fire-stopping, moisture, vermin and pressurisation problem. The building steel is part of the ground grid. None of that is standard commercial MEP practice, and all of it is decided by the electrical design — which is why we lead these projects from the electrical side and coordinate the mechanical and plumbing scope with the licensed specialists who perform it.

30+	4	11	4
YEARS ACROSS SUBSTATIONS, GENERATION & FACILITIES	BUILDING TYPES — CONTROL HOUSE, E-HOUSE, BATTERY, COMMERCIAL	INTEGRATED ENGINEERING SERVICE LINES	U.S. OFFICES — TAMPA, AUSTIN, SACRAMENTO, BALTIMORE

SCOPE | **Building power** | **Lighting** | **Standby systems** | **Fire alarm** | **HVAC coordination** | **Plumbing coordination**

WHAT WE DESIGN

01
Control buildings
Relay and control houses, heat load, pressurisation, cable entry and grounding interface.

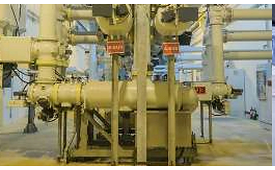
02
E-houses
Prefabricated modules — the compliance case, transport envelope and interface control.

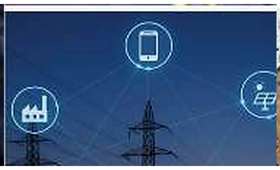
03
Battery rooms
Hydrogen ventilation, containment, eyewash and the lithium distinction.

04
Building power
Load calculations, panel schedules, branch circuits and receptacles.

05
Life safety
Emergency and standby systems, egress lighting, fire alarm circuiting and power.

06
Commercial
Offices, operations centres and institutional facilities, electrical-led with coordinated M&P.






START A SCOPE ›› Tell us the building, what is going inside it and which authority has jurisdiction — we will come back with a scoped fee and a clear statement of what we seal and what our mechanical and plumbing partners seal.

CONTACT 813-389-7871 · contact@keentelengineering.com · keentelengineering.com · Tampa · Austin · Sacramento · Baltimore

SAY IT BEFORE THE FIRST MEETING

What We Seal, and What We Coordinate

Most US states issue a generic Professional Engineer licence and then bind practice to demonstrated competence. We work inside that rule rather than around it.

DISCIPLINE	WHO SEALS IT	WHAT THAT COVERS
Electrical	**Keentel, under our own seal**	Single-line diagrams, load calculations to NEC Article 220, panel schedules, branch circuit and feeder design, short circuit, coordination and arc flash studies, grounding and bonding, lighting design and photometrics, fire alarm circuiting and power, emergency and standby power systems and their classification, cable and raceway design, and the electrical performance requirements that drive the mechanical design
Mechanical	Licensed mechanical engineer — coordinated and managed by us	HVAC load calculations and equipment selection, duct and piping design, ventilation system design, and the ASHRAE 62.1 and 90.1 compliance path. We supply the heat rejection loads, equipment dimensions and code-required ventilation rates that set the design
Plumbing	Licensed plumbing engineer — coordinated and managed by us	Sanitary, domestic water and International Plumbing Code compliance, including the supply and drainage for emergency eyewash and drench equipment, and battery room spill containment plumbing
Fire protection	Fire protection engineer — coordinated by us	Suppression hydraulics, clean agent concentration calculations and sprinkler layout. We specify and seal the detection circuits, the power supplies, and the shunt-trip and interlock schemes
Structural & civil	Specialists — coordinated by us	Foundations, framing, seismic and wind design of the enclosure. We supply equipment weights, loading and anchorage requirements

Why we lead with this

Because a firm that answers this question vaguely is telling you something. Sealing documents prepared by others is permitted in most states only where the sealing engineer has genuinely reviewed and taken responsibility for them — and boards have been explicit that competence is not acquired by informal multidisciplinary collaboration. We would rather name the split than blur it.

What this arrangement is good at

- **One point of accountability.** We hold the coordination and the interface control, so the owner has one number to call rather than three consultants pointing at each other
- **The electrical drives the design, and it should.** On these buildings the heat load, the ventilation rate and the room layout are all consequences of the electrical equipment
- **Nothing is claimed that is not held.** Every sheet is sealed by someone licensed and competent in that discipline, which is what a plan reviewer is checking for anyway

Why this arrangement is common

It is the normal industry model, not a workaround. Each discipline's drawings are sealed by a licensee in that discipline while the lead discipline holds the prime agreement and the coordination responsibility.

Why electrical should lead here

Because on a control house, an e-house or a battery room the electrical equipment sets the heat load, the ventilation rate, the containment requirement and the room dimensions. Everything else is downstream of it.

And when it should not

On a building whose difficulty is mechanical — a laboratory, a healthcare facility, a process plant — a mechanical-led firm should hold it and we should support. We will say so rather than take the work.

