

PORTLAND PUBLIC SCHOOLS
TECHNICAL DESIGN AND CONSTRUCTION STANDARDS

DIVISION 26 – ELECTRICAL

26-00-00 Common Work Results for Electrical

A. References and Standards

1. State of Oregon Codes
 - a. OAR Oregon Administrative Rules
 - b. ORS Oregon Revised Statutes
 - c. OESC Oregon Electrical Specialty Code
 - d. City of Portland Fire Code
 - e. OMSC Oregon Mechanical Specialty Code
 - f. OPSC Oregon Plumbing Specialty Code
 - g. OSSC Oregon Structural Specialty Code
 - h. OEESC Oregon Energy Efficiency Specialty Code
 - i. Oregon Elevator Specialty Code
2. American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) Standards
3. Leadership in Energy and Environmental Design (LEED)
4. Illuminating Engineering Society (IES)
5. International Dark-Sky Association (IDA)
6. National Fire Protection Association (NFPA) Standards

B. General Electrical Provisions/Design Requirements

1. Due to the District's requirement to support greater flexibility and adaptability for education in the 21st century, some portions of these electrical standards exceed code. While the standard requirement may increase the initial cost of a new or major renovation, the long-term outcome will reduce costs for future modifications. Serviceability and the ability to stock fewer components throughout the district are key approval criteria for all projects. It is required to include the PPS Maintenance through the entire design review and approval process. See 26 00 00 H.
2. General work practices for electrical construction shall be in compliance with NECA 1, Standard Practices for Good Workmanship in Electrical Construction.
3. Coordination with Energy Trust of Oregon (ETO) is required early in the design phase to maximize incentives. All LED lighting must meet ETO incentive requirements.

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4. Design systems that stress durability, resistance to vandalism, and ease of maintenance, reliability, and energy conservation.
 5. Evaluate and provide designs which address the existing electrical system for:
 - a. Compliance with current codes and jurisdictional requirements.
 - b. Electrification of existing building systems converting fossil fuel infrastructure in the current or a future project to electric infrastructure to meet [PPS Climate Crisis Response Policy](#). Coordinate with other disciplines and serving power utility. Evaluation to consider existing conditions including existing utility service capacity. Coordinate with PPS program administrator for resulting impacts of electrification. Clearly identify existing impacted items versus proposed new for all significant items included in evaluation.
 - c. Size for future expansion panels for service required and anticipated in future needs.
 - d. Age of equipment and availability of spare product parts.
 - e. Physical constraints of existing main service room.
- C. Sustainability
1. For a complete summary of Portland Public School's vision refer to [PPS Energy and Sustainability Standards](#) and [PPS Climate Crisis Response Policy](#).
 2. Systems shall be selected for meeting the target Energy Use Intensity (EUI) identified in PPS Energy and Sustainability Standards as a primary goal. The district encourages the use of new and proven materials, means and methods for meeting this goal. However, specified systems must have a proven record of delivering energy savings while meeting PPS requirements for low operations and maintenance costs while delivering a life cycle cost of 30-years.
 3. In accordance with PPS Climate Crisis Response Policy, the installation of fossil fuel infrastructure (gas-fired equipment) is prohibited in all new buildings. Fossil fuel infrastructure in existing buildings will be phased out in all existing buildings by 2050.
 4. Designers are encouraged to follow ASHRAE High Performance Building guidelines when designing and specifying systems to meet PPS Energy and Sustainability standards.
- D. Design Criteria
1. Base Service: State voltage, phase and wire count.
 2. Submit service and feeder data load calculations.

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3. Submit fault duty calculations for the entire electrical distribution system for new projects. Submit fault duty calculations for panels with modification for remodel projects.
4. Submit voltage drop calculations from main service to distribution panels.
5. Coordinate with the serving utilities for remodel projects:
 - a. Perform minimum 30-day load study for existing buildings or obtain serving utility 12-month peak demand and add NEC 125% factor to calculate load per NEC.
 - b. For existing buildings to be remodeled perform 30-day minimum load metering log of peak and demand loads at any panel or distribution where modifications are required. 30-day load study must be completed during school year except over winter break and spring break.
 - c. Upgrade service if new loads warrant.
 - d. Upgrade utility transformer and distribution if new loads warrant.
 - e. List information needed and needed classroom program requirements (for CTE spaces) from PPS or others early in design that may impact service upgrades. Send a check-off form to the PPS program administrator for stakeholders to vet the needed design criteria.
6. Lighting
 - a. Provide luminaires, branch circuiting and switching complete in compliance with the Oregon State Energy Code, NEC, and all other applicable jurisdictional requirements.
 - b. All new and major replacements of lighting fixtures to be LED and eligible for current energy trust incentives, wherever possible.
 - c. Interior Lighting
 - i. Provide dimmable 34000K lamp-color temperature lighting in all instructional spaces unless otherwise indicated and approved by the District.
 - ii. Provide lighting for special education classrooms-sensory rooms according to Portland Public Schools requirements. See 26-50-00.FG
 - iii. Gymnasiums: Pendant lighting and fixtures hung by a chain are not allowed.
 - d. Renovations and Retrofits: Match existing fixture types in remodeled areas where existing fixtures remain. Use the most current lighting technology available at the time of the project. Provide relamping for existing fixtures with LED wherever possible. Ensure compliance with PPS and jurisdictional requirements.

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- e. Minimize the use of different fixture types, characteristics, and lamp types for ease of maintenance and stocking components.
 - f. Specify and design luminaires with accessible or “service below” drivers.
 - g. Exterior Lighting
 - i. All exterior lighting to be provided with Dark Sky Compliant, full cut-off fixtures, with color temperature 3000K or lower unless other specific requirements for a cooler color temperature prevail.
 - ii. All sports field lighting systems to comply with the most current version of IDA-Criteria for Community-Friendly Outdoor Sports Lighting.
 - iii. All site lighting to be LED with the ability to reduce lamp output to 10% with motion sensing activation to 100% full output. Provide timeclock control for the ability to turn lights off.
 - h. Provide emergency lighting to comply with current required code and in coordination with PPS emergency operations requirements.
 - i. Submit point by point foot-candle calculations for all exterior lighting.
 - j. Submit lighting level calculations for all occupied spaces, corridors and other components of each building’s exiting system, including but not limited to stairs and vestibules. Include levels at working surface height (desk or counter top) in classrooms, cafeterias, media centers / libraries, offices, and conference rooms.
 - k. Wall mounted fixtures are required in stairways; coordinate with PPS Maintenance to ensure work access requirements are incorporated. Ceiling perimeter fixtures and other fixtures accessible from a stair or ramp landing are only acceptable as reviewed and approved on a case-by-case basis.
7. Signal Systems
- a. Provide extension of telephone service lateral as required by serving utility.
 - b. Provide 3/4” thick, 4’x8’ plywood fire rated backboard with double duplex receptacle and 12-inch ground bus bar.
 - c. Provide minimum of 1-inch distribution to each data and phone device location.
8. Demolition
- a. Coordinate with PPS so that work can be scheduled not to interrupt operations, normal activities or building access.
 - b. Determine exact location of existing utilities and equipment prior to commencing work and compensate Owner for damages caused by failure to locate or preserve utilities.

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- c. For items to be demolished: remove wiring, devices and conduit complete, do not abandon in place.
 - d. Provide temporary wiring and connections to maintain electrical continuity of existing systems during construction. All temporary installations shall be code compliant.
 - e. Remove and restore wiring which serves usable existing outlets clear of construction or demolition.
 - f. If existing junction boxes will be made inaccessible or if abandoned outlets serve as feed through boxes, provide new conduit and wire to bypass inaccessible junction boxes and abandoned outlets.
 - g. Existing lighting which is to remain, leave luminaires in proper working order, clean and re-lamp.
- E. Solar
- 1. All modernizations and new construction must meet State of Oregon's 1.5% mandate for renewable energy (<http://www.oregon.gov/energy/energy-oregon/Pages/GET.aspx>)
 - 2. Solar inverters are required to be installed in an accessible area such as in electrical or mechanical rooms, not on a roof.
 - 3. A solar feasibility assessment is required on every modernization or new construction with approval by Energy Program Manager. (Energy Trust incentive available). Evaluate use of State of Oregon's 1.5% mandate funds for a battery energy storage system (BESS). See section 26-32-13.13.
 - 4. Please see the related PPS Solar Standards Document <https://www.pps.net/Page/15497> under Division 26 - Electrical 26-1 Solar Standards
 - 5. Consider an energy control center (Schneider Electric) / microgrid switchboard (Eaton) where project includes large Solar PV and BESS for connection and control of energy. See section 26-32-13.13 regarding standby branch system.
 - 6. Provide ability to monitor power at individual panels for troubleshooting.
 - 7. Manufacturers of panels and inverters must have a distribution presence within the U.S. and have replacement parts readily available (i.e. not overseas).
- F. Electric Vehicle Charging
- 1. Wired data connection.
 - 2. Provide with credit card tap / application.

