SPARK electric

Seattle Childrens Theater

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April, 2017

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Executive Summary

May 1, 2017

Seattle Children's Theatre
201 Thomas St
Seattle, WA 98109

RE: Energy Efficient Upgrades for Seattle Children's Theatre

Dear Mr. Welborne,

We appreciate the opportunity to present our proposal for **Seattle Children's Theatre**. Spark Electric intends to complete the proposed scope of work in 205 calendar days beginning June 5, 2017 and achieve substantial completion by September 26th, 2018. Our proposed project total is **$ 991,326,** with a payback period of **6.1** years. Seattle Center's Capital Improvement Plan will be financing the entirety of the project.

Our scope of electrical work includes tightening the building's envelope, improving the energy consumption of existing lighting systems, and installing a source of renewable energy. We aim to ensure the longevity of the Seattle Children's Theatre through our innovative solutions to the current lighting systems. Spark Electric will increase energy efficiency throughout the facility thereby setting the benchmark for the Seattle Center Campus.

After a detailed analysis of the building, Spark Electric identified the following items that would optimize the functionality of the Seattle Children's Theatre:

1. Insulate and seal glass façade
2. Implement LED lighting fixtures and dimmable daylight controls for all architectural fixtures
3. Upgrade existing halogen theatrical lighting system to LED
4. Install a 31.2 kWh photovoltaic system
5. Re-commission all mechanical systems

Spark Electric recognizes the importance of theater, culture, the arts, and their profound effect on the lives of young people. Through our dedication to quality, environment, and community, we are confident that our proposal will exceed expectations.

Sincerely,

Kelli Desrosier

Kelli Desrosier
Project Manager
Spark Electric

Figure 1.1

The Seattle Children's Theatre (SCT) is located in the heart of the Seattle Center Campus. Seattle is a national leader in energy conservation, green energy production, and sustainable building. Seattle Center's Capital Improvement Program (CIP) is at the core of the Center's vision to be the "nation's best gathering place," a place "to delight and inspire the human spirit in each person and bring us together as a rich and varied community."

The primary goal of Seattle Center's CIP is to repair, renew, and redevelop the facilities and grounds of the entire campus, in order to provide a safe and welcoming place for the millions of annual visitors it attracts. Because of this goal, we believe the community will be supportive of our aim to bring energy efficient upgrades to the Seattle Children's Theatre.

Figure 1.2

The Seattle Children's Theatre is one of the most prominent theatres for young audiences across the United States, dedicated ***"to provide children of all ages access to professional theatre, with a focus on new works, and theatre education."*** Seattle Children's Theatre Association is a Washington Nonprofit Corporation established in 1975. As SCT celebrates their 42nd season, the Theatre can lay claim to a rich history of collaboration and partnership to achieve their mission onstage, in the schools, and in the surrounding community.

Annually, SCT's mainstage audiences include more than 120,000 children, families, and teachers. The Drama School reaches approximately 3,500 people, and the Education Outreach program serves 5,500. SCT works in partnership with more than 400 schools in 36 districts, as well as many nonprofits, including the Seattle Art Museum and the Woodland Park Zoo.

At the core of SCT's mission is their School Children Access Program (SCAP), which provides free and subsidized tickets to 55,000 children and teachers each year. Over the past 42 years, the Theatre has produced more than 236 plays, including 110 world premier productions. This ensures that the Theatre stays relevant for the ever-changing audience, playwrights, and youth that SCT caters to. SCT provides a strong sense of community through its culture of sharing the arts throughout Seattle. SCAP sparks creativity and imagination in children.

The Seattle Children's Theatre (SCT) is composed of three connected buildings covering 64,500 SF; it consists of the original Eve Alvord Theatre which was built in 1956 and the Charlotte Martin Theatre which was built in 1993. Over the following seven years, SCT renovated the neighboring Pacific Arts Center into office space and constructed the Technical Pavilion, adding both workshops and classrooms.

Seattle Children's Theatre does not wish to upgrade the Eve Alvord Theatre at this time so we have excluded it from our bid package.

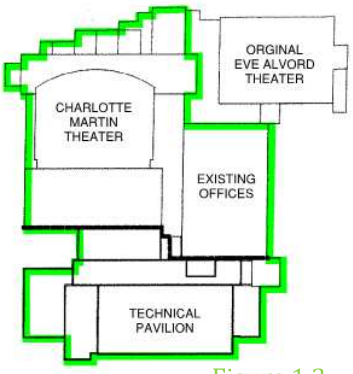

Figure 1.3

Quality of Light

Seattle Children's Theatre has expressed the importance of the quality of light with respect to color rendering and color saturation of the proposed upgraded fixtures. The Technical Pavilion ranked at the top of their concerns. The Technical Pavilion houses the shops and work areas where SCT constructs and paints props and set material for the productions. The type of light, the temperature of the color, and the lumen output can significantly affect the final design of all sets and props and how they appear under stage light. Our proposed lighting and control design has taken into consideration the importance of these qualities while still providing the most energy efficient system.