What sealing someone else's work actually requires

State boards are explicit that a licensee sealing documents prepared by others must have performed a thorough written evaluation — drawings and specifications, reports, design calculations and references to applicable codes — and may be treated as having accepted responsibility as though they had prepared everything personally. That is a real obligation, and it is why we do not seal mechanical or plumbing sheets rather than treating the licence as generic.

THE COMPLIANCE BASIS

Published Is Not the Same as Enforced

The National Electrical Code runs on a three-year cycle. States adopt on their own timetable, and the enforced edition commonly lags the published one by one or two cycles.

CURRENT EDITIONS

DOCUMENT	EDITION
NFPA 70 — National Electrical Code	2026
NFPA 70E — Electrical Safety in the Workplace	2024
NFPA 72 — National Fire Alarm and Signaling Code	2025
NFPA 13 — Installation of Sprinkler Systems	2025
NFPA 101 — Life Safety Code	2024
NFPA 110 — Emergency and Standby Power Systems	2025
NFPA 111 — Stored Electrical Energy Systems	2025
NFPA 855 — Stationary Energy Storage Systems	2026
NFPA 850 — Electric Generating Plants and HVDC Converter Stations	2026
NFPA 2001 — Clean Agent Fire Extinguishing Systems	2025
IBC / IMC / IPC / IECC — International Codes	2024
ASHRAE 90.1 · 62.1	2025

THE THING MOST FLYERS GET WRONG

We design to the edition your AHJ enforces

The 2026 NEC is published. Most US jurisdictions are still enforcing the 2023 or 2020 edition, and some remain earlier. The same lag applies to the International Codes, and to ASHRAE 90.1 by reference through the energy code.

> Confirming the enforced edition with the authority having jurisdiction is the first task on every project, and it changes real requirements — not just citations

> We will not print a count of how many states have adopted which edition. The published maps are not machine-readable and every count in circulation traces back to an aggregator rather than a primary source

NFPA 850 changed status

- NFPA 850 is now a **Standard** rather than a Recommended Practice, and its 2026 edition covers electric generating plants **and HVDC converter stations**
- That is a meaningful change: a recommended practice is guidance an owner may adopt, while a standard is a document an authority having jurisdiction or an owner's specification can invoke directly
- If your fire protection basis of design cites NFPA 850 as a recommended practice, it is now out of date

Why the lag matters in practice. Between editions the NEC changes arc energy reduction thresholds, labelling content, working space provisions and receptacle requirements — so designing to the newest edition on a jurisdiction enforcing an older one produces a compliant building and a failed plan review

Amendments matter too. Many states and cities adopt a code with amendments that delete, modify or add requirements — the energy storage tables are a common example

The reverse is also true. Designing to a superseded edition on a jurisdiction that has moved on produces rework at the worst possible moment. The only safe answer is to ask, in writing, before design begins

We record the answer. The enforced edition and any local amendments are stated on the basis of design and carried through to the drawing set

Two documents that changed recently and are worth checking

NFPA 850 became a Standard covering HVDC converter stations as well as generating plants. NFPA 855's 2026 edition made a hazard mitigation analysis the default for essentially every storage technology other than lead-acid and aqueous nickel. If your standard specification or basis of design predates either, it is now citing a document that no longer says what it used to.

THE BUILDING WE KNOW BEST

Substation Control Buildings

There is no IEEE guide for control building HVAC. The design is engineering practice built on manufacturer heat data and ASHRAE fundamentals — not a code compliance exercise, and we say so.

What actually drives the design

- **Internal heat gain** from relay panels, chargers, station service transformers, inverters and switchgear losses — established from manufacturer dissipation data, not a per-square-foot rule of thumb
- **Dew point control**, not just temperature. Relay electronics fail from condensation on cold surfaces, which is a humidity and surface-temperature problem
- **Positive pressurisation with filtration** against airborne contaminants, salt and dust ingress — the single most effective life-extension measure for the equipment inside
- **Sealed cable entries** — simultaneously a fire-stopping, moisture, vermin and pressurisation problem, and the detail that most often defeats all four
- **Bonding of the building steel** to the substation ground grid, and the step and touch potential at the entrance
- **Redundancy and failure behaviour** — what happens to the room when one HVAC unit fails on a summer afternoon, and whether anyone finds out before the relays do

The commissioning check worth insisting on

Run the building at full electrical load, in summer conditions, with one cooling unit out of service, and measure. A design that only works with everything running is not a design, it is an assumption.

The standards that genuinely apply

- **IEEE Std 80** — substation grounding, and the interface between the yard grid and the building steel
- **IEEE Std 693 with its 2024 amendment** — seismic qualification of substation equipment. Note that IEEE 693 qualifies **equipment** while ASCE 7 through the IBC governs the **structure**. They are different load bases, and reconciling them is one of the most common coordination failures on these projects
- **IEEE Std 979** — substation fire protection
- **IEEE Std 1402** — physical security of substations, retitled in its 2021 edition
- **NFPA 70, 72, 101 and 110** for the electrical installation, detection, life safety and standby power

IEEE Std 605 is sometimes cited in this context. It covers bus design in air-insulated substations, not building design — we do not cite it as one.