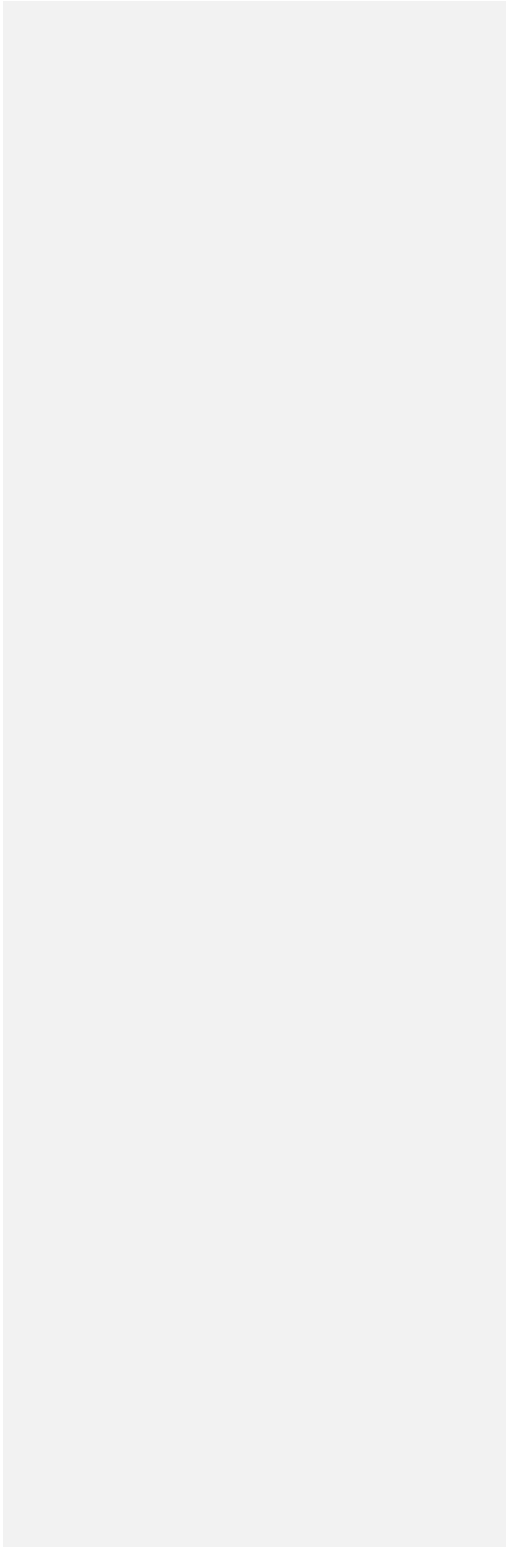
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3. Provide PPS badge access for maintenance employees to bypass payment.
 4. Include in submittal requirements for monthly service costs to be provided.
- G. Electric Hand Dryers
1. Electric hand dryers are recommended in new and full modernization projects in grouped student restrooms with Electric shop review and approval. The unit must be commercial, recessed, have no heating element and be vandal resistant.
 2. Acoustic separation from teaching spaces is required; dryers must not be installed on wall adjacent to offices, classrooms, or other spaces with acoustic needs. The sound energy produced by the dryer is required to be mitigated through acoustic absorption in the space. Provide room acoustic performance data for PPS review prior to finalizing selection and installation details.
 3. Wood backing is required.
 4. At least (1) electric hand dryer per restroom to be on optional standby power.
- H. Deviations from Standards
1. Maintain a log of deviations from standards organized by specification division. List each deviation separately and include all technical references and document links for stakeholder review.
 2. Update the log of deviations no later than at each phase review milestone (e.g. Schematic Design, Design Development, Construction Documents, and Bid Documents) as established in the project schedule approved by the District.
 3. Provide the log of deviations for stakeholder review at the established milestones, allowing a minimum of two full work weeks for review by the District.
 4. At the conclusion of each District milestone review, record results of the review for each item in the log and provide to the District for incorporation into the project record and the Program Administrator's tracking. Incorporate approved deviations into the project documents.

26-01-00 Operation and Maintenance of Electrical Systems

- A. Equipment and raceway systems shall be installed in compliance with manufacturer's recommendations. Location of Equipment:
1. Locate motors, starters, switches, relays, contactors, transformers and similar electrical equipment in readily accessible, ventilated and lit spaces.
 2. Specify ambient compensating equipment in high or low ambient temperature atmospheres.

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- B. Acceptance
 - a. Systems are not considered for acceptance until work is complete and demonstrated to meet contract documents.
 - b. Acceptance by the Authority Having Jurisdiction (AHJ), or City/ State/ County Inspectors does not demonstrate work meets contract documents.
- C. Training to be provided for the following which includes servicing the systems. Include training requirements for the following in coordination with each project scope:
 - 1. Lighting controls including daylight harvesting and access into system.
 - 2. Theater lighting and lighting controls.
 - 3. Kitchen appliances and equipment (coordinate with Kitchen Consultant or Architect).
 - 4. Hood fire suppression systems.
 - 5. Kiln control systems and other power controls and cabinets such as for shunt trip.
 - 6. Energy Control Centers.
 - 7. Sub-metering system.
 - 8. Electric vehicle charging equipment.
 - 9. Solar photovoltaic systems.
 - 10. Battery energy storage systems.
 - 11. Generators, docking stations, and transfer switches.
 - 12. Lighting battery inverters.
 - 13. UPS systems.
 - 14. Sports field lighting systems.

26-05-09 Equipment Wiring

- A. Motors
 - 1. 1/2 HP and under: 120V, 1 phase.
 - 2. 3/4 HP and over: 208V, 3 phase or 480V, 3 phase.
- B. Verify connection requirements with equipment nameplate and submittals prior to installation.
- C. Install disconnects and motor starters in readily accessible locations.
- D. Provide appropriate cable and cord cap for final connection unless equipment is provided with the same. Provide receptacle to match cord cap.

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- E. Kitchen Class 1 Exhaust Hood:
 - 1. Obtain shop drawings prior to rough-in. Connect hood lights, fire suppression and control panel. Provide interlocks to exhaust, make up air, solenoid valves, and shunt trip breakers.
 - 2. Provide note on drawings for a design walk-through meeting be held between City inspector and installing Contractors.
- F. Verify with district to determine which kitchen equipment need to be on back-up power.
- G. Test for proper motor rotation of poly-phase motors. Provide high efficiency motors when replacement is needed.
- H. Equipment mounted above a ceiling must have enough clearance below it to accommodate a lift or ladder for future repairs.

26-05-19 Low-Voltage Electrical Power Conductors and Cables

- A. Wire and Cable Conductors
 - 1. Terminate feeder conductors with indent compression lugs.
 - 2. Feeder conductors - copper; no substitution.
 - 3. Aluminum wire prohibited in all sizes.
 - 4. Insulation for new conductors shall be, "THHN" or "THWN" unless approved by owner.
 - 5. Conductors installed in a manufacturer's standard assembly, such as a light fixture, may be solid wire.
 - 6. Size feeder conductors for 125% of connected feeder load.
 - 7. Grounding conductors shall be installed with all new feeders and new branch circuits.
 - 8. Multiple branch circuits in the same conduit may share a common ground conductor.
 - 9. Conductors used for grounding shall be No. 12 AWG minimum.
 - 10. Stranded MC (Metal Clad) cable is limited to branch circuits only. Homeruns are to be in conduit.
- B. Installation
 - 1. Minimum conduit size 3/4 inch unless approved by PPS Electrical Shop.
 - 2. Install 12 AWG minimum unless stated otherwise on drawings.

