SECTION 26 00 00 – ELECTRICAL NARRATIVE

PART 1 - GENERAL

1.1 GENERAL

A. Scope
1. This electrical scope narrative and specifications is intended to provide general direction for the design and initial cost budgeting for the electrical system design for power, lighting, and special systems.

B. Work Included
1. The electrical work shall comply with architectural, structural, and mechanical requirements and all documents referred to therein.
2. The work will be installed in compliance with all local, state and national codes including the 2017 National Electrical Code with the State of Washington and the City of Seattle Amendments. In addition, standards for NHL and NBA facilities shall be used as a guideline.
3. Materials, equipment and installation will be to above codes, and generally accepted good practice.

C. System Scope
- The following list of systems and components is included under this general electrical provision:
- Utility Service
- Secondary Distribution
- Emergency Power System
- Mechanical Equipment & Connections
- Branch Power Receptacles & Connections
- Concession Power & Connections
- Lighting & Lighting Control
- Fire Alarm System
- Lightning Protection System
- Equipment List
- General Electrical Requirements

1.2 INTENT

A. This narrative provides information, consistent with the level of detail available at a concept level to help confirm the cost and configuration of the Electrical systems.

B. All systems shall be constructed in accordance with all appropriate building codes and be installed complete for a fully-functional facility.

C. The design intent is that the electrical systems enhance the facility's flexibility of use, provide a safe and comfortable environment, optimize energy consumption, and minimize maintenance costs, all for the lowest possible construction cost.

D. This Narrative supplements the concept drawings and includes details that may not be reflected on those plans.

E. The Contractor's Scope of Work shall be based on all drawings and narratives including architectural, structural, mechanical, plumbing, electrical, civil, and landscape. All systems shall be priced as complete, working systems. The Contractor shall review this narrative and the drawings for "scope" not "take-offs." The Contractor shall price all components necessary to extend the Schematic Design drawings to full and complete working systems. In the case of discrepancy between this narrative and the drawings, this narrative shall take priority.

PART 2 - DESCRIPTION

2.1 DESCRIPTION OF WORK

A. Demolition
   1. Service
      a. Remove the existing primary switchgear line-up and all associated medium voltage feeders.
      b. Coordinate removal of the Seattle City Light (SCL) primary switches and transformers.
      c. Remove existing services, unit substations within the arena, West Court Building and the NASA Building.
   2. Building Equipment and Lighting
      a. Remove all existing electrical distribution equipment – including but not limited to all switchboards, transformers, panelboards, transfer switches, feeders, etc.
      b. Remove all existing devices – including but not limited to all outlets, light fixtures, disconnects, branch wiring, etc.
      c. Remove all existing fire alarm devices – including but not limited to all notification devices, control panels, wiring, etc.
      d. Remove the existing diesel generator set.
   3. General Demolition
      a. All demolished equipment shall be disposed of according to all local, state and federal requirements including recycling.
      b. Owner has first right of refusal for equipment.

B. Utility Service
   1. The basis of the arena utility service will consist of two underground 13.8 kV circuit feeders from Seattle City Light (SCL) that will enter the building at the south end and terminate at a medium voltage switchgear lineup.
      a. Primary Metered: This method of service will consist of SCL providing two 13.8 kV feeders which will each be terminated to a medium voltage switchgear line-up. The customer will be responsible to connect to the 15kV switchgear, 13.8 kV to 480 volt dry type substation transformers, 277/480 volt unit substations and 15kV cable required to feed each of the substation transformers. This service will require the customer to maintain all 15kV switchgear, 15kV feeders, unit substations and 600volt equipment downstream. It is our recommendation to improve the reliability of this type of service that the customer's 15kV main service switchgear be configured in a main-tie-main arrangement with an automatic throw-over which transfers to the other SCL transformer source should one 13.8 kV feeder or transformer fail.
      b. Secondary Metered: Given the site constraints, a secondary service is not under consideration at this time.
   2. Primary service shall have the following:
      a. This contractor shall provide incoming medium voltage conduits from the street to the main electrical room. The 13.8 kV incoming cabling will be provided by SCL.

b. This contractor shall provide the 13.8 kV switchgear configured in a main-tie-main arrangement with automatic throw-over vacuum main breaker devices, utility metering and fusible load interrupter switches to serve the unit substations.
c. A total of seven (7) 2500/3330 kVA, 4000 amp unit substations will be required. A 500 kVA, 1600 amp fire pump unit substation will be required.
d. The unit substations shall include a dry type transformer rated for 2500/3330 kVA, 13.8 kV, 3-phase delta primary and a 480/277 volt wye secondary. Each transformer shall feed a 4000 amp switchboard rated 277/480 volt, 3 phase, 4-wire. The equipment shall be located inside in a 1-hour rated room.
e. Medium voltage cable shall be provided from each fusible load interrupter switch to each unit substation. All medium voltage cable shall be copper or aluminum, EPR, 133% insulation and the conduits shall be concrete encased.
f. Provide test cabinet (and wiring) for operation of the main vacuum bottle breaker outside of the enclosure without high voltage present.
g. Provide breaker truck lift for removal of the vacuum bottle breaker.

3. All equipment will be fastened/restrained on a 4” housekeeping pad.
4. Close coordination with SCL will determine the most appropriate location to bring service into the site.