Costs

The CIP funds all Seattle Center Campus renovations, including those of the Seattle Children's Theatre. The 2017-2022 Capital Improvement Plan, adopted by Seattle City Council, prioritizes funding for projects that will significantly reduce operating costs. Designing energy efficient systems is a top concern for Spark Electric. By implementing a solar energy production system as a new alternative to the current power supply, the Seattle Children's Theatre has the opportunity to achieve increased energy efficiency and sustainability.

Schedule

Since we will be working in an occupied, fully functioning theater, phasing of all construction activities have been carefully planned to accommodate the schedule of the Theatre. To mitigate disturbance to the staff, students, and patrons of the Seattle Children's Theatre, Spark Electric has separated the scope of work into three phases: The Technical Pavilion, the office spaces, and the Charlotte Martin Theatre area. To minimize potential hazards, Spark Electric will be taking extra safety precautions to ensure all overhead fixture and glazing upgrades are performed in the safest, most efficient manner. Our project-wide safety inclusive plan, integrating the Client, the Subcontractors, and our own employees, is integral for the success of a project.

MISSION:

"Sparking the Path to a Greener Future"

Over the last 25 years, Spark Electric has been a leader in the greater Seattle area. Our achievements in providing our clients with innovative and cost effective energy solutions has earned us a reputation trusted in the electrical industry. In every project, we strive to provide our clients the best value through comprehensive preconstruction planning, cost analysis of the latest technology, feasibility studies, and our commitment to energy efficiency. Your satisfaction *sparks* our ambition.

Seattle Children's Theatre Project Team:

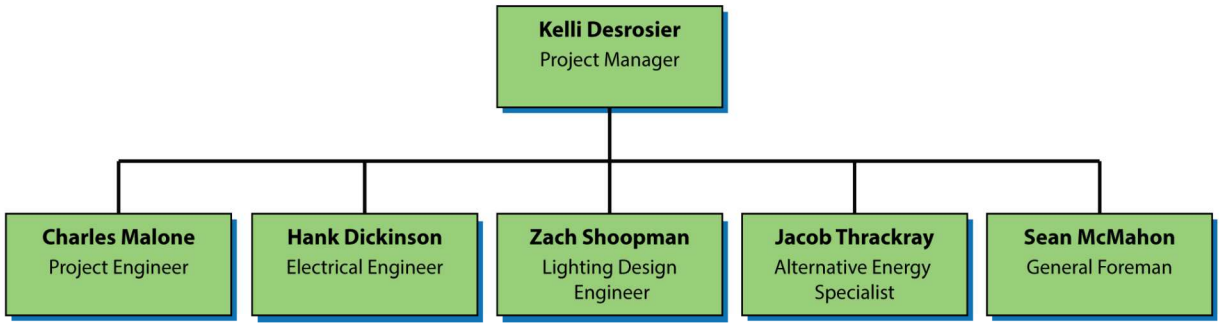

Figure 1.4

Kelli Desrosier, Project Manager
Kelli acted as the principle in charge for the project. Her chief responsibility was to develop a detailed cost estimate, finance place, and an extensive payback analysis of the proposed systems for the energy retrofit. Kelli had overall decision and approval authority.

Charles Malone, Project Engineer
Charles coordinated all volunteer efforts and community outreach events. He is also responsible for client communication and assisting all other team members when needed.

Hank Dickinson, Electrical Engineer
Hank conducted the initial analysis of the efficiency of the building utilizing the EPA Portfolio Manager tool and the DOE Building Asset Score tool. He worked closely with our Lighting Designer, Zach to maximize the efficiency of our proposed lighting design.

Zach Shoopman, Lighting Design Engineer
Zach conducted the initial analysis of the lighting conditions to develop a lighting retrofit design based on The Electrical Engineer's findings and needs of the client. Design includes upgraded LED Fixtures, integrated controls, and a glazing system.

Jacob Thackray, Alternative Energy Specialist
Jacob is responsible for the photovoltaic systems incorporated in this project. He has developed the proposed PV system using the latest and most efficient technology in his design. He also developed a schematic estimate for photovoltaic systems.