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3. Provide dedicated neutrals for:
 - a. Multi-conductor branch circuits fed from a single overcurrent protection device.
 - b. Dimmer controlled circuits.
 - c. GFCI breaker installed in panel board.
 - d. Electronic equipment with a high level of harmonic distortion.
4. Homeruns for 20A branch circuits may be combined to a maximum of six current carrying conductors including neutral conductors in homeruns.
5. Identify wire and cable per 26 05 53, Identification for Electrical Systems.
6. Test conductor insulation for feeders of 100 amp and greater. (MEGGER)

26-05-26 Grounding and Bonding for Electrical Systems

- A. New Services
 1. Provide ground electrodes per code.
 2. Provide accessible copper grounding bus bar, minimum 12-inch long with insulators in main electrical room.
 3. Provide Grounding Test Well, minimum 8-inch diameter and well cover with cast iron cover embossed with legend "GROUND"
- B. Grounding Electrode: soft drawn bare stranded copper for wire sizes larger than 10 AWG bare.
- C. Raceway Grounding
 1. Ground metallic raceway systems.
 2. Connect metal raceways, which terminate within an enclosure but without mechanical connection to enclosure by grounding bushings and ground wire to grounding bus.
 3. Install ground conductor in all metallic and non-metallic conduit.
- D. Grounding system resistance not to exceed 5 ohms.

26-05-33 Raceways and Boxes for Electrical Systems

- A. Ceiling Attachments
 1. When attaching raceways and electrical boxes to ceilings the appropriate type of anchor shall be used.
 - a. PPS Approved Electrical Fasteners <https://www.pps.net/Page/15497> under Division 26 - Electrical 26-2 Approved Electrical Fasteners.

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2. Ceiling tiles shall not be used as the only means of support for boxes and raceways.
3. The ceiling grid shall not be used as the only means of support for boxes and raceways.
- B. Lead type drive anchors shall not be used to anchor electrical equipment, enclosures, and conduit.
- C. Feeder conductors shall be installed in rigid conduits with threaded connections.
- D. Pull strings are required in all raceways, pathways and conduits. Label pull lines as to conduit starting or terminations point.
- E. Conduit Materials
 1. Approved conduit types shall be Galvanized steel or EMT where specifically approved.
 2. Underground 90-degree bends shall be GRC rigid conduit or Fiber Glass. Treat GRC threads with a copper coat to avoid moisture and corrosion.
 3. Underground conduit shall be Galvanized Rigid Conduit (GRC) or PVC. GRC required for heavier weight bearing areas and where accessible to vehicular traffic.
 4. Exterior above ground conduit to be Galvanized Rigid Conduit (GRC) if accessible to the public. No substitutions. No PVC conduit above grade unless authorized by PPS Electric Shop.
 5. EMT allowed on rooftops and areas not accessible by public only if there is no other viable location.
 6. Aluminum conduits prohibited.
- F. Junction Boxes
 1. Exterior junction boxes located below 8 feet from grade to be equipped with security screws.
 2. Underground junction boxes / vaults to be concrete or stainless steel with security screws. Plastic is prohibited.
 3. Interior junction boxes: No stacked/ganged boxes allowed beyond one extension ring.
- G. Cast EMT fittings are prohibited.
- H. EMT box connectors shall be steel with nylon throats.
- I. Standard long radius elbows are required or District approved equal.
- J. Size branch circuits to allow 4 circuits per classroom.

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- K. Use of existing feeder conduit is encouraged when possible.
- L. Flex conduit is prohibited as a substitute for rigid or EMT conduit.
- M. 6 feet maximum length flex conduit is allowed at devices such as motors.
- N. All conduits shall be routed below the lowest level of a Metal Deck profile.
- O. Minimum Conduit Size: 3/4 inch for power and control unless otherwise noted.
- P. Install conduit seals at boundaries where ambient temperatures differ by 10 degrees F or more.
- Q. Exposed conduits are permitted only in the following areas:
 - 1. Mechanical and electrical rooms or spaces where walls and ceilings will not be covered with finished materials.
 - 2. Existing walls that are concrete or block construction.
 - 3. Route exposed conduit parallel and perpendicular to walls, tight to finished surfaces and neatly offset into boxes.
 - 4. On roofs within 3-feet of device being served. Conduits on roof should be approved by PPS prior to installation and shall be limited to reduce exposure as much as possible.
- R. Surface Raceway
 - 1. Conceal raceway where possible. Use of existing concealed raceway systems is encouraged. Where surface raceway is required, follow these standards:
 - 2. All surface raceway shall be continuous and installed to manufacturers specifications.
 - a. Raceway may be installed on the surface only if extensive repairs will be required for concealment.
 - b. "Wiremold" and Plugmold should be used in labs, classrooms, and all other areas requiring numerous closely spaced outlets.
 - c. Ivory or white colored "Wiremold" and Plugmold fittings, boxes, etc.
 - d. Avoid cutting existing wood trim, backsplashes, and paneling or other interior finish systems.

26-05-53 Identification of Electrical Systems

- A. Wire Identification
 - 1. Phase, neutral and grounding conductors shall be color-coded at equipment terminals, source, and junction boxes. Colored bands or with continuous color insulation are acceptable.

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2. Wiring for 120/208V or 120/240V systems shall be continuously color coded in accordance with the following schedule:
 - a. Phase A-Black
 - b. Phase B (Orange - Wild leg in 240 V Delta)-Red
 - c. Phase C-Blue
 - d. Neutral-White
 - e. Ground-Green
3. Wiring for 277/480 V and 120V systems shall be continuously color coded in accordance schedule:
 - a. Phase A-Brown
 - b. Phase B-Orange
 - c. Phase C-Yellow
 - d. Neutral-Gray
 - e. Ground-Green
 - f. Device labeling:
 - i. All junction boxes and device plates will have an extra strength, laminated, adhesive tape label with a minimum of 3/16 inch letters on clear or white background indicating the circuit number and source.

26-05-73 Electrical Distribution System Studies

- A. Provide System study for all new buildings or additions over 10,000 square feet and for projects with main service replacement. Studies to consist of the following analysis:
 1. Selective Coordination Study.
 2. Short Circuit Study.
 3. Arc Flash Hazard Analysis.
- B. Study Preparer Qualifications: Qualified engineer of switchgear manufacturer or professional engineer.
- C. Provide Arc Flash Labels compliant with NFPA 70E guidelines with (PPE) listed, incident energy and protective boundary.
- D. Installation
 1. Adjust installed protection devices have adjustable settings to conform to the requirements determined by coordination analysis.
 2. Submit report showing final adjusted settings.
 3. Coordinate with contractor to install labels.

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26-06-00 Schedules for Electrical

- A. Electrical Record Drawings
 - 1. Exact routing of feeders and service conduits.
 - 2. Conduit dimensions.
 - 3. Exact location of junction boxes.
 - 4. Exact location of conduits installed for future construction. Provide dimensions and depth of burial.
 - 5. All Drawings of Record shall include a one-line diagram including Sub-panels, and note Switchgear/Panel locations by room number.
 - 6. All Switchgear and Panel Schedules shall be listed on Drawings of Record.

26-06-20 Schedules for Low-Voltage Electrical Distribution

- A. Electrical Labeling
 - 1. Nameplates and labels: Engraved stock melamine or lamacoid plastic laminate in size and thickness indicated below, provide 1/8 inch thick material:
 - a. Letter color: white.
 - b. Letter height: 1/4 inch.
 - c. Background color: black.
 - d. Locations:
 - i. Each distribution and control equipment enclosures and panel boards.
 - ii. Communications cabinets.
 - iii. Transformers.
 - iv. Disconnects and starters.
 - 2. Equipment nameplates: Engraved phenolic plastic, 1/16 inch thick.
 - a. Letter color: white
 - b. Letter height: 1/4 inch.
 - c. Background color: black.
 - 3. Handwritten labeling is not allowed.
 - 4. Provide typewritten branch panel schedules with clear transparent covers accounting for every breaker installed.
 - 5. Label panels with engraved labels.
 - 6. Label junction boxes with panel identification, voltage, and circuit number. Label tape products are acceptable.
 - 7. Label devices with panel and circuit numbers. Label tape products are acceptable.

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8. Label motor controller and disconnects with engraved labels.