What we deliver

- Building power one-line, panel schedules and load calculations
- Lighting and emergency lighting design with photometrics
- Receptacle, small power and convenience circuits
- Heat load schedule and ventilation requirement issued to the mechanical engineer
- Cable entry, raceway and grounding details
- Fire alarm device layout, circuiting and power

Heat load schedule by panel	Ventilation and pressurisation basis	Dew point and humidity criteria
Cable entry and sealing details	Ground grid interface details	Lighting and emergency lighting
Panel schedules and load calcs	Fire alarm layout and power	Equipment layout and access

The failure mode nobody designs for

Control houses fail slowly, through humidity and contamination, not suddenly. Relay electronics degrade, terminations corrode and connectors become intermittent — and the eventual symptom is a protection misoperation attributed to the relay rather than to the room it lived in for fifteen years. Pressurisation, filtration and dew point control are the cheapest protection reliability measures available, and they are decided at building design.

Retrofit is most of this market. Existing control houses with added relays, added chargers and no added cooling are common, and the fix is usually a heat load survey and a targeted HVAC upgrade rather than a new building

Spare capacity is a design decision. How many panel positions, how much floor space and how much cooling headroom the building carries for the next modification should be stated, not inherited

PREFABRICATED POWER MODULES

E-Houses Have No Single Governing Standard

There is no US standard that governs an e-house as an assembly. The compliance case has to be built from several documents — and the engineer builds it.

What actually applies

- **IEC 62271-202** is the closest product standard for prefabricated substations — but it is IEC rather than a US listing basis, and its scope caps at 52 kV
- **IEEE C37.20 series and UL 1558** govern the switchgear inside, not the enclosure around it
- **The IBC** governs the module as a structure — and the threshold question is whether it is treated as a building or as equipment, because that decides whether occupancy classification, egress and fire-resistance ratings attach at all
- **ASCE 7 through the IBC** for seismic and wind on the structure, alongside **IEEE 693** for the equipment — two different load bases on one object
- **NEC 110.26** working space, which has to survive inside a module that also has to survive road transport

The question to settle in week one

Is this module a building or a piece of equipment, in the eyes of the authority having jurisdiction at this site? The answer changes the code path, the review process, the inspection regime and sometimes the wall construction. It is a conversation with the AHJ, and having it early is worth more than any amount of design work done before it.

Transport sets the envelope

- Federal width on the National Network is **102 inches**; there is **no federal height limit** — states set it, commonly 13 feet 6 inches to 14 feet
- Federal gross weight on the Interstate is **80,000 pounds**, with single- and tandem-axle limits and the bridge formula behind it
- Beyond that you need state oversize and overweight permits, and **permit routing drives module width, roof height and split-line placement**
- Which means the transport study is an input to the electrical layout, not a check performed after it

WHERE THESE PROJECTS GO WRONG

Late switchgear changes cascade

The electrical package fixes heat rejection, cable entry geometry and equipment weight distribution before the envelope, HVAC and fire protection can be designed. A switchgear change after that point cascades into cooling capacity, floor loading, door and removal-path clearances, and often the transport permit.

> We manage that with an **interface control document** — heat loads, weights, dimensions, entry points and clearances, frozen and version-controlled between the electrical design and the module fabricator

For the owner

We write the specification the fabricator bids against, and review what comes back — which is the only point at which the compliance case is still cheap to correct.

For the fabricator

We provide the electrical design and the code compliance case behind a module, including the AHJ engagement, so the shop can build rather than research.

For either

The interface control document, maintained through the project, so that a change on one side is visible on the other before it becomes a field problem.

Split lines are an electrical decision. Where a module divides for transport determines which cables cross the joint, how they are terminated in the field and what has to be re-tested on site

Site work is not zero. A prefabricated module still needs foundations, grounding connections, field cabling, re-testing across split lines and an AHJ inspection — and schedules that assume otherwise slip

Two different seismic conversations on one object

IEEE 693 qualifies the equipment; ASCE 7 through the building code governs the structure that carries it. They use different load bases and different qualification methods, and on a prefabricated module both apply at once to the same steel. Reconciling them — and agreeing with the AHJ which governs what — is one of the few genuinely technical arguments on an e-house project, and it belongs at the start.

THE MOST DEMANDING ROOM IN THE BUILDING

Battery Rooms — and the Distinction That Matters

A station battery room and a lithium storage room are not the same room. They are different hazards, different codes and different designs, and they should never be presented as one service.