C. Secondary Distribution (600 volt and less)

1. The 4000 amp service switchboards shall consist of indoor 480Y/277V sections which will feed the electrical riser. The riser will distribute power to lighting, receptacles, mechanical equipment and concessionaire loads located on each of the levels.
2. This scope of work will include all distribution panelboards, step-down transformers and panelboards as required to serve the loads of the arena.
3. Bus bars in all switchboards, distribution panelboards and lighting/appliance panelboards shall be copper.
4. Circuit breaker types and interrupting capacities will be selected based on the results of a short circuit study. Circuit breakers, panelboards, transformers and feeder load capacities will be selected based on the completion of the design and appropriate load calculations as well as coordination, short circuit and arc flash studies. All overcurrent protection devices shall be fully rated for the short circuit condition.
5. Switchboards and panelboards will include twenty percent spare capacity and space for future additional circuit breakers and switches. Circuit breakers will be provided for all base building branch circuits. All 15amp and 20amp breakers shall be UL listed as a “Switching Breaker” and carry the “SWD” marking.
6. Distribution and lighting panelboards shall utilize bolt-on circuit breakers.
7. Shielded Noise isolation K-13 rated harmonic mitigating transformers and local Surge Protective Devices (SPD) units shall be provided in areas where significant harmonic loads are present. Areas that contain these types of loads are the scoreboard, broadcast and sound rooms.
8. Dry Type 480-208/120 volt transformers will be provided for 120-volt loads.
9. Equipment will generally be supplied painted with the factory standard color i.e. ANSI 61 gray.
10. All equipment exposed to the exterior shall be rated for such conditions.
11. All electrical equipment will be fastened/restrained on a 4" housekeeping pad.
12. All equipment shall be provided with engraved nameplates.

D. Emergency Power System

1. Provide one (1) 3,000 kW pad mounted diesel generator in acoustical enclosure (80dba) complete with control panel, batteries, jacket heaters, and base mounted fuel tank for 24 hours of run time, etc. The generator set will feed all emergency and standby loads required by code. Exhaust piping and ventilation system to be supplied by Div. 23.
2. A 2,500 amp generator distribution switchboard with separate vertical sections will be required.

3. Circuit breakers, fuses, transfer switches, panelboards, and feeders will be selected based on the completion of the design and appropriate load calculations, coordination study, and short circuit study.
4. Emergency battery lighting units will be provided at the generator location, the main electrical rooms, main telephone, in addition to the generator-powered emergency lighting system.

E. Mechanical and Equipment Connections
1. Mechanical:
   a. Power wiring shall be provided for all Division 23 equipment including all starters in motor control centers, local disconnect switches and thermal overload switches.
   b. Ice Rink Equipment: Provide all conduit, power wiring, etc. for a single point connection to the ice chiller – normal and standby. The standby ice chiller will be connected to the standby system via a separate transfer switch.
   c. Starters for all packaged equipment, such as chillers, air-handling units, exhaust fans, etc., shall be provided by the mechanical contractor (MC). If motor control centers are not shown, it is assumed all starters will be provided by the MC.
   d. Outlets on dedicated standby circuits will be provided for BMS controls in each mechanical room.
   e. The Control system shall be provided by Division 25. Conduit & wiring by the Division 25.
2. Equipment Connections:
   a. Power to all escalators and elevators including wiring to controllers. Power to passenger elevators shall be 480volt, 3 phases from the legally required standby system and have shunt trip breakers in the machine room. Final breaker sizes shall be based on manufacturer's shop drawings.
   b. Power will be supplied to overhead doors, dock levelers, dock locks, power mandoors, trash compactors, etc.
   c. ADA and other powered entrance doors to be connected to the motor and controller. Provide pushbutton in mullion (120V, 1Ph, 20Amp).
   d. All equipment supplied as part of the construction of the new arena will be provided with the appropriate electrical power connection.

F. Branch Power Receptacles & Connections:
1. Receptacles: In general receptacles shall be provided where needed, including the following:
   a. The mechanical, electrical, and storage area receptacles to be 18"AFF, rated 20amps with stainless cover plates, generally one on each wall.
   b. The workshop room with a dedicated panel and transformer and a minimum of four outlets per wall, 20amp, 277volt disconnect for testing arena lighting and a 50amp, 480volt, 3 phase disconnect switch for a welder.
   c. Provide two receptacles in each column on the main, suite and upper concourse.
   d. Provide receptacles in each lobby, corridor, hallway, catwalk, etc.
   e. Provide three duplex receptacles and one quad receptacle in each office.
   f. Provide GFCI type receptacles at counters in each washroom, within 6 feet of a sink, elevator pits and elevator machine rooms. All exterior receptacles shall be GFCI type with a metallic weatherproof cover.
   g. Provide GFCI receptacle in trees and planters for holiday lighting.
   h. Provide receptacles on 2-foot centers above all counters.
   i. For all battery chargers and electric carts. Provided a minimum of four (4) locations with dedicated 20amp, 120volt receptacles.
   j. Provide 40Amp, 208V, 1Ph connections for each electric vehicle charging station.
   k. For cleaning (on 40' centers in corridors and concourses).
   l. A 20Amp, 120volt receptacle mounted at each ATM machine.
   m. Adjacent to all IPTV outlets.
   n. Within 25 feet of mechanical equipment.