26-06-30 Photovoltaic System

- A. Refer to PPS Solar Standard documentation for requirements and additional information. <https://www.pps.net/Page/15497> under Division 26 - Electrical 26-1 Solar Standards
- B. Provide electrical panel and pathway dedicated for future PV system.
- C. Refer to 26-00-00 above.

26-08-00 Commissioning of Electrical Systems

- A. General Requirements
 1. Provide Fundamental Commissioning for LEED projects.
 2. Provide Enhanced Commissioning where requested by PPS.
 3. For small or remodel projects confirm with PPS if commissioning is desired and what system need to be commissioned.

26-09-13 Power Monitoring and Control

- A. Power monitoring and control system of the same manufacturer as the electrical distribution equipment.
- B. Provide power monitor at main breaker and branch panels to obtain individual loads (lighting, receptacle, mechanical equipment, kitchen, etc. per LEED requirement).
- C. Monitoring system to be its own dedicated system, separate from BAS system.

26-09-23 Lighting Controls

- A. All controls to meet or exceed current version of ASHRAE 90.1.
- B. Line voltage relays with occupancy sensors is the standard for existing facilities. Digital lighting controls will be considered for new projects or additions conditional to District approval. Controls systems to not require reprogramming settings if a luminaire or driver is switched out.
- C. Wireless devices to be evaluated case-by-case. No battery-operated devices allowed.
- D. Classrooms (including shops, CTE, Maker Spaces, labs, [Special Education](#))
 1. Use Dual technology sensors with override off switches located at entry doors. Provide capability to lock out classroom sensors during school hours.

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2. Room controllers to be mounted in consistent hidden but accessible ceiling space from classroom to classroom. Where mounted above ceiling tiles, the maximum height above finished ceiling is 3' for accessibility. Label ceiling tile "CONTROL ACCESS".
 3. ON/OFF switch with dimming control at each entry door, and near teaching station at the teaching wall.
 4. Where possible, separate direct from indirect component lighting control in direct/indirect pendant linear lighting system.
- E. Faculty lavatories use occupancy sensors and wall switch.
- F. Mechanical, Electrical, and Data rooms use toggle switches.
- G. Corridors, cafeterias, restrooms, locker rooms, gymnasiums and stairwells use occupancy sensors and key switches.
1. Gymnasiums to have switches to control zoned lighting with dimming to support assemblies, class activities, and events.
- H. Storerooms and workrooms use occupancy sensors and wall switches.
- I. Lounges, and conference rooms use occupancy sensors and wall switches with dimming control.
- J. Breakers controlling lighting circuits are to be high use switch rated.
- K. Refer to sections 26-09-61 and 26-09-69 for lighting requirements in Performing Arts spaces.
- L. Exterior lighting controls including all building exterior locations, site pathways, parking lots, and other exterior common areas to provide adjustment of lamp output from 10% with motion sensing activation to 100% or full output. Provide timeclock control. Coordinate with PPS Security and PPS Electrical shop.
- M. Sports field lighting system controls to comply with the most current version of IDA-Criteria for Community-Friendly Outdoor Sports Lighting and in compliance with jurisdictional requirements. Include sequence of operations to dim field lighting for non-competition events and pre- and post-event work.
- N. Provide automatic control via relay panel. Automatic control is a required upgrade per Oregon Energy Code for remodels.
- O. Power packs and relays are required to be installed in readily accessible locations. Do not install in attics or similar areas.
- P. Field adjust all sensors to optimize coverage.
- Q. Test and commission all sensors.

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26-09-61 Dimming and Controls for Theater Lighting

- A. Include system components and fabrication requirements for dimmers, relays, control stations, control consoles, Stage Manager's Panel, Emergency Lighting Transfer Devices, digital data network and other stage lighting control devices.
- B. Provide dimmers, relays, control receptacles, control stations and processors for a complete lighting control system for general lighting, work lighting and stage lighting in the auditorium and stage, and in the Drama Classroom / Black Box.
- C. System shall be configurable via software, firmware and hardware, utilizing Ethernet and other non-proprietary means.
- D. Include requirements for full system commissioning by factory, along with user training in operation and maintenance.
- E. Include requirements for high-wear and critical need spare parts as directed.
- F. Dimming & Controls for Theater Lighting shall be utilized in Main Theater, and Drama Classroom / Black Box.
- G. Occupancy Sensors used as part of a theater control system shall not be connected to, or part of the general occupancy sensor system, but shall be configured and connected to the specific requirements of the theater lighting controls.
- H. The theater lighting control system shall receive input from the building-wide lighting controls system, but shall arbitrate between following master commands from the building control system, or ignoring commands during rehearsal or performance activities. The theater lighting control system shall auto-reset to following commands from the master lighting controls system when events are completed and no activity is present in the theater or drama class space.
- I. Basis of Design should use the following manufacturers and equipment systems:
 - 1. ETC "Paradigm", "Echo", "IQ" and "Sensor3", for general controls, switching and dimming.
 - 2. ETC "ION XE20, with Universal Fader Wing 40 fader, for production lighting controls.
 - 3. ETC "DEBC", "EDBK", "ELTS2" and "SC1008" for emergency egress lighting controls.

26-09-62 Stage Lighting Distribution Devices

- A. Include system components and fabrication requirements for plug boxes, floor pockets, gridiron junction boxes and connector strips used for theatrical lighting. Define tests, inspections and user training requirements.

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- B. Include floor pockets, plug boxes, connector strips, Grid Junction Boxes, & multi-conductor power cables.
- C. Stage lighting power distribution receptacles to be coordinated with, and matched to, lighting fixture plugs and connectors.
- D. All distribution devices shall include mounting hardware suitable for the location used.
- E. All equipment shall be UL Listed and Labeled for Theater Lighting Use.
- F. Provide clear content on drawings for locations, quantities and fabrication details.
- G. Stage Lighting Distribution Devices shall be utilized in Main Theater, and Drama Classroom / Black Box.
- H. Acceptable Manufacturers
 - 1. ETC
 - 2. SSRC
 - 3. Performance Electric

26-09-69 General Illumination for Performance Spaces

- A. Define special criteria for general illumination, house lighting, work lighting and certain safety lighting in and around the Performing Arts spaces.
 - 1. LED general lighting in auditorium must incorporate the following minimum attributes:
 - a. Fully dimmable from 100% output to 0% output without flicker, whether decreasing or increasing intensity across entire range.
 - b. Color shall be 2700K reference, with not less than 80 CRI rating.
 - c. Controllable by means of daisy-chained DMX/RDM high-resolution digital signal from lighting control system.
 - d. Each fixture shall have a unique assignable control address.
 - 2. Where LED general lighting fixtures in auditorium must dim, but the form factor or type is not available in DMX/RDM control, then 0-10VDC control means is acceptable provided that dimming quality and depth is similar, with no greater than 1/2 of 1% of maximum output is attainable as the low-end level during dimming.
 - 3. Direct line-voltage dimmed LED fixtures should be avoided to the greatest extent possible.
 - 4. LED fixtures that do not require dimming as part of the design application, may have a switched, line voltage input driver / power supply.

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5. Color rendering for LED and all other general-work lighting fixtures on the stage, or in costuming, set construction, makeup, dressing, costuming shop or all other areas where color consistency is critical for production design values, shall be 2700K CCT, and not less than 90 CRI rating for accuracy and consistency in color rendering.
- B. Horizontal illumination levels at seating shall have ability to reach 35FC (maintained) for custodial activities and for teaching/educational events.
- C. Provide egress pathway lighting fixtures that are part of the general lighting system but switch to emergency when appropriate. Comply with code required illumination levels.
- D. Provide aisle pathway minimum illumination by means of integral seat-mounted, shielded LED lighting units and low-wall mounted shielded step lighting fixtures. Color temp shall be 2700K and lighting cutoff angle shall not exceed 85 degrees above nadir. Minimal illumination shall be per current code.
- E. All lighting fixtures in the auditorium, catwalks, galleries, stage shall be controlled by the system in 26-09-61, except for EXIT sign fixtures.