	STATION BATTERY — FLOODED LEAD-ACID, VRLA, NICKEL-CADMIUM	LITHIUM-ION ENERGY STORAGE
The hazard	Hydrogen accumulation, electrolyte spill, corrosion	Thermal runaway, deflagration, flammable gas release
Governing basis	IMC and IFC ventilation provisions; IEEE 484, 1187 and 1188; IEEE 1635 / ASHRAE Guideline 21 for ventilation and thermal management	NFPA 855, UL 9540 listing and UL 9540A large-scale fire testing, with explosion control
Ventilation	Designed to limit hydrogen to **1.0% of room volume** — 25% of the lower flammable limit — with continuous mechanical exhaust and gas detection	Driven by the hazard mitigation analysis and the deflagration case, not by a fixed gas concentration limit
Hazard mitigation analysis	Not required for lead-acid and aqueous nickel systems	Since the 2026 edition of NFPA 855, the **default for virtually all other technologies**
Also required	Spill containment, eyewash and drench facilities, working space, guarding of live parts, and egress doors with panic hardware	Detection broadened to smoke, thermal imaging or radiant energy; thermal runaway propagation prevention; emergency power to critical safety systems

Where the 1% and 2% figures come from

They are not alternatives. **1.0% of room volume is the code number** — the International Mechanical Code requires the ventilation system to limit hydrogen to 1.0% for flooded lead-acid, flooded nickel-cadmium and VRLA batteries, and hydrogen's lower flammable limit is around 4%, so 1% is a 25% LEL design. The 2% figure that circulates is a recommended-practice level at 50% LEL. We design to the code number and say which one we used.

A note on the standards

- **IEEE 1188 was revised in 2025.** Most reference lists still cite the 2005 edition. If your maintenance programme references the old one, it is out of date
- **IEEE 1635 and ASHRAE Guideline 21** are the calculation basis for hydrogen evolution rate and thermal management — a guide, not a code, and we present it that way
- The NEC battery-location section was **renumbered between editions**, so we confirm the number against the edition your AHJ enforces rather than citing from memory
- Energy storage threshold quantities and maximum allowable quantities are **edition- and jurisdiction-specific** — the 2024 IFC restructured the chapter and some states delete the tables outright. We check yours; we do not print universal numbers

The room design follows the ventilation, not the other way round. Exhaust location relative to the cells, the make-up air path, the detector position and the interlock that alarms on fan failure are all part of the same design

Thermal management is a life question, not a comfort one. VRLA cell life falls sharply with sustained elevated temperature, so the room design decides how often the owner replaces the battery

Where owners most often get caught

Adding lithium storage to a building that already has a station battery. The two rooms are governed differently, the storage room may trigger a hazard mitigation analysis, explosion control and separation requirements that the existing building was never designed for, and the maximum allowable quantities are jurisdiction-specific. It is a solvable problem and an expensive surprise, and which one depends entirely on when it is raised.

SCOPE NOTE Ventilation rate, containment and eyewash requirements are established by us and issued to the licensed mechanical and plumbing engineers who design and seal those systems

DETECTION, SUPPRESSION AND THE INTERLOCKS

Fire Protection & Alarm

The electrical engineer owns the detection circuits, the power and the interlocks. The suppression hydraulics belong to a fire protection engineer. Both have to be designed against the same sequence of operation.

What we specify and seal

- **Detection layout and circuiting** to NFPA 72, with device selection appropriate to the environment
- **Power supplies to fire alarm control panels** under NEC Article 760 and NFPA 72, including secondary supply sizing
- **Shunt-trip and interlock schemes** for switchgear, and equipment shutdown on agent release
- **Emergency power to alarm and releasing panels**, and its classification
- **The sequence of operation** — the document that ties detection, suppression, shutdown and notification into one described behaviour, and the one most often missing

What we coordinate

- Suppression hydraulics and sprinkler layout under NFPA 13
- Clean agent concentration calculations under NFPA 2001
- Room integrity testing where a clean agent system depends on enclosure integrity

A GENUINE ENGINEERING TRADE-OFF

Clean agent versus water in a switchgear room

Clean agent protects electronics without water damage, but it needs an enclosure whose integrity has been verified and it provides no cooling — a deep-seated fire in a cable tray can re-ignite after the agent disperses. Water-based protection is required by the building code in many occupancies regardless of what the owner would prefer. This is an analysis with an owner decision at the end of it, not a rule.