   o. Duplex outlets shall provide for ADA seating areas within the seating bowl. Assume two outlets per handicap seating section.
   p. For all suite equipment (icemaker, refrigerator, induction burners, etc.). Provide a dedicated circuit for each induction burner and additional circuits for icemaker and refrigerator.
   q. Refer to Technology Systems narrative for power requirements in the Data Center, Main Comm Room, IDF Rooms, etc.
   r. Generally, arenas such as this it will require between 3750-4500 outlets. This quantity should represent a summary of the total of the above receptacle requirement.
2. Connections shall be provided to interior concourse signs, advertisement boards and LED graphics panels on the fascia of the seating bowl.
   a. These individual connections shall include a junction box with a 120volt circuit and an empty 1" conduit to the telephone room or cable tray. Assume 130 locations throughout the concourse and 50 locations in the seating bowl.
   b. The location of the signage and advertisement boards will be coordinated with the Architect and owner.
3. Power connections to all novelty carts, ATM machines, and other owner-related equipment.
4. Power for ticket office messaging on windows.
5. Power for security screening and wireless ticketing at entries.
6. Power connections for electric water cooler for drinking fountains and electronic valve systems.
7. Power connections to training equipment, and other locker room equipment.
8. Power connections to office equipment (i.e. copiers, furniture partitions, printers, computers, etc.) and other owner related equipment.
9. Power connections to maintenance area equipment (i.e. welders, air compressors, table saws, hand tools, etc.) Provide a 400 amp panelboard in shop area to serve the equipment.
10. Power to eight (8) photo strobes locations (120volt, 1phase, 30amps) with 4 outlets per location and twenty (20) spotlights (208volt, 1phase, 30amps).
11. Power to eight (8) blackout curtain motors in the bowl (208volt, 3phase, 30amps) and (4) blackout curtain controls in the bowl (120volt, 20amps).
12. Power to Scoreboard hoist motor(s) (480volt, 3phase, 100amps each).
13. Scoreboard Unit:
   a. Provide all conduit for power and control wiring to connect to a center hung scoreboard(s). Provide 120/208 volt, 3 phase, 4 wire feed from a transformer / switchboard located on the catwalk. Provide power wiring and connections as required for the scoreboard system.
   b. Provide a 500kva K-13 rated transformer and a 1,600 amp switchboard with 200 amp connections.
14. LED Ribbon Boards:
   a. Provide all conduit, power wiring and control conduit to matrix boards. Assume eight (8) LED matrix board connections total on two levels within the seating bowl, each with a 120/208volt, 3 phase feed.
15. LED Displays:
   a. Provide all conduit, power wiring and control conduit media mesh LED wall display. Provide 120/208volt, 3 phase panelboards to feed the wall displays.
16. Sound System:
   a. Provide all conduit, wiring and power as required for the system's sound racks located on the catwalk and other areas in the arena.
   b. Allow for a 400 amp 208/120volt, 3 phases, 4-wire panelboard (with TVSS) fed from a noise isolation transformer that is connected to the emergency system.
   c. Provide branch wiring and outlets to amplifier racks and equipment.
   d. This branch wiring shall be protected by a 1 hour rated enclosure.

17. Broadcast Truck Power:
    a. Provide all conduit, wiring and fused disconnect switches to feed the broadcast truck power cabinet which consist of 200-amp company switches with Cam-Lock plug-in receptacles. Company switches shall be provided by Union Connector or approved manufacturer. This will include twelve (12) total 200-amp switches, and 208/120volt switches with Cam-Loc plug-in receptacles.
18. Auxiliary Broadcast Power:
    a. Provide all conduit, wiring and fused disconnect switches to feed the auxiliary broadcast truck power cabinet which consist of 200-amp company switches with Cam-Lock plug-in receptacles. Company switches shall be provided by Union Connector or approved manufacturer. This will include six (6) total 200-amp switches, and 208/120volt switches with Cam-Loc plug-in receptacles.
    b. Each enclosure shall be a NEMA 3R enclosure manufactured by American Midwest Power or approved manufacturer.
19. Satellite Uplink and ENG Truck Power:
    a. Provide all conduit, wiring, Cam-Locks and disconnect switches for two (2) 30amp, two (2) 50amp, (1) 100amp, and one (1) 200 amp, 208/120volt switch for uplink truck enclosures.
    b. Each enclosure shall be a NEMA 3R enclosure manufactured by American Midwest Power or approved manufacturer.
20. Satellite Down Link Antennas:
    a. Provide a 1” and 2” empty conduit from the head-end equipment room to the nearest telephone room and then to each antenna for video communications. Assume 4 antennas will be required.
    b. A dedicated 20amp, 120volt circuit will be required at each antenna for the positioning and de-icer/heater systems.
21. Event Power:
    a. Provide a transformer feeding a 120/208volt switchboard at the stage right and stage left corner of the stage end of the event floor – total of two 750 kVA K-13 rated transformers feeding a 2,500 amp switchboard. Provide distribution at each of the switchboards to have multiple 200amp and 400amp company switch with Cam-lok type connectors. Provide 100amp, 480volt at one end of the stage for lasers.
    b. Provide a transformer feeding a 120/208volt switchboard for rear stage power. Provide distribution at each of the events to have multiple 200amp and 400amp company switch with Cam-lok type connectors.
    c. Provide a transformer feeding a 120/208volt switchboard at the catwalk level for center stage power. Provide distribution at each of the events to have multiple 100amp and 400amp company switch with Cam-lok type connectors.
22. Tour Bus Power: Provide eight (8) 60amp, 208/120volt fusible disconnect switches with downstream 50amp range plug at dock area for tour buses.
23. Courtside Press Power:
    a. Provide 120/208volt, 3-phase connections at the front row of seating on the press sideline for connections to pre-wired tables.
24. Scoreboard Control Room:
    a. Provide all conduit and power wiring for all equipment within the room. A dedicated panelboard (with TVSS) fed from a noise isolation transformer shall be provided. Assume fifty 20amp, 120volt circuits will be required.
    b. Provide a 25kw 480-208/120volt UPS and 100amp panelboard to feed critical scoreboard components.
    c. Provide (15) 20 amp, 120volt circuits from the UPS system for emergency messages to the scoreboard.
25. Technical Power (isolated): For all camera locations, TV/Radio booths and Media rooms provide the following per location:
    a. Broadcast Booth — 14-20amp, 120volt dedicated circuits
    b. Radio Booth — 6-20amp, 120volt dedicated circuits

c.	Local Media Rooms	14-20amp, 120volt dedicated circuits
d.	Camera (JBE) Locations	4-20amp, 120volt dedicated circuits
e.	Camera (JBT) Locations	1-20amp, 120volt dedicated circuits
f.	Camera (JBA) Locations	1-20amp, 120volt dedicated circuits and 1-30amp, 120volt dedicated circuit
g.	Replay Control Room	16-20amp, 120volt dedicated circuits
h.	Coaches Video Room	4-20amp, 120volt dedicated circuits