26-09-99 Electrical Work for Theater Equipment of Other Divisions

- A. Provide drawing and specification content under Division 26, to direct the Contractor to provide all appropriate equipment installation, electrical conduit, wireway, standard backboxes, line and low voltage wire and terminations required for the equipment furnished under the following specification sections:
 1. 11 61 61 – Stage Rigging and Drapes: Electrical power and control for motorized stage rigging hoists or other powered stage rigging equipment, including drapery track or acoustical banner operators.
 2. 11 61 64 - Flown Acoustic Concert Reflector: Distribution devices, installation and connection of power and control wiring to lighting fixtures which are furnished as an integral part of the flown acoustic concert shell reflector assemblies that are on the stage.
 3. 12 61 13 – Fixed Audience Seating: Raceways, wiring and connection to the low-voltage aisle lighting fixtures that are furnished as an integral part of the seating units. Installation and wiring /raceway for low voltage power supplies which are furnished by the seating manufacturer.

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26-22-00 Low-Voltage Transformers

- A. Installation of transformers above the floor level is prohibited without pickpoint. Coordinate with PPS program manager for review and approval.
- B. Dry type autotransformers, “K” type to change 208V to 120/240V circuits.
 - 1. K rated transformers shall be used in all locations
 - 2. K-4 for the following loads: Discharge Lighting, UPS w/optional input filtering, Welders, Induction heating equipment, PLCs and Solid-State Controls.
 - 3. K-13 for the following loads: Telecommunications equipment, UPS w/o input filtering, concentrated computer workstations.
 - 4. K-20 for the following loads: Computer/server rooms, VFDs.
 - 5. Sized to reduce harmonic distortion, for shops, range and dryer outlets.
 - 6. Provide Class 220 insulation with 80 degree C average temperature rise.
 - 7. Sound levels: NEMA ST 20.
 - 8. Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.
 - 9. Impedance range: 3 to 5 percent. Minimum reactance 2 percent.
 - 10. Installation
 - a. Set transformers plumb and level.
 - b. Provide seismic restraints.
 - c. Minimum clearances per manufacturers’ installation instruction. Front clearance per NEC 110.
 - d. For exterior installations, provide concrete housekeeping pad, minimum 3 inches thick.
 - e. Perform turns ratio tests at tap positions and adjust as required.

26-23-00 Low-Voltage Switch Gear

- A. Distribution Switchboards
 - 1. New service and distribution equipment shall be freestanding metal-enclosed and seismically braced, dead-front type with bus bracing for a minimum interrupting current capacity of 100,000 amperes (A.I.C.).
 - 2. Installing distribution gear in the basement is discouraged. If installed in basement, a drain or sump pump is required. Coordinate with PPS Facilities and Maintenance for installation and access requirements.
 - 3. Acceptable brands are Square D, Siemens, Cutler Hammer, GE or District approved equal.

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4. Available fault current will be utilized to calculate and label all Switchgear with Arc-Flash hazard level and PPEs required.
 5. Bus material: Copper.
 6. Neutral Bus: 100 percent rated, full length of switchboard.
 7. Ground bus shall be provided in each section for continuous ground continuity.
 8. Service and distribution equipment shall be of the fusible switch type, except for the main switchboard where a molded case main circuit breaker shall be used.
 9. The main circuit breaker shall be 100% rated with short circuit interrupting capability of 65K RMS symmetrical amperes.
 10. NEMA Standard PB-2 and UL 891 compliant.
 11. Over current protective devices shall be selected to clear any fault current that may be subjected to without damage to equipment.
 12. Fusible switches shall be "J" type to 600 amperes and "L" type above 600 amperes.
 13. Fusible switch shall be identified with an engraved nameplate. Cardholders are not acceptable.
 14. Locate service and distribution equipment to permit future expansion.
 15. Avoid locating service and distribution equipment in high ambient temperature areas such as boiler rooms.
 16. Size service equipment for total connected load plus minimum 1.5 times design capacity.
 17. Provide space in switchboard for future switches or circuit breakers.
 18. Provide spare capped conduits stubbed into accessible areas from switchboard unless such conduits can be installed with little difficulty in the future.
 19. Generally, replace existing single phase of 120/240 V 3 phase delta systems with a 120/208V 4-wire WYE system.
 20. Provide common bonding point at main service for other grounding systems to terminate.
- B. Branch Circuit Panels
1. All panels will be labeled with Arc-Flash hazard level and PPEs required.
 2. Panels shall be Panel Board type and "door in door" construction with hinged doors. Acceptable brands are Square D, Siemens, Cutler Hammer, GE or District approved equal.
 3. Flush lift latch and locks keyed to match building standard.

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4. Use compression lugs on all feeder conductors. Set screw lugs not permitted.
5. Equipped with molded case thermal magnetic circuit breaker having a minimum interrupting rating of 20,000 A.I.C. or greater if available fault current exceeds 20 A.I.C.
6. Bolt-on type circuit breakers.
7. All breakers shall have "SWD" rating.
8. Permanent numbers, engraved, stamped or painted shall be affixed to each panel next to breakers.
9. Stick-on numbers are not acceptable.
10. Panels shall be identified with engraved nameplates.
11. All branch circuit conductors shall be labeled at breaker with circuit number.
12. Branch circuit conductors shall be labeled at junction boxes and devices with Panel ID and circuit number.
13. Lighting: Provide separate panels with switch rated breakers.
14. Instructional technologies: Provide dedicated panelboard/s sized to provide minimum of 4 dedicated receptacle circuits per Non-computer Lab classrooms.
15. Branch panels: New, 42 circuits, 225 Amp (or larger if load warrants it) 3 Φ , 4 wire with copper buss, with neutral and ground busses rated at 200%. Provide sub-feed lugs for future connection of additional panel board. Provide isolated ground buss rated the same as neutral buss. Complete hinged cover.
16. Futures: Flush mounted branch panels. Provide (three) 3/4-inch diameter capped conduits and (two) 1" electrical conduits into accessible spaces above and below.
17. Locate branch panels near center of loads.
18. Panels to be equipped with factory installed surge protective devices (SPD) built into panels. Factory approved components shall be used where retrofitting panels with SPD.
19. Circuits shall be identified for use and location, including room numbers, in panels with complete panel schedules attached.
20. Provide handle guards on each circuit supplying obviously constant loads such as fire alarm, security, lighting controls, refrigerators, freezers, and fire protection.
21. Breakers being added to existing panel boards: Coordinate breaker type and short circuit rating with existing panel board. Provide new schedule in clear, typed lettering in PDF format. Scans of handwritten or other non-OCR data are not acceptable.

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26-27-26 Wiring Devices

- A. All devices shall be UL approved and labeled.
1. Motor Starters or VFDs shall be Allen Bradley or District approved equal and located in accessible lighted areas.
 2. VFDs, at a minimum, shall incorporate an appropriately sized internal or external Line Reactor.
 3. Duplex receptacles shall be 20 AMP, Spec Grade minimum, tamper resistant.
 4. GFI receptacles shall be 20 AMP, Spec Grade minimum.
 5. All receptacles shall be the grounding type.
 6. Use exceptions (see 2021 OEESC 8.4.2) in the energy code to avoid use of controlled receptacles where possible. Use of controlled receptacles are discouraged.
 7. Overhead pull-down outlets with 14 AWG Cord, seismically braced. Reelcraft LD2030 Cord Reels or District approved equal. Unit must be secured with one visible quick link chain loop through the hoop bolt at top of frame. See Cord Reel Detail - <https://www.pps.net/Page/15497> Under Appendix A Detail Drawings S-301 Typical Cord Reel Mount.
 - a. No plastic retracting rotators allowed due to durability issues.
 8. Multi-outlet assemblies shall not be used where individual receptacles cannot be replaced.
 9. Color: ivory.
 10. Control switches rated 20 AMP.
 11. Single pole, double pole 3-way and 4-way switches shall be toggle-type, or keyed type when specified elsewhere in this document.
 12. Light Switches shall be located adjacent to room entry doors on the door strike side.
 13. Device plates and covers shall be brush finish stainless steel. Plastic device covers are allowed 8' and above at wall and ceiling installations to match adjacent finish color for aesthetics and as acceptable per Electric Shop.
 14. Floor receptacles are discouraged in locations where they are not required by code.
 15. When floor receptacles are necessary, provide flush type with brass cover and flange. Types: "Hubble", "Walker duct", "Steel City" or District approved equal.