> Detection in electrical rooms is complicated by **high air movement**, which dilutes smoke before it reaches a detector. NFPA 72 contains provisions for this; the spacing and device selection have to be designed against the actual air change rate rather than a default

Where NFPA 850 now applies

- Its 2026 edition is a **Standard** covering electric generating plants and HVDC converter stations — promoted from Recommended Practice
- **IEEE Std 979** remains the substation fire protection guide
- For storage, **NFPA 855** governs, and its interaction with the building code on separation and maximum quantities is jurisdiction-specific

Detection device layout and type	Initiating and notification circuits	FACP power and secondary supply
Shunt trip and interlock schematics	Agent release and shutdown logic	Sequence of operation document

The document that prevents the arguments

A sequence of operation names, in one place, what each detector does, what it initiates, what shuts down, what is annunciated where, and in what order. Without it, the fire alarm contractor, the suppression contractor, the switchgear vendor and the commissioning agent each hold a partial and slightly different understanding — which is discovered during the first integrated test, at the worst point in the schedule.

Detection in an electrical room is genuinely difficult. High air movement dilutes smoke before it reaches a detector, so device type, spacing and position have to be designed against the actual air change rate rather than a default layout

Clean agent depends on the room staying sealed. Enclosure integrity is a design requirement and a commissioning test — a system installed in a room that leaks will discharge and not hold concentration

THE CORE ELECTRICAL SCOPE

Building Power, Lighting and Standby Systems

The everyday work — done to the same discipline as the substation studies, because a plan reviewer checks the panel schedule as carefully as anything else.

Power distribution

- **Load calculations to NEC Article 220** — branch circuit, feeder and service, with demand factors applied and continuous loads at 125%
- **Panel schedules** that balance, and that a contractor can build from without calling
- **Service and distribution equipment** selection, ratings and available fault current marking
- **Receptacle, small power and equipment circuits**, including maintenance receptacles where they will actually be needed
- **Grounding and bonding** to NEC Article 250, and its interface with the substation grid where one exists
- **Raceway, cable tray and conduit** design, fill and support

Lighting

- Interior lighting design with photometric calculations against the task
- Exterior, yard and security lighting, including light trespass and glare control
- Controls, occupancy sensing and daylight response as the energy code requires
- Lighting power density compliance under the energy code edition your AHJ enforces — the allowances change every cycle and by space type, so we compute rather than quote

Emergency and standby systems

- **NEC Article 700** emergency systems, **701** legally required standby and **702** optional standby — which article applies is a code determination with real consequences for wiring separation, transfer time and testing, and it is made early
- **NFPA 110 classification** — the standard classifies systems by Level, by Type (the maximum permitted interruption at the load terminals) and by Class (the minimum operating time at rated load without refuelling). Naming all three in the basis of design prevents the most common generator specification argument
- Generator and transfer switch sizing, paralleling where used, and fuel supply
- Egress and emergency lighting under **NFPA 101**, with illumination levels and duration to the enforced edition
- Testing and maintenance provisions, because a standby system that is never exercised is a standby system that will not start

The determination worth making on day one

Whether a system is an emergency system, a legally required standby system or an optional standby system is decided by code and by the authority having jurisdiction — not by the owner's preference or the generator vendor. Getting it wrong is expensive to correct because it reaches wiring separation, transfer scheme and the entire testing regime.

Load calculations that survive the first year

The most common defect we find in existing buildings is a service sized to a load calculation that omitted growth, then filled to capacity by the second expansion. We calculate the connected and demand load honestly, state the spare capacity explicitly as a percentage rather than as a feeling, and note what a future addition would require — because the cost of one more spare breaker position at design is nothing, and the cost of a service upgrade later is not.

Service and distribution design	Panel schedules and load calculations	Lighting design and photometrics
Energy code compliance path	Emergency and standby systems	Egress and emergency lighting

Generator sizing, done properly

A generator sized by summing nameplates is usually oversized for the load and undersized for the step — because motor starting, UPS walk-in and the transfer sequence determine the real requirement. We size against the actual step loads and starting behaviour, and state the assumed sequence, so the set that arrives is the set that works.

SAFETY BY DESIGN

Arc Flash, Working Space and the Room Around It

Most electrical safety outcomes are decided at design stage, in decisions about clearance, access and protective device settings — long before anyone writes a procedure.

Arc energy reduction

- **NEC 240.87** requires arc energy reduction where a circuit breaker is rated or can be adjusted to **1,200 A or more**; **240.67** applies the equivalent requirement to fuses
- Accepted methods include zone-selective interlocking, differential relaying, energy-reducing maintenance switching with a local status indicator, an energy-reducing active arc flash mitigation system, and instantaneous settings or overrides below the available arcing current
- **Documentation and performance testing** of the chosen method are part of the requirement — the scheme has to be shown to work, not merely specified
- **IEEE Std 1584** is the incident energy calculation basis, and **IEEE Std 1584.1** specifies what an arc flash study must actually deliver
- **NEC 110.16** governs the labelling, and **NFPA 70E** the work practices and PPE regime that follow

Because we also do the studies

The short circuit model that sizes your service and verifies equipment ratings is the same model that produces your incident energy results. When the building electrical design and the arc flash study come from one firm, the mitigation is designed in rather than discovered afterward — and the label matches the equipment on day one.