26. Distributed Television System:
    a. Include outlets for all television sets distributed throughout the arena. Each outlet shall consist of a box and empty conduit to ceiling space for signal wiring plus a receptacle, within a common cover plate. Signal wiring shall be by others. Refer to the architectural drawings and narrative for locations / quantities.
27. Arena Naming Signs:
    a. Provide multiple 120 volt 20 amp circuits at each naming rights location – including each building façade direction and on the roof.
28. Plaza Power:
    a. Provide GFI outlets in the plaza (total of 30 outlets and a 100amp, 208volt, 3phase company switch) for live entertainment.
29. X-ray Equipment:
    a. Provide a 45kVA and 150amp panelboard with shunt trip main breaker and EPO at the door.
    b. Provide a 100 amp 480 volt 3 phase connection to the x-ray generator.

G. Concession Power and Connections
1. The building design shall include the following electrical events for concession spaces:
    a. A 120/208 volt, 3 phase empty panelboard at each concession location. Space and code required clearances for panelboards will be required in each concession stand. Large stands will have a 400 amp panelboard and small stands a 225 amp panelboard.
    b. Power for the electric water heater.
    c. Partial emergency lighting circuit.
    d. Lensed light fixtures.
    e. All panelboard branch breakers, power and lighting distribution within the concession.
    f. Shunt trip breakers for the cooking equipment under the hood.
    g. Fire alarm connection to the hood fire suppression system.
    h. Beverage conduit – refer to Food Service Narrative for more information.
2. Power receptacles for 20amp, 120volt carts, 30amp, 60amp and 100amp, 208/120volt, 3 phase portable concession carts. The total quantity shall be sixty (60) 20amp at 120volt, thirty (30) 30amp, twenty (20) 60amp and (4) 100amp at 120/208volt.

H. Lighting & Lighting Controls
1. All interior areas of the arena will be provided with a lighting system to maintained illumination levels recommend by IES/ASHRAE, NEC, and NFPA.
2. All lighting will meet all required energy codes including but not limited to the IECC/ASHRAE 90.1 and Washington State and Seattle Energy Code.
3. All light fixtures utilizing will be commercial quality grade fixtures. The lighting system will be complete with panelboards, feeders, branch circuits, and controls all as specified herein. Circuiting will generally be 277 volts for LED and fluorescent lighting and 120 volt for some LED fixtures.
4. LED light fixtures will have drivers appropriate for conditions, dimming, etc.
5. Provide LED exit signs along all paths of egress exits. A sign shall be no further than 100 feet apart in any egress corridor or path. An exit sign shall be provided at every egress door and stairway. It is anticipated that 300 edge lit acrylic exit signs will be required for the arena.

6. Lighting Controls:
   a. All lighting shall be controlled by a networkable lighting control system with a built-in time scheduling software and local overrides. The lighting control system shall be a stand alone low voltage system, which is specifically design for controlling lighting in an arena and interfacing with building automation system to control certain zones.
   b. System shall be microprocessor based with processors in each relay cabinet. Multiplexed data bus shall be routed between processors. Provide Windows based software for the system programming and control. Control screens shall be field programmable. All graphic screens shall be customized for this particular project and show every level of the arena floor plan and elevations (Allow for a minimum of 50 screens).
   c. The lighting control system shall include low voltage control and DMX functions, interface, controller, etc. to control specific light fixtures to be determined as the design progresses.
   d. Relay panels to be located adjacent to lighting panels as required for a complete low voltage control system.
   e. Lighting circuit for the inside lighting will be controlled by lighting control relays. The exterior lighting will be controlled by photocell and the relays in the lighting control panel which can be over-ridden by the lighting control system.
   f. The lighting control system will require multiple control stations with the main station located at the scoreboard control room, and additional remote stations at 24 hour security office, engineering office and the Event floor tunnel. The remote stations shall be wireless removable LCD touch screens.
   g. Private suite local dimming controls to be over-ridden by the lighting control system for blackout conditions.
   h. Daylighting will be incorporated in public areas which are not viewable to the bowl.
   i. All lighting control / dimming panels shall be able to support DMX control. At a minimum several universes shall be provided to facilitate control of the lighting within the arena.
   j. Light switches in home and visiting team areas, office areas, suites, storage rooms, and mechanical/electrical rooms will be line voltage, with local toggles and lighting control override.
   k. All offices, toilets and conference rooms shall have occupancy sensors that are tied into the lighting control system.
   l. Line voltage switches will be provided at each entry to room in all areas controlled by lighting control.
   m. All non IPTV advertising panels, arena signage, LED displays and blackout fixtures shall be connected to the lighting control system for blackout conditions.
   n. Each riser electrical room shall have a remote control pushbutton station to control all lighting zones on the floor for that riser.
   o. Provide a minimum of 80 hours of training on system after the system has been accepted by the owner.
   p. The lighting control manufacturer shall participate in the commissioning process with the contractor.
   q. The lighting control manufacturer shall have technical representatives at the first two of each type of event – minimum six events.
7. The interior lighting concepts will be developed with the architectural team during the design development phase. The overall fixture quantity for this type of projects is typically between 9500-10,500 fixtures. For pricing purposes linear fixtures shall be calculated as follows:
   a. 4’ Linear Pendant = 1 fixture
   b. 8” Continuous Linear Pendant = 1 fixture
   c. Linear Fixtures over 8’ in length = 1 fixture for each 8’ increment. Examples: Continuous 12’ pendant = 2 fixtures, Continuous 16’ pendant = 2 fixtures and Continuous 20’ pendant = 3 fixtures.