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B. Installation

1. Ivory or white colored “Wiremold” and Plugmold fittings, boxes, etc.
 2. Secured to minimize vandalism.
 3. Use of existing concealed raceway systems is encouraged.
 4. Classroom computers: Provide minimum of 5 duplex receptacles:
 - a. Outlets centered on designated network connection.
 - b. Spaced 3’-0” on center.
 - c. Locate to minimize vandalism.
 5. Corridors: Duplex receptacles, each side on separate circuits. Each side 50 foot on center placed alternating sides 25-foot centers overall.
 6. Lavatories and toilet rooms, locate duplex receptacles in corridors near entry. Do not install in lavatories or toilet rooms.
- C. For wiring devices and enclosures for Theater and Drama Classroom / Black Box production lighting use, refer to 26-09-62 above.**

26-29-23 Variable Frequency Motor Controllers

- A. All motors under VFD control shall be VFD Duty rated and equipped to mitigate bearing currents.**
1. VFDs will have integral Harmonic Mitigation or have appropriately sized Line Reactors installed.

26-32-13.13 Emergency Motor Generator

- A. Packaged Generator System**
1. New and modernized schools must provide a new generator.
 2. For projects that have spaces that serve community disaster and emergency management support, include option for electrical infrastructure for a mobile temporary generator to serve loads associated with this support to reduce overall size of the permanent emergency system.
 3. Generator to serve exit lighting, egress lighting, emergency lighting, kitchen cooler and freezer, intrusion alarms, programmed clock systems, PBX phone system, communications / wifi including cooling systems, and EMS systems control power. PPS Electric Shop prefers that the fire alarm is not on the generator due to damage to power supplies during transfers.
 - a. Preferred spaces to be included on standby power if project allows: Gymnasiums, Commons, and Main Office.

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4. Generator set will meet requirements for Level 1, Class 96, Type 10 system as per NFPA 110. System will be capable of providing power within 10 seconds following loss or failure of normal power supply. It will accept full load at each level of priority in single step.
 5. Voltage and load rating of generator set is as indicated on drawings. Load rating to be for standby; prime; or continuous service at 0.8 power factor and derated to allow for operation of accessories (cooling fan, pumps, radiator, fan, air cleaners, lubricating oil pump, fuel injection pump, jacket water pump, governor, charging generator, alternating current generator, exciter regulator and alternator) and for service at an altitude 500 -feet in -20-degree F to 110 degree F ambient temperature.
 6. [PPS Climate Crisis Response Policy](#) and Sustainability
 - a. Use of propane and natural gas generators is prohibited.
 - b. Evaluate use of one or more central battery inverters in lieu of the life safety emergency branch distribution system. Coordinate with PPS program administrator.
 - c. Evaluate use of a portion of State of Oregon's 1.5% mandate for renewable energy funds for a battery emergency storage system (BESS) connected with the standby branch system with solar photovoltaic energy production to reduce fuel usage. Coordinate with PPS program administrator.
 - d. Evaluate genset best suited for transition to bio diesel systems. Evaluate whether generator may be acceptable for project to run on bio diesel for systems not backing up life safety (NEC 700) or legally required standby systems (NEC 701). Fuel has been discouraged from use in emergency standby generators because the manufacturer cannot foresee the actual shelf-life before fuel degrades and cannot foresee the effects of inconsistency between batches of fuel from different suppliers on these critical systems. Coordinate with PPS program administrator.
 - e. If BESS is not installed part of current project but is planned to be included in the future, provide allocated space at building exterior as part of the design.
 - f. If BESS is used, provide for exterior plug to support alternate stand-by generator that can be added in case of catastrophic event sized to support the standby loads.
- B. Engine
1. Type: Water-cooled, four stroke cycle, compression ignition Diesel internal combustion engine producing 1.5 Hp per Kw.

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2. Emissions: Engines must comply with current Federal EPA Tier for Exhaust Emissions and possess Best Available Current Technology to provide absolute minimum smoke, fumes, and exhaust emissions discharge.
 3. Engine Speed: 1800 rpm.
 4. Safety Devices: Engine shutdown on high engine temperature, low oil pressure, over speed, and engine over crank. Limits as selected by manufacturer.
 5. Engine Starting: DC starting system with positive engagement, number and voltage of starter motors in compliance with manufacturer's instructions. Include remote starting control circuit, with MANUAL-OFF-REMOTE selector switch on engine-generator control panel.
 6. Engine Jacket Heater: Thermal circulation type water heater with integral thermostatic control, sized to maintain engine jacket water at 90 degrees F.
 7. Engine Accessories: Fuel filter, lube oil filter, intake air filter, lube oil cooler, fuel transfer pump, fuel priming pump, gear-driven water pump. Include fuel pressure gauge, water temperature gauge, and lube oil pressure gauge on engine/generator control panel.
 8. Mounting: Unit to be mounted on structural steel base and be provided with spring type vibration isolators and seismic restraints as required. Restraints/isolators to be in compliance with seismic design requirements.
- C. Fuel System
1. Fuel Oil: No. 2 diesel conforming to VV-F-800. Diesel engines requiring premium fuels will not be considered.
 2. Fuel System Accessories: Fuel filter, fuel/water separator, fuel cooler, fuel transfer pump, fuel priming pump, injection pumps, lines, and nozzles. Transfer pump will deliver fuel under low pressure to individual injection pumps - one for each cylinder. Nozzles will inject fuel directly into cylinder in optimum spray pattern for efficient combustion.
 3. Provide dual fuel filters, independently valved.
 4. Unit fuel injector to be mounted in each cylinder head, with external feeder lines requiring less than 5 bar (75 PSI) fuel pressure. As function of maximizing efficient combustion and minimizing exhaust smoke levels, injection timing and duration will be electronically controlled by an engine-mounted Electronic Engine Control Module, with injection pressure accomplished by piston pump driven from engine camshaft.
 5. Engine: Mounted integral manual fuel-priming pump to facilitate priming and bleeding air from system.

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6. Filter/Separator: In addition to standard fuel filters provided by engine manufacturer, there will be installed primary fuel filter/water separator in fuel inlet line to engine.
 7. Unit mounted fuel piping to be black iron or flexible fuel hose rated for this service. No galvanized piping will be permitted. Flexible fuel lines will be minimally rated for 300 degrees F and 100 PSI. Shield flexible fuel lines from potential vandalism and operational impacts such as standard equipment movement.
 8. Fuel cooler, as required, to be mounted on radiator and cool fuel before return to day tank.
 9. Generator to be equipped with a Fuel Technologies International fuel polishing system (Model FTI-1.5A).
- D. Construction
1. Provide generator with revolving field, single bearing type, coupled directly to engine flywheel through a flexible driving disc for positive alignment. Provide rotor dynamically balanced up to 25 percent over speed.
 2. Provide generator of heavy duty, compact design. Insulation is Class H or better on stator and rotor, as recognized by NEMA MG-1 and both will be further protected with 100 percent epoxy impregnation and overcoat of resilient insulating material on end coils to reduce possible fungus and/or abrasion deterioration. Generator is equipped with full amortisseur windings for paralleling.
 3. Permanent magnet or AREP excitation system to derive excitation current from pilot exciter mounted on rotor shaft. It will enable alternator to sustain 300 percent of rated current for ten seconds during fault condition.
 4. Digital Voltage Regulator: Microprocessor based with fully programmable operating and protection characteristics. Regulator will be capable of sensing true RMS in three phases of alternator output voltage, or operating in single phase sensing mode. It will exhibit the following operational characteristics:
 - a. Alternator output voltage maintained within plus or minus 0.25 percent at steady state conditions.
 - b. Alternator output voltage maintained within plus or minus 0.25 percent of rated value for any load variation between no load and full load.
 - c. Alternator output voltage drift no more than plus or minus 0.25 percent of rated value at constant temperature.