Working space, which decides the room

- **NEC 110.26** sets depth by condition and voltage, width as the greater of the equipment width or **30 inches**, and headroom at **6.5 feet** or the equipment height
- Equipment rated **1,200 A or more and over 6 feet wide** requires **two entrances**, one at each end, each at least 24 inches wide and 6.5 feet high — with limited exceptions for unobstructed egress or doubled working space
- That single requirement drives room length, door placement and often the entire building footprint. It is the reason a control house is the size it is, and it has to be settled before the architectural layout is fixed rather than after
- Add removal paths, lifting access, cable bending radius at terminations and future spare capacity, and the room is designed by the equipment rather than by the floor plan

Designed-in mitigation

- Remote racking and remote operation where incident energy justifies it
- Arc-resistant switchgear where the arrangement and budget support it
- Maintenance-mode schemes designed as schemes, with a procedure and a way to confirm the state
- Instrumentation and monitoring that removes a reason to open a door energised at all

Working space is checked in three dimensions and against reality — door swings, panel doors at full open, cable bending radius at terminations, and the path used to remove the largest component. Plans that satisfy the dimension and fail the removal are common

Labels are computed, not copied. Incident energy results come from the model of this system, not from a table — and are re-run whenever a source, a device or a setting changes

The two-entrance rule catches people out

Equipment rated 1,200 A or more and over six feet wide needs an entrance at each end of the working space. On a control house or an e-house that requirement frequently sets the building length, the door positions and sometimes the module split — and it is far cheaper to discover during layout than during plan review, which is where it is usually discovered.

Arc energy reduction is a scheme with a procedure — maintenance-mode switching needs status indication, a defined operating instruction and a way to confirm it was returned to normal

Documentation and performance testing are part of the code requirement, not extras — the chosen method has to be shown to work rather than merely specified

BEYOND THE SUBSTATION FENCE

Commercial and Institutional Facilities

Operations centres, offices, municipal and institutional buildings — the same electrical-led model, with mechanical and plumbing coordinated and sealed by licensed specialists.

What we bring that a general MEP firm may not

- **The service side.** We design the utility service, the metering and the distribution upstream of the building as readily as the panels inside it — which matters on any facility with a substantial or unusual load
- **The studies.** Short circuit, coordination and arc flash are core practice here, not a subcontracted specialty
- **Standby power that is engineered.** Generator sizing against actual step loads and starting behaviour, not a nameplate sum
- **Power quality.** Harmonics from drives, UPS and LED lighting, and the correction or filtering where it is warranted

Typical facility scope

- Service, distribution, panel schedules and load calculations
- Lighting, controls and energy code compliance
- Fire alarm layout, circuiting and power
- Emergency and standby systems, egress lighting
- Low voltage and communications rough-in coordination
- Construction administration, submittal review and site observation

HOW THE COORDINATION ACTUALLY RUNS

One interface, three seals

We hold the prime agreement and the coordination responsibility. Mechanical and plumbing are designed and sealed by licensed engineers in those disciplines working to our coordination. The owner deals with one firm; the plan reviewer sees every sheet sealed by someone competent in that discipline. Both of those are true at once, and neither is a compromise.

> The interface documents — heat loads, equipment schedules, space requirements, ventilation rates and power requirements — are issued formally and version-controlled, not exchanged in email

When we are the wrong firm

A large healthcare, laboratory or process facility whose difficulty lies in the mechanical systems should be led by a mechanical-led MEP firm, with electrical as a supporting discipline. We will say so. Our value is on projects where the electrical scope is the hard part — which describes most buildings in the power industry and a fair number outside it.

Operations centres

Control rooms, video walls and the standby power behind them — where the electrical reliability requirement is closer to a data hall than to an office.

Industrial & process support

Motor control rooms, substation-adjacent buildings, and facilities where classified areas or process interlocks reach the building electrical design.

Municipal & institutional

Public works, utility service centres and campus buildings, where the procurement is public and the documentation has to withstand it.

> **We are comfortable as the supporting discipline.** Plenty of our facility work is electrical scope delivered into an architect or a mechanical-led MEP firm holding the rest — and that is a normal engagement here, not a lesser one

> **Design review is a real service.** An independent read of someone else's package against code and the owner's standard is usually cheaper than the change orders it prevents

What a utility client gets that a general MEP firm may not offer

The building and the system it serves designed against one set of assumptions. The service study, the coordination, the arc flash and the panel schedules come from the same model and the same firm — which matters most on the buildings where the electrical scope is genuinely the difficult part, and matters not at all on a building where it is not. We are candid about which yours is.

THE GOVERNING BASIS

Codes, Standards and What Each One Does

Some of these are adopted law, some are listing standards and some are guides. Treating a guide as a code, or a code as a guide, is how projects fail plan review.