2.1 ARCHITECTURAL LIGHTING SCOPE

A. NOTE:
1. Allowances represent material cost only and does not include installation, wiring, controls, sales tax, markup, shipping, etc.

B. GENERAL

1.	Interior Graphics Lighting:	**$150,000**
2.	Facade:	**$1,000,000**
3.	Base Building including garage and all premium areas:	**$4,500,000**
4.	**Total**	**$5,650,000**

Not included in the budgets above but to be carried as option(s) to be considered:
- Color changing LED roof lighting.
- Color changing LED façade lighting.

C. ARENA BOWL LIGHTING
1. Provide sports lighting and general bowl illumination as detailed below and as indicated on the arena bowl lighting plan. The levels will be provided over the floor surfaces and ancillary locations.
2. All luminaries will be mounted on the catwalk support rails.
3. Catwalk positions are anticipated at the following angles – 42^{o} from the center of the playing surface to the catwalk rail and 5^{o} from the edge of the dasher to the catwalk rail.
4. Ensure shadows do not occur. Identify face of scoreboard illumination to not exceed 50 Foot-candles.
5. L.L.F. - A light Loss Factor of 0.90 will be used to calculate the maintained foot-candle level.
6. Luminaries will be made of aluminum housing with integral heat sink, top and bottom adjustable glare shields on all fixtures.
7. Foot-candle levels will be taken 3ft off the ice floor and on 10 foot centers. Readings to be ± 5% of computer design drawings.
8. Manufacturer will provide shop drawing computer layouts for hockey indicating number of points, number of luminaries, type of each luminaire, average foot-candle level, minimum foot-candle level and max./min. ratio.
9. Each fixture will come complete with a twistlock male connector and female outlet with remote driver. Female outlet will be installed in a wireway on the catwalk by Division 26.
10. All catwalk fixtures shall have safety cables which connect the fixture to the catwalk.
11. All drivers shall be connected with Cat. 5E cable – daisy chained for control. Provide a minimum of one universe.
12. Control scenes at a minimum will include at a minimum the following:
    a. Hockey
    b. Basketball
    c. Maintenance
    d. House
    e. Concert Infill
    f. Full House
    g. Half House
    h. 270 House
    i. 240 House
    j. Chase
    k. Flash
    l. 10 spare scenes

13. Each of the acceptable manufacturers shall provide fixtures for the sports lighting or as required to meet the all the specification and the NBA and NHL guidelines. The acceptable manufacturers and additional information is as follows:

300 Watt Fixtures Ephesus	Arena 300
355 Watt Fixtures Musco	Musco LED Lineup
400 Watt Fixtures Giga Tera	Giga Tera SufaX

2.2 THE FOLLOWING IS THE ARENA BOWL LIGHTING REQUIREMENTS:

Arena Bowl Lighting Luminaries

Key	Lamp(s)	Luminaire Description	Location	Ave Maint. Foot-Candles
S1	LED	LED sports lighting fixture with a heavy duty aluminum housing; high power factor remote driver; clear tempered and impact resistant glass, stainless steel hardware; knuckle or yoke mount with protractor base-plate, vertical adjustment aiming. A total of 300 fixtures are anticipated.	Catwalk	See requirements below
S2	LED	LED maintenance / egress lighting fixture with a heavy duty aluminum housing; high power factor remote driver; clear tempered and impact resistant glass, stainless steel hardware; knuckle or yoke mount with protractor base-plate, vertical adjustment aiming. A total of 76 fixtures are anticipated.	Catwalk	10-20 FC Seating Area & Floor CRI 80+ 4,500K
S4	LED	Aisle lighting fixture shall be located on the catwalk. (Framing Projector) Provide a quantity of 160 fixtures. ETC Source 4 with LED retrofit kit or approved equal.	Catwalk	1-2 FC Seating Bowl Aisle
S5	LED	Aisle lighting fixture shall be located on the catwalk. (Framing Projector) Provide a quantity of 10 fixtures. ETC Source 4 with LED retrofit kit or approved equal.	Catwalk	N/A

NHL Lighting Criteria

Hockey	Vertical Illuminance		Horizontal Illuminance		Properties of Diodes			Glare Rating
	Ev Cam **Minimum**	Uniformity	Eh **Minimum**	Uniformity	Color Temperature (Full Spectrum)	Color Rendering Index	TLCI (Television Color Index)	GR
Calculation Towards	FC	Max:Min	FC	Max:Min	Tk	Ra	TLCI	
Main Camera	140	1.35:1	160	1.35:1	≥ 5400 K ≤ 5800 K	≥ 80	≥ 75	≤ 40
Reverse Camera								
Coefficient of Variance					<0.15			
Vertical to Horizontal Modeling Ratio					Between 1:1.15 and 1:1.70			
Ice to Dasher Shadow Ratio					1:0.75 of the horizontal Eh average			
Ice to Penalty Box Ratio					1:0.75 Minimum			
Ice to Player Benches Ratio					1:0.75 Minimum			
Ice to Spectator Ratio					1:0.75 Minimum for first 10 rows			
					1:0.50 Minimum for next 15 rows			
					1:0.25 Minimum to the concourse level			

NBA Lighting Criteria

Basketball	Vertical Illuminance		Horizontal Illuminance		Properties of Diodes			Glare Rating
	Ev Cam **Average**	Uniformity	Eh **Average**	Uniformity	Color Temperature (Full Spectrum)	Color Rendering Index	TLCI (Television Color Index)	GR
Calculation Towards	FC	Max:Min	FC	Max:Min	Tk	Ra	TLCI	
Main Camera	145	1.35:1	230-270	1.35:1	≥ 5400 K ≤ 5800 K	≥ 80	≥ 75	≤ 40
Reverse Camera								

			Baseline			Sideline		
			Distance from Court	Horizontal (FC)	Vertical (FC)	Distance from Court	Horizontal (FC)	Vertical (FC)
Sideline True Vertical	130	1.5:1	10 feet	155 - 195	105 - 145	10 feet	155 - 195	105 – 145
			30 feet	75 - 125	45 - 60	30 feet	75 – 125	45 – 60
Baseline True Vertical	110-120	1.5:1	50 feet	15 - 45	15 - 35	50 feet	15 – 45	15 – 35
			70 feet	5 - 15	5 - 15	70 feet	5 - 15	5 - 15

2.3 FIRE ALARM SYSTEM

A. The fire alarm system shall be designed in accordance with the program requirements, latest industry standards, applicable codes (NFPA, ADA, and NEC). All equipment shall be U.L. approved or code equivalent.