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- d. Alternator output voltage drift no more than plus or minus percent of rated value within 40 degrees C change over ambient temperature range of -40 degrees C to 70 degrees C.
 - e. Response time less than 20 milliseconds.
 - f. Voltage buildup with alternator output as low as 6 volts.
 - g. At full throttle engine starting, output voltage overshoot no more than 5 percent of its rated value, with respect to volts/Hz curve. Meets ISO 8325-3 class G2 specifications.
 - h. Power dissipation 55 W at 15 amps; <100 ma at rest.
 - i. Telephone Influence Factor (TIF) of less than 50.
 - j. Electronic Interference/Radio Frequency Interference (EMI/RFI) suppressed to MIL.
 - k. STD 461C Part 9 and VDE 875 level N.
 - l. Maintain stable voltage control with 20 percent total harmonic distortion.
5. Voltage regulator to include the following features:
- a. Voltage level rheostat to provide alternator output voltage adjustment of minus 10 percent to plus 10 percent of nominal. This will be in addition to programmable output voltage level of minus 25 percent to plus 10 percent.
 - b. Automatic gain adjustment to provide output voltage compensation for changes in load or frequency.
 - c. Manual gain adjustment 0 to 10 percent to provide compensation for line losses between alternator output terminals and load.
 - d. Reactive droop adjustment programmable to allow paralleling without interconnect wiring between alternators, with 10 percent minimum droop at full load and 0.8 PF.
6. Provide generator output circuit breaker integral to generator output terminal enclosure.
7. Remote annunciator panel to monitor breaker and report trouble signal when open.
- E. Generator Set Performance
- 1. Provide voltage regulation from no load to rated load within band of plus or minus 0.5 percent of rated voltage. Steady state voltage stability remains within 0.5 percent band of rated voltage. Steady state voltage modulation does not exceed 1 cycle per second.
 - 2. For addition of load up to and including 100 percent of rated load, voltage dip does not exceed 15 percent of rated voltage. Voltage recovers to and maintains within steady band in not more than 1.5 seconds.

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3. Frequency Regulation: Steady state no load to steady state rated load. Random frequency variation with any steady load not to exceed plus or minus 0.5 percent. For addition of load up to 90 percent of rated load, frequency recovers to steady state frequency band within 5 seconds.
 4. Alternator produces clean AC voltage waveform, with not more than 5 percent total harmonic distortion at full linear load, when measured from line to neutral, and with not more than 3 percent in any single harmonic, and no third order harmonics or their multiples. Telephone influence factor: Less than 40.
 5. Engine manufacturer certifies generator set to be suitable for use at installed location and rating, and will meet applicable exhaust emission requirements at time of commissioning.
- F. Diesel generator suitable for exterior. Interior generators are prohibited.
1. Provisions shall be made for temporary connection of a Load Bank. Type shall be Crouse-Hinds ED200 or ED400 Posi-lock with all phases, Neutral and Ground present. No substitutions.
 2. UL2200 listed.
 3. Preferred location, away from residential properties, secured in alcove or courtyard accessible for fuel delivery. If any part of the generator footprint is within 20 feet of exterior building walls, exhaust must be plumbed to exit above the roof line. Location(s) to be reviewed and approved by District Electrical Foreman.
 4. Minimum enclosures, 9-gauge cyclone fence material. Framed with schedule 40 pipe including roof supports, secured with padlocked door.
 5. Generator enclosure must be sound rated. Consider neighborhood noise factor. Factor and compliance with applicable noise ordinances.
 6. Capacity for 24 hours of operation.
 7. Automatic weekly self-test, half hour Monday between 6 and 7 AM.
 8. Exercise time clock to be integrated in ATS i. e. ASCO ATS.
 9. Manufacturers, "Cummins", "Caterpillar" and "Kohler" or District approved equal.
 10. Confirm with District if resistive load bank is required as part of the project.
 - a. Load bank overall tolerance -5 to +5 percent kW at the rated voltage. Deliver fully rated kW at the rated voltage.
 - b. Standard remote load dump circuit.

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- c. Provide ability to remove the load bank off-line from operation with a remote normally closed set of auxiliary contacts from a transfer switch or other device. In the event of the remote contact opening, all load is removed.
 - d. Provide Radiator/Duct mounted load bank as a supplemental load to the generator set sized at 50-60 percent of the generator kW rating.
 - e. Cooling: Verify engine generator provides the required amount of air, CFM, to cool the load bank, maintain the load bank and generator warranty compliance, and not exceed the static pressure required to operate the engine generator at load.
11. Confirm with the District if a temporary generator hook up is required as part of the project.

26-36-23 Automatic Transfer Switches

- A. Automatic transfer switches branded by ASCO or of the same manufacturer as the engine generator equipment.
 - 1. Transfer Switches
 - i. 4-pole type provided with a switched neutral pole.
 - ii. Neutral pole of the same construction and have the same ratings as the phase poles.
 - iii. Switch poles simultaneously using a common crossbar.
 - 2. Provide relays and control circuits to obtain fixed preferential control with transfer switch connected to the normal source of power under normal conditions.
 - 3. Provide a manual operator for maintenance servicing of the transfer switch in accordance with UL-1008.
 - 4. Provide an override switch to bypass the automatic transfer controls so that the transferred switch will remain indefinitely connected to the standby power source, regardless of the condition of the normal power source.
 - 5. Each automatic transfer switch furnished with voltage sensing relays for each phase. Connection of these sensing relays made to the normal power input terminals of the transfer switch. Voltage range field adjustable.
 - 6. Install automatic transfer switch in a NEMA Type I wall mounted enclosure conforming to NEMA ICS and comply with the requirements of UL-508.

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26-42-00 Cathodic Protection

- A. Corrosion Control
 - 1. Systems piping shall be installed with corrosion control integrated into the approach.
 - 2. Underground systems protected by cathodic protection magnesium anodes or impressed direct current.

26-43-13 Surge Protection Devices

- A. Same manufacturers being provided for switchboards and panelboards.
- B. Compatible with the electrical system voltage, current, system configuration and intended applications and NRTL listed for such application.
- C. Parallel design only with individual protection components:
 - 1. Line to Ground and Line to Line for Delta and High Resistance Grounded systems.
 - 2. Line to Ground, Line to Neutral and Neutral to Ground for Wye and Single Phase distribution systems.
- D. Short Circuit Current Ratings (SCCR): Suitable for location SPD is to be installed.
- E. Visual indication of protection status on each phase, visible from the front of the equipment.
- F. Protection Status
 - 1. Normally open and normally closed contacts for remote monitoring.
 - 2. Rated a minimum of .5A, AC or DC.
 - 3. Change state upon device failure or loss of power.
 - 4. As a minimum, Branch Panel, Sub-Panel and series installed (branch circuit) SPD includes a passive circuit which allows the SPD to actively follow the voltage waveform and provide a clamping envelope to limit low level IEEE C62.41 Category A ring waves (of either polarity) at all locations on the sine wave. Circuit to perform in the Neutral to Ground Mode.

26-50-00 Lighting

- A. Defer to PPS Energy Program Manager for corrections/additions/substitutions of lighting sections 26-50-00 through 26-56-68.
 - 1. PPS encourages the use of new emerging technologies that provide high quality lighting with greater efficiency. Designer and manufacturers should ~~contact~~ provide product information to the PPS Energy Specialist Facilities with product information for review and approval.

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2. The ~~owner-District~~ has adopted energy conservation measures. All applicable LED products should be certified through the Energy Trust and Design Lights Consortium (DLC) or Energy Star Certified. See the following links for reference:
 - a. <http://www.designlights.org/>
 - b. [Energy Star product finder](#)
 3. Designers are encouraged to introduce documented energy conserving devices into lighting system designs.
 4. New construction and modernizations should minimize the number of different fixture types for ease of maintenance.
 5. ~~The~~ District requires wall mounted fixtures for stairways. Ceiling perimeter fixtures and other fixtures accessible from a stair or ramp landing are only acceptable as reviewed and approved on a case-by-case basis. See 26 00 00 H.
 6. Maximum District lift working height is 36'.
- B. Luminaires
1. Suspended luminaires: Provide minimum of 24-inch adjustability in cable length.
 2. Recessed luminaires: Frame compatible with ceiling material. Provide proper factory trim to fit location and ceiling material. Avoid mud-in trims unless fixture is modular to allow components to be replaced without damage to finish or extensive finish repair.
 3. Plastic diffusers: 100 percent virgin acrylic.
 4. Prismatic acrylic: 0.125 minimum thickness.
 5. Provide wire guards on all exposed lamps.
 6. Ballast total harmonic distortion not to exceed 20 percent of input current.
 7. Provide manufacturer's warranty covering luminaire system for a minimum of 5 years, preferred 10 years from date of installation.
 8. Extra attic stock recommended for fixtures in critical areas that require light levels to be maintained, such as exit path locations. Quantity of all attic stock to be determined by design team and ~~owner~~PPS Facilities. Parts to be stored on campus.
 9. Old luminaires to be recycled to the extent possible.
- C. Lighting Levels
1. General classrooms: 15 foot candles for dedicated computer use, 40 foot candles for paper tasks, max watts / square foot in compliance with current energy code and PPS requirements.
 2. Offices: 30-50 foot candles.