DOCUMENT	WHAT IT IS	WHAT IT GOVERNS HERE
NFPA 70 (NEC)	Adopted code	The electrical installation — Article 220 load calculations, 250 grounding, 700/701/702 emergency and standby, 480 batteries, 760 fire alarm circuits, 110.26 working space, 240.67/240.87 arc energy reduction
NFPA 70E	Standard	Electrical safety work practices, PPE and the labelling regime the arc flash study feeds
NFPA 72	Adopted code	Fire alarm and signalling — detection, circuiting, power supplies, and provisions for high air movement environments
NFPA 101	Adopted code	Means of egress, egress illumination and emergency lighting
NFPA 110 · 111	Standards	Emergency and standby power systems, and stored electrical energy systems — Level, Type and Class classification
NFPA 855	Standard	Stationary energy storage installation, hazard mitigation analysis, listing and testing, separation and detection
NFPA 850	Standard (2026)	Fire protection for electric generating plants and HVDC converter stations — promoted from Recommended Practice
NFPA 2001 · 13	Standards	Clean agent systems and sprinkler installation
IBC / IMC / IPC / IECC	Adopted codes	The structure and occupancy, mechanical and battery ventilation, plumbing, and the energy code path
ASHRAE 90.1 · 62.1	Referenced standards	Energy efficiency including lighting power density, and ventilation for acceptable indoor air quality
IEEE 484 · 1187 · 1188	Recommended practices	Installation design for vented lead-acid and VRLA batteries, and VRLA maintenance, testing and replacement — 1188 revised 2025
IEEE 1635 / ASHRAE Guideline 21	Guide	Ventilation and thermal management calculation basis for stationary batteries
IEEE 80 · 693 · 979 · 1402	Guides & practices	Substation grounding, seismic qualification of equipment, substation fire protection, and physical security
IEEE 1584 · 1584.1	Standards	Incident energy calculation, and the required scope and deliverables of an arc flash study
IEC 62271-202	Product standard	Prefabricated substations to 52 kV — the closest thing to an e-house product standard, and not a US listing basis
ASCE 7 (via IBC)	Referenced standard	Seismic and wind loading on the structure — a different basis from IEEE 693 equipment qualification
29 CFR 1910	Regulation	OSHA general industry requirements, including emergency eyewash and drench facilities where corrosive exposure exists

Three categories, treated differently

An **adopted code** is law in that jurisdiction at the edition adopted. A **standard** binds when a code, a contract or an owner's specification invokes it. A **guide or recommended practice** is engineering guidance that carries weight in review but is not mandatory unless invoked. Every citation in our deliverables is labelled with which of the three it is, and at which edition — because a reviewer's first question about an unfamiliar citation is exactly that.

DELIVERY

How a Building Project Runs Here

The order matters. On these buildings almost every mechanical and architectural decision is downstream of an electrical one, and running them in parallel produces rework.

1
Basis of design
Code path and enforced editions, AHJ position on the building-versus-equipment question, occupancy, and the emergency versus standby determination.

2
Equipment first
Electrical equipment selection, heat dissipation, weights, dimensions, working space and removal paths — which together set the room.

3
Interface issue
Heat loads, ventilation rates, containment and power requirements formally issued to mechanical, plumbing, fire and structural.

4
Coordinated design
All disciplines developed against the frozen interface, with reviews at 30 / 60 / 90 percent so nothing surfaces at issue.

5
Issue & support
Sealed sets by discipline, submittal review, RFIs, site observation, and commissioning support through beneficial use.

What we need to start

- The site, the jurisdiction, and who the authority having jurisdiction is
- What electrical equipment is going inside, or the one-line that implies it
- Battery technology and quantity, if there is a battery
- Whether the building is site-built or a prefabricated module, and who is fabricating it
- The owner's design standards, if you have them
- Any existing drawings, and how much you trust them

Engagement models

- **Full building package** — we hold the prime and coordinate the sealed mechanical and plumbing scope
- **Electrical scope only** — delivered into an architect or MEP firm holding the rest
- **Design review** — independent review of someone else's package against code and the owner's standard
- **Programme support** — a repeatable control house or e-house design applied across a fleet of sites, which is far cheaper per site than designing each one

The AHJ conversation is step one, not step three. On e-houses and battery rooms especially, the jurisdiction's position changes the code path — and it is a fifteen-minute call that saves weeks

Reviews at 30 / 60 / 90 percent are real reviews. Comments are recorded and dispositioned in writing, so nothing is rediscovered at issue for construction

Repeatable designs pay for themselves fast. A standard control house or e-house design, engineered once and adapted per site, cuts both cost and review risk across a build programme

Construction support is part of the job. The engineer who designed it answers the RFIs, rather than a document control queue

Freezing the interface is the whole trick

The single most effective thing on a multidiscipline building project is to fix the electrical equipment schedule — heat loads, weights, dimensions, clearances, entry points — and issue it formally before mechanical and structural design begins. Changes after that point are handled as changes, with their consequences priced, rather than absorbed silently by whichever discipline notices last.