B. The fire alarm system for the arena will be electronically supervised, microprocessor based, analog/digital addressable, multiplexed networked fire alarm system, fully integrated with an emergency voice communication system and the seating bowl non-supervised public address system. This shall also integrate with the Building Management System (BMS) and any required smoke control panel.

C. The fire alarm system will be comprised but not limited to the following key components:
1. Fire Alarm Control Panel.
2. Emergency Voice Communication Panel.
3. Floor Graphic Annunciator Panels.
4. Fire Alarm Audible, Visual and Initiating Devices.
5. Smoke Control Panels and wiring to interface with Smoke Control Fans.
6. Interface with Mechanical/Sprinkler/HVAC Security System.
7. Interface with Elevator Controllers

D. The fire alarm voice communication system shall interface with the arena's public address system in an alarm conditions to make emergency voice announcements to the seating bowl.

E. OSID type beam detectors or an air sampling system will be provided at the catwalk level of the bowl.

F. The Fire Command Center will shall include the fire alarm control panel system printer and floor graphic annunciators, generator control panel, elevator status/control panel, fire pump status/control panel and Smoke Control graphic control panel.

G. The fire alarm wiring shall be Class A and be installed in an approved raceway. Raceways to be painted red. Provide 2 hour rated cable or cable in a 2 hour rated enclosure where required by the IBC and NFPA.

H. The fire alarm system shall be equipped with a common event reporting digital alarm communication transmitter (DACT). Provide two telephone lines to the DACT and the specified programming and establish the proper reporting to the off-site monitoring system as part of the construction project.

I. Provide fire alarm trouble and alarm outputs to building management and security system if located remote from Fire alarm panel.

J. Submit a Record of Completion using the form found in NFPA 72, 2013.

2.4 LIGHTNING PROTECTION SYSTEM

A. Provide a complete lightning protection system with air terminals, down conductors and grounding in accordance with NFPA 780. The system must be Master C label and be U.L. listed.

B. As an alternate, provide price to provide and install an Early Streamer Emission (ESE) type lightning protection system. A minimum of two masts will be required.

2.5 COMMUNICATION SYSTEMS

A. Refer to Technology Systems Narrative for raceway, power and cabling requirements.

2.6 SECURITY SYSTEMS

A. Refer to Technology Systems Narrative for Additional Requirements.

2.7 EQUIPMENT LIST

A. The following is a list of manufacturers who are proposed (as applicable) for the purpose of pricing.

ITEMS	MANUFACTURER
Metal Enclosed Medium Voltage Breaker and Interrupter Switches	General Electric Schneider Eaton Siemens-ITE
Medium Voltage Cable	American Insulated Wire Okonite South Wire
Unit Substations	General Electric Schneider Eaton Siemens-ITE
Switchboards and Panelboards	General Electric Schneider Eaton Siemens-ITE
Dry-Type Transformers (Low Voltage)	General Electric Schneider Eaton Siemens-ITE

ITEMS	MANUFACTURER
Motor Controls Motor Control Center	Schneider General Electric Siemens Cutler-Hammer
Wires and Cables	American Insulated Wire Okonite South Wire
Electrical Boxes and Fittings	Appleton Hubbell-Raco Steel-City
Receptacles Switches	Hubbell Pass & Seymour Cooper Leviton
Dimmers	Lutron Lightolier
Fire Alarm System	Notifier Simplex Siemens EST
Relays and Contactors	Allen Bradley Eaton General Electric
Low Voltage Lighting Controls	Douglas Lighting Control ETC Wattstopper
Dimming System	Lutron ETC
Coverplates	C.G.E. Type 301 stainless steel
Generator Set	Onan Kohler Caterpillar Generac
Lightning Protection System	Thompson Lightning Protection Erico
Access Doors	Milcor Maxam Titus

PART 3 - GENERAL ELECTRICAL REQUIREMENTS

3.1 ELECTRICAL REQUIREMENTS

A. Review the Contract Conditions and General Requirements for information and requirements that apply.

B. The word "provide" is used to mean "furnish and install".

C. Provide all items for a complete and successful operation of all electrical systems.

3.2 RACEWAYS

A. Conduits to be of size and be installed according to NEC unless noted otherwise herein.

B. The minimum conduit size for branch circuits is ¾" and 1" for feeders.

C. Rigid conduit, intermediate metal conduit or electrical metallic tubing as permitted by NEC. Flexible metal conduit to be used only for final connection to equipment with maximum length 6 feet.

D. Conduit systems shall be concealed in areas (other than mechanical/electrical rooms) where studs and drywall are provided. Public spaces using concrete as the finish shall, where practical, have all conduit concealed within the concrete. All exposed conduits to the public must be painted and be coordinated and approved by architect prior to installation.

E. Branch circuit conduits will not be permitted in the slab unless approved by the structural engineer.

F. All medium voltage ductbanks shall be encased in red concrete and be a minimum of 36" below finish grade. The conduit shall be schedule 40 PVC with PVC coated galvanized rigid steel elbows. A 6" wide red warning tape shall be installed 18" above all duct banks.