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3. Study halls: 30 foot candles.
 4. Science labs: 50 foot candles at benches and 100 foot candles at demonstration areas.
 5. Shops: 100 foot candles.
 6. Corridors: 5-10 foot candles.
 7. Restrooms: 5-10 foot candles with 10-20 foot candles at showers and 15-30 foot candle at vanities.
 8. Stairways: 10-20 foot candles.
 9. Cafeterias and similar areas: 15-30 foot-candles.
 10. Elementary and non-competition / performance gymnasium: 30 minimum average foot-candles of general illumination
 11. Middle Schools competition / performance gymnasium: 50-75 foot-candles of general illumination.
 12. High Schools competition / performance gymnasium: 75 foot candles of general illumination.
 13. Under no circumstance will any interior space exceed 2.1 watts/square foot.
- D. Interior Lighting - Existing Facilities
1. The following standards are to be used for small remodels or repairs of existing buildings.
 2. Match existing lighting fixtures when the product is available. Use the most current technology sources wherever possible.
 3. Replace incandescent luminaires and other outdated ~~or energy~~-inefficient products with current technology to comply with code and PPS requirements.
 4. Indirect lighting is acceptable ~~win~~ in certain spaces, such as offices and computer labs.
 5. If replacing existing fluorescent lamps, use LED tube replacement lamps of color temperature to match existing. PPS standard color temperature for interior lighting is ~~34~~4000k.
 6. Entire room conversion to LED is required when the majority of fixtures are impacted. Review with Energy Program Manager and Electric Shop Senior Manager.
 7. Fixtures are to be free of noise.
 8. Provide flat, opaque, light diffusing, replaceable lenses.
 9. Fixtures are to be selected for maximum durability.

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10. Vandal-resistant fixtures are required for gyms, cafeterias, restrooms, and non-supervised spaces open to students and CUB users such as stairs and other common areas.
 11. Pendant or suspended ceiling flush mount:
 - a. Fixtures hung by chains are not preferred.
 - b. Finish: white, 85% minimum reflectance.
- E. Interior Lighting - New Facilities or Full Facility fixture Upgrades
1. Provide energy efficient (LED) high quality lighting fixtures.
 2. Lighting fixtures are to be selected for maximum durability.
 3. Fixtures hung by chains are not preferred.
 4. Vandal-resistant fixtures are required for gyms, cafeterias, restrooms, and non-supervised spaces open to students and CUB users, such as stairs and other common areas.
 5. Submit product cut sheets with lighting plans to design team and the District for review and approval. See 26 00 00 H.
 - a. All luminaires to be Energy and Sustainability approved.
 - b. For product deviation approval, submit cut sheets to [the District project representative, PPS](#) Energy and Sustainability and the [PPS](#) Electrical Shop.
- F. Lighting for Classrooms
1. Where ceiling height is 11'-6" or higher, use pendant or suspended linear direct/indirect luminaires. Where ceiling height is 11'-0" or lower, use recessed ceiling mount luminaires or fixtures to match existing conditions in existing facilities; in new or substantially renovated facilities use direct/indirect fixtures.
 2. LED fixtures with dimming down to 1% minimum for smooth dimming and daylight switching transitions.
 3. Specification quality driver to be used to minimize potential flicker, confirm smooth dimming, and provide modularity for maintenance replacement.
 4. All LED drivers/dimmers to be specifically designed and documented for compatibility with LED fixtures.
 5. Fixtures with direct lamp source to have volumetric diffusion lenses.
 6. Pendant mounted Indirect or direct/indirect LED source is recommended.
 7. Vertical illumination on wall to be no less than 1/3 of the level on the work surface.
 8. Provide daylight dimming for fixtures within 20 feet of windows or skylights.

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9. Maximum of 35 foot-candles maintained at full output.
- G. Lighting for Special Education ~~Classrooms~~Sensory Rooms
1. LED fixtures with tuneable color temperature capabilities and full range dimming down to 1% minimum (.1% preferred) to allow teachers to control the color temperature and intensity of light output.
 2. If LED lamps with fixed color temperature are used then they should not exceed 2700K and have dimming down to 1% minimum (.1% preferred).
 3. All LED drivers/dimmers to be specifically designed and documented for compatibility with LED fixtures.
 4. Fixtures with direct lamp source to have volumetric diffusion lenses.
 5. Pendant mounted indirect or direct/indirect LED source is preferred.
 6. Vertical illumination on wall to be no less than 1/3 of the level on the work surface.
 7. Provide daylight dimming for fixtures within 20 feet of windows or skylights.
 8. Maximum of 35 foot-candles maintained at full output.

26-52-00 Emergency Lighting

- A. Provide an external identifier (“E”) on all emergency lighting system fixtures.
 1. Emergency Power System: Per current local and national code requirements.
 2. Emergency lighting required in all multi-stall restrooms.

26-53-00 Exit Signs

- A. Battery powered – by written request and district approval only.
 1. High abuse vandal resistant all conditions.
 2. Exit signs to be substantially white in color with green lettering.
 3. Approved manufactures “Lithonia Extreme”, Kenall Trailmate 6500 high abuse” LED or Cold Cathode or District approved equal.
 4. Incandescent is not allowed.

26-56-16 Parking Lighting and Security

- A. Fixture selection and placement for parking areas is to minimize glare to occupied spaces both within and beyond site property line in alignment with jurisdictional requirements and International Dark-Sky Association (IDA) recommendations.

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- B. 3000K color temperature, LED, full cut-off (fully shielded), Dark Sky Certified lighting fixtures are required. Coordinate with PPS Security to confirm illumination approach for all parking lighting, including at 'back of house' or service spaces as well as parking lots.
- C. Fixtures requiring a boom truck to be installed no higher than 40 feet from the adjacent hard surfacing used for truck access.
- D. Installation height of exterior fixtures is to be high enough to mitigate vandalism. Coordinate with PPS Security and Maintenance to review proposed installation locations.
- E. Photoelectric controls and time clocks with skip-a-day and manual override bypass.
- F. Key or standard switches shall not be used.

26-56-33 Walkway Lighting

- A. Exterior Door and Pathway Lighting
 - 1. Provide illumination at all exterior doors and pathways to the right of way in compliance with jurisdictional and PPS requirements.
 - 2. 3000K color temperature, LED, full cut-off (fully shielded), Dark Sky Certified lighting fixtures are required. Coordinate with jurisdictional requirements and PPS Security to confirm illumination approach for all exterior door and pathway lighting. Vandal resistant cast metal base with poly carbonate lenses.
 - 3. Stainless steel vandal resistant wire guards are acceptable.
 - 4. Photoelectric controls and time clocks with skip-a-day and manual override bypass. Alternate, included as part of the Energy Management System.
 - 5. Fully programmable time clocks. Intermatic ET9000 Series or District approved equal.
 - 6. Key or standard switches shall not be used.

26-56-68 Exterior Athletic Lighting

- A. Sports Field and Stadium (Grandstand) Lighting
 - 1. All sports field lighting systems to comply with the most current version of IDA-Criteria for Community-Friendly Outdoor Sports Lighting with field illumination levels as recommended in the most current version of IES guidelines for sports and recreational area lighting. Coordinate with PPS Athletics to review and approve each design proposal, including illumination levels, controls programming and access information. See 26 00 00 H.
 - a. Include fixture rigging for lowering fixtures during maintenance.

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- b. Include dimming control for field lighting and incorporate into sequence of operations.
 - c. Include option for manual overrides during emergencies and for early shut-off.
 - d. Include dimming control for lower illumination levels during non-competition events and pre- and post-event work. Incorporate into sequence of operations.
- B. Covered Play Areas and Sheds
- 1. Provide illumination at all covered play areas and sheds in compliance with jurisdictional and PPS requirements.
 - 2. 3000K color temperature, LED, full cut-off (fully shielded), Dark Sky Certified lighting fixtures are required. Coordinate with jurisdictional requirements and PPS Energy Program Manager, PPS Electrical Shop Senior Manager, and PPS Security to confirm illumination approach and fixture selection.
 - 3. Lenses to be high impact resistant Lexan or polycarbonate.
 - 4. Fixtures to be equipped with fall protection chains.