- Basis of design and code path
- Interface control document
- 30 / 60 / 90 percent reviews
- Sealed sets by discipline
- Submittal review and RFIs
- Site observation and closeout

MISSING DATA IS NORMAL Field verification and drawing reconciliation can be the first phase of the work — scoped and priced as such rather than assumed away

WHO WE WORK FOR AND HOW

Engagement & Capability

WHO COMMISSIONS THIS WORK

- Investor-owned utilities
- Municipals & cooperatives
- Renewable & storage developers
- Data center developers
- E-house fabricators
- EPC contractors
- Industrial owners
- Generators & IPPs
- Architects & A/E firms
- Public agencies
- OEMs & integrators
- Developers & asset managers

TYPICAL DELIVERABLES

- Basis of design & code path
- Building power one-line
- Load calculations & panel schedules
- Lighting design & photometrics
- Emergency & standby system design
- Fire alarm layout & circuiting
- Heat load & ventilation schedule
- Battery room ventilation basis
- Grounding & bonding details
- Raceway & cable schedules
- Arc flash study & labels
- Interface control document
- Specifications & bills of material
- Submittal review & RFI responses
- Site observation reports

OUR CLIENTS

entergy · EDF power solutions · aps · AVANGRID · aypa · SIEMENS energy · octa DATA CENTER · PIKE ENGINEERING · RRC · FISHER ASSOCIATES · BRASSWATER · RISK WORK · ANTHROPIC · PAE · tenova ADVANCED TECHNOLOGIES · NLINE ENERGY · UTILITY · Austin Energy · Shermco · PRO SERV INDUSTRIAL CONTRACTORS · Solvida Design + Engineering

Delivered as part of substation and plant work — control buildings, switchgear and battery rooms across transmission substations, generating stations and renewable and storage facilities

And standalone — e-house specification and review, commercial and institutional facilities, and independent design review of other firms' packages

- Full building packages
- Electrical scope into an A/E
- E-house specification and review
- Independent design review
- Repeatable fleet designs
- Construction and commissioning support

How an engagement starts

A short call to establish the building type, what is going inside it, and which authority has jurisdiction — followed by a written scope naming the deliverables, the code editions we will design to, which sheets we seal and which our mechanical and plumbing partners seal, the inputs we need from you, and the fee.

START HERE

Four Things and We Can Scope It

01	02	03	04
The building	**What is inside**	**The jurisdiction**	**The scope**
Type, size, site-built or prefabricated module.	Electrical equipment, and whether there is a battery.	Who the AHJ is and which editions they enforce.	Full package, electrical only, or design review.

WHY KEENTEL ENGINEERING

01
We design the equipment first
On these buildings the heat load, the ventilation rate and the room size are consequences of the electrical design. Leading from there removes most of the rework.

02
The studies come with it
Short circuit, coordination and arc flash are core practice here, so mitigation is designed in rather than discovered at commissioning.

03
Explicit about the seals
We seal electrical. Mechanical and plumbing are designed and sealed by licensed specialists we coordinate. Stated in the scope of work, not discovered at plan review.

04
We know the battery room
Station battery and lithium storage are different hazards, different codes and different designs. We do not present them as one service.

05
We check the enforced edition
Published is not adopted. The code path is confirmed with your AHJ before design, because the gap is commonly one or two cycles.

06
P.E.-sealed and defensible
Florida-registered firm, Reg. No. 36853. Written to pass plan review the first time.

PRIMARY AUTHORITIES BEHIND THIS FLYER

Codes and standards. NFPA 70, 70E, 72, 13, 101, 110, 111, 850, 855 and 2001; the International Building, Mechanical, Plumbing and Energy Conservation Codes; ASHRAE 90.1 and 62.1; and the Department of Energy determinations on energy code editions published through energycodes.gov.

Battery and storage. IEEE Std 484, 1187, 1188 and 1635 with ASHRAE Guideline 21; the International Mechanical Code hydrogen ventilation provisions; International Fire Code energy storage provisions as adopted; and UL 9540 and 9540A as referenced by NFPA 855.

Substation and equipment. IEEE Std 80, 605, 693 with its 2024 amendment, 979, 1402, 1584 and 1584.1; the IEEE C37.20 series and UL 1558 for switchgear; IEC 62271-202 for prefabricated substations; and ASCE 7 as referenced by the IBC.

Regulatory and licensure. 29 CFR 1910 general industry requirements; state engineering board rules on practice within areas of competence and on sealing documents prepared by others; and Federal Highway Administration vehicle width and weight limits.

Code editions, adoption status and standard versions are current as of August 2026 and provided for orientation only. Nothing here is legal or regulatory advice. The edition adopted and enforced by the authority having jurisdiction controls.

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