G. Schedule 80 PVC shall be used where conduit penetrates the concrete slab.

3.3 WIRE AND CABLES (600 VOLT AND LESS)

A. All conductors to be copper, solid for #12 AWG and smaller, stranded for # 10 AWG and larger. Provide an alternate price for aluminum conductors. Aluminum shall be compact type for sizes 1/0 and larger. Aluminum is not acceptable for emergency, standby or mechanical loads.

B. Minimum conductor size No. 12 AWG.

C. All conductors shall be Type THWN/THHN insulation unless otherwise noted.

D. Factory color coding to be utilized for appropriate system voltages and phase identification.

E. All fire alarm wiring shall be in conduit.

3.4 MEDIUM VOLTAGE CONDUCTORS

A. All Medium voltage cable shall be copper, EPR 133% Insulation.

B. All conduits for medium voltage cabling shall be concrete encased.

3.5 OUTLET BOXES

A. Four-inch square or octagonal, zinc coated sheet steel boxes.

B. Provide 3/8-inch no-bolt fixture studs for fixture outlets.

C. Provide covers set to come flush with finished walls.

D. Utility or sectional switch boxes shall not be used.

E. Verify mounting heights of all outlets prior to installation. Locate outlets to clear counters, benches, baseboards or fin tube heaters, etc., or as required to service equipment.

F. All outlet boxes and exposed conduit shall be corrosion protected.

3.6 WIRING DEVICES

A. Specification grade receptacles. Hubbell HBL 5362 or equivalent. Ivory color. Telephone room receptacles shall be Hubbel IG HBL 5362. (Orange color).

B. A.C. quiet operating type switches, Hubbell HBL-1121, 20 amp or equivalent.

C. Cover plates to be determined by Architect.

D. All wiring will be installed in conduit.

E. Connections in #8 wire and smaller to be made with Scotchlock Type, UL approved, pressure connectors. Connections in #6 wire and larger to be made with approved lugs and/or connectors. NO splices are to be made within conduit.

F. Wall switch outlets at door locations are to be installed on the latch side of doors and are to be mounted 4 feet above finished floor. Receptacles and telephone outlets are to be mounted at +18" unless noted otherwise.

3.7 MEDIUM VOLTAGE SWITCHGEAR LINE-UP

A. The 15kV metal enclosed switchgear shall be provided with the number and type of breakers and load interrupter switches shown on the drawings. Bus rating shall be 1200amp with manual load interrupter fusible switches for feed to unit substations and vacu-break circuit breakers for the main and tie breakers.

B. Equipment shall be dead front type with interlock door to prevent accessing switch in the closed position. Cable terminations shall be front accessible utilizing stress cone assembies.

C. Fuses to be solid material type and equipped with blown fuse indicators.

D. Provide CT and PT compartments on incoming sections from utility. Coordinate exact requirements with local utilities.

E. The switchgear shall be fastened/restrained on a 4” housekeeping pad provided by the contractor.

F. The Contractor provides grounding per the NEC.

3.8 UNIT SUBSTATION

A. Provide unit substation as indicated on the drawings with features and equipment as outlined. Units shall be indoor type, 3 phase, 60 cycle, with secondary voltage of 480Y/277volt. Comply with NEMA, UL and ANSI standards. Furnish in sections for field settings and joining with bus ties as shown on the drawings.

B. Transformers shall be dry-type fan cooled with 115 degree Celsius rise. Provide 4-2 ½ percent taps, 5.75% impedance and 65kV BIL. Sound level shall not exceed 70dB. Provide complete factory test results on losses, ratio and excitation.

C. The unit substation switchboards shall be equipment with the same devices and material as specified in Main SERVICE Entrance Switchboard.

D. All equipment 1200amps and larger shall accommodate maintenance bypass switches for arc flash mitigation.

E. The transformers shall be fastened/restrained on a 4" housekeeping pad provided by the contractor.

F. Provide grounding per the NEC.

3.10 MAIN SERVICE ENTRANCE SWITCHBOARD

A. The switchboard shall contain insulated case circuit breakers with metering for volts, amps, KVA, KVAR, power factor, peak KW and KWHR. Bussing to be silver-plated copper. Provide TVSS device on the secondary. (Current Technology "MP" Series or approved equal.)

B. Switchboard shall be copper, fully rated and bussed for rating indicated on drawings.

C. All equipment 1200amps and larger shall accommodate maintenance bypass switches for arc flash mitigation.

D. All switchboards shall be fastened/restrained on a 4" housekeeping pad.

3.11 DISTRIBUTION SWITCHBOARDS

A. Switchboards shall be self-supporting structures with silver plated copper bussing, AIC ratings per the drawings, equipped with branch fusible switches and circuit breakers as shown. Full size neutral and ground buses are required. Units shall be dead front with all terminations front accessible.

B. Panelboards shall be provided with full size neutral and ground bars, all tin plated copper bus of 98% conductivity, with thermal magnetic type molded case main and branch breakers.

C. All equipment 1200amps and larger shall accommodate maintenance bypass switches for arc flash mitigation.

D. All switchboards shall be fastened/restrained on a 4" housekeeping pad.

3.12 LIGHTING POWER PANELBOARDS

A. Provide dead-front safety type lighting and appliance panelboards as indicated, with switching and protective devices in quantities, ratings, types and arrangements shown. Equipped with anti-turn solderless pressure type lug connectors approved for use with copper conductors; construct unit for connecting feeders at top of panel; equip with copper buss bars, full-sized neutral bar, with bolt-in type heavy duty, quick-make, quick-break circuit breakers, with toggle handles that indicate when tripped. Provide suitable lugs on neutral buss for each outgoing feeder required; and provide bare uninsulated grounding bars suitable for bolting to enclosures. Select galvanized sheet steel cabinet enclosures fabricated by same manufacturers as

panelboards, which mate and match properly with panelboards. Employ breakers that are fully rated for available short-circuit condition but not less than 10,000 sym AIC at 120/208 volts; and 14,000 sym AIC at 277/480 volts.

B. Provide factory-assembled, molded-case circuit breakers of frame sizes, characteristics, and ratings including RMS symmetrical interrupting ratings sized for available short circuit. Select breakers with permanent thermal and instantaneous magnetic trip. Construct with overcenter, trip-free, toggle-type operating mechanisms with quick-make, quick-break action and positive handle trip indication. Provide breakers with mechanical screw type removable connector lugs, AL/CU rated.

C. Emergency / Standby panels shall be fused coordination type by Bussmann, Eaton, Littlefuse or approved equal. Each panel shall be provided with a dedicated SPD per NEC requirements.

3.13 TRANSFORMERS (600 V - and Less)

A. Transformers shall be two winding type for each phase, with silicon steel cores, aluminum windings in compliance with NEMA ST-20.

B. Units shall have 115° C class insulation with four taps at 2 1/2 percent rated at full capacity on the high side winding.

C. Provide site or manufacturer insulation resistance testing specific for each unit.

D. All transformers shall be fastened/restrained on a 4” housekeeping pad.

3.14 MECHANICAL EQUIPMENT WIRING AND CONNECTIONS

A. Provide all line voltage power for mechanical equipment motors and motor starters furnished under Division 23.

B. Provide feeder circuits to mechanical equipment and motor starter, and make all connections.

C. Provide disconnect switches (heavy duty, HP rated, quick-make, quick-break, fusible or non-fusible) and/or thermal overload switches as required. Disconnects for equipment located on the roof, or where exposed to weather are to be NEMA 3R.

D. Flexible metallic conduit is to be used for connections to motors and other equipment where vibration is encountered or as required. All flexible connections exposed to the weather are to be made with liquid tight flexible metal conduit.

3.15 GROUNDING

A. All service equipment, conduit systems, supports, cabinets, equipment, fixtures, etc., and the grounded circuit conductor shall be properly grounded in accordance with the latest issue of NEC and local electrical code. Provide bonding jumpers, grounding bushings, clamps, etc., for complete grounding.

B. Provide a separate grounding conductor in all raceways. The conduit shall not be acceptable as an equipment ground. Securely ground each side of all raceways containing sections of plastic, fiber, or flexible raceway. Size conductor in accordance with NEC.

C. Provide a green grounding jumper from the ground screw to a box grounding screw or clip for all grounding type devices. Use insulated wire.

D. Provide a main building ground riser (12" x 3" x 1/4" copper bus bar on stand-offs) in electrical rooms and a communication ground system riser in the MC and all IC's rooms. A building ground riser (#250KCMIL) shall be provided and connect each of the electrical rooms and tied into the building ground loop.

E. Provide a #4/0 copper building ground loop around the perimeter of the arena. Connect a #4/0 copper cable to every other column. A counterpoise grounding system shall be used around the building to obtain 5 Ohms or less on the system.

3.16 TESTING

A. Acceptance and startup testing requirements for electrical power distribution equipment and systems. Contractor shall retain and pay for the services of a recognized independent testing firm for purpose of performing inspections and tests as herein specified.

B. The Contractor shall perform routine insulation resistance, continuity, infrared scans, and rotation tests for all distribution and utilization equipment prior to and in addition to any acceptance testing.

C. The Contractor shall perform a load bank test for all show power company switches.

D. The Contractor shall perform a 1000-volt DC insulation resistance test (Megger) on all 600 Volt and less conductors.

E. The Contractor shall test all lighting, low voltage relays and circuits to ensure proper operating conditions prior to acceptance testing.

F. The Contractor shall perform visual and mechanical inspections, verifying that the equipment nameplate information meets the intent of the drawings and specification.

G. The Contractor shall be responsible for all final settings and adjustments on protective devices and tap changes.

H. Provide a complete short-circuit, coordination and arc flash study, equipment interrupting/withstand evaluation, and a protective device coordination study for the electrical distribution system described below. This study shall be submitted with electrical equipment submission and electrical room layouts.

The studies shall include all portions of the electrical distribution system from the normal and alternate sources of power throughout the low-voltage distribution system. Normal system operating method, alternate operation, and operations which could result in maximum fault conditions shall be thoroughly covered in the study.

The study shall be calculated from the utility meter to the unit substation to the lowest overcurrent device or equipment on the electrical distribution system. The utility conductors shall not be used for calculations.

All equipment shall be labeled with the available arc flash category and appropriate PPE required.

I. The Contractor shall engage the services of a recognized corporate and financially independent testing firm for the purpose of performing inspections and tests as herein specified.

J. The firm shall provide all material, equipment, labor and technical supervision to perform such tests and inspections.

K. It is the purpose of these tests to assure that all tested electrical equipment is operational and within industry and manufacturer's tolerances and is installed in accordance with design specifications.

L. The tests and inspections shall determine suitability for energization. Equipment shall not be energized until accepted by the testing firm.

PART 4 – ENERGY CONSERVATION MEASURES AND SPECIFIC ELECTRICAL / LIGHTING SYSTEM NOTES

4.1 GENERAL

A. All systems will be designed to reduce the consumption of energy and operate as efficiently as possible.
B. Energy conservation measures and electrical and lighting options listed as *under consideration* are not included for "base" pricing and are intended as items for discussion.

4.2 SPECIFIC SYSTEMS

A. Energy conservation features include the following:
   1. Daylighting controls in lobby and other public areas.
   2. Future connection accommodation for photovoltaic panels.
   3. Sub metering to facilitate measurement and verification will be explored.

END OF ELECTRICAL NARRATIVE