Sean McMahon, General Foreman
Sean documented existing conditions and site logistics of the facility to prepare a schedule for the proposed work. He used NECA labor rates and research to develop a staffing plan. His expertise assisted the Project Manager, Kelli in estimating the general conditions of the project.

Kelli Desrosier
Project Manager

425-361-5256 • kellidez@uw.edu

PAST EXPERIENCE

Cochran, Inc. - Seattle, WA
Project Intern – June 2016- Present

- Subcontractor management and material procurement
- Generating take-offs for various electrical equipment
- ASI/RFI drawing review and coordination
- Marking up as-built drawings
- Developing/managing subcontractor bid proposals

Pier Java Latte Stand – Mukilteo, WA
Assistant Manager/Barista – June 2011-Jan 2016

EDUCATION

University of Washington - Seattle, WA
Bachelor of Science in Construction Management - Expected Graduation: Spring 2018

Affiliations

UW NECA Chapter Team Captain
UW ASC Mixed Use Team Captain – Reno Competition
MCAA Team Member

Charles Malone
Project Engineer/ Volunteer Coordinator

510-847-5636 • tanner.malone@uw.edu

PAST EXPERIENCE

Pellco Construction - Mukilteo, WA
Project Intern – June 2016- Present

- Estimating concrete and ductwork quantities
- Processing expense reports
- Communicating with suppliers
- Developing future bid proposals

Kiewit Corporation – Bayonne, NJ
Project Intern – Start June 2017

EDUCATION

University of Washington - Seattle, WA
Bachelor of Science in Construction Management - Expected Graduation: Spring 2018

Affiliations

UW NECA Chapter Team Member
UW ASC Heavy Civil Team Member– Reno Competition
Husky Traders Club – Board Member

Zach Shoopman
Lighting Design Engineer

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PAST EXPERIENCE

Cochran, Inc. - Seattle, WA
Project Intern–Dec 2016-Presemt

- Generating lighting quantity take offs
- Tracking/filing RFI's and change orders
- Submittal/shop drawing review

MacDonald Miller Facility Solutions - Seattle, WA
Service Special Projects Intern- Jun 2016 – Sep 2016

EDUCATION

University of Washington - Seattle, WA
Bachelor of Science in Construction Management - Expected Graduation: Spring 2018

Affiliations

UW NECA Chapter Team Member
UW MCAA Team Captain
UW ASC Virtual Design Team Captain– Reno Competition
Alpha Delta Phi Fraternity President

Jacob Thackray
Solar Energy Specialist

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PAST EXPERIENCE

Milestone Northwest. - Seattle, WA
Construction Assistant–Dec 2016-Presemt

- Collaborating with cohort on multi-unit housing developments and single family homes
- Organizing, distributing, and tracking building material deliveries
- Managing waste disposal and clearing excess resources/debris from construction sites
- Managing daily work tracking logs

Skanska - Seattle, WA
Project Engineer Intern – Start Jun 2017

EDUCATION

University of Washington - Seattle, WA
Bachelor of Science in Construction Management - Expected Graduation: Spring 2018

Affiliations

UW NECA Chapter Team Member
Theta Chi Fraternity

Hank Dickinson
Electrical Engineer

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PAST EXPERIENCE

Columbia Pacific Construction - Vancouver, WA
Laborer – June 2014 – Aug 2016

- Operated heavy machinery
- Lead daily safety meetings
- Digging and laying sewer/storm pipe
- Directing material deliveries

GLY Construction– Seattle, WA
Project Intern- Start Jun 2017

EDUCATION

University of Washington - Seattle, WA
Bachelor of Science in Construction Management - Expected Graduation: Spring 2018

Affiliations

UW NECA Chapter Team Member
Theta Chi Fraternity

Sean McMahon
General Foreman

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PAST EXPERIENCE

PCI - Woodinville, WA
Project Intern – June 2016-Aug 2016

- Estimating and pricing out change orders
- Updating change order & RFI Logs
- Facilitated coordination between foremen, subcontractors, and suppliers
- Submittal/shop drawing review

Kiewit Corporation – Los Angeles, CA
Field Engineer – Start Jun 2017

EDUCATION

University of Washington - Seattle, WA
Bachelor of Science in Construction Management - Expected Graduation: Spring 2018

Affiliations

UW NECA Chapter Team Member
UW ASC Heavy Civil Team Member– Reno Competition
UW Rowing
Phi Delta Theta Fraternity

Assessment

The annual energy usage of Seattle Children's Theater is 1,550,896 kWh. Annual energy costs equate to $310,179. The primary building loads contributing to energy consumption are HVAC and lighting systems. Figure 2.1 illustrates the annual power consumption per system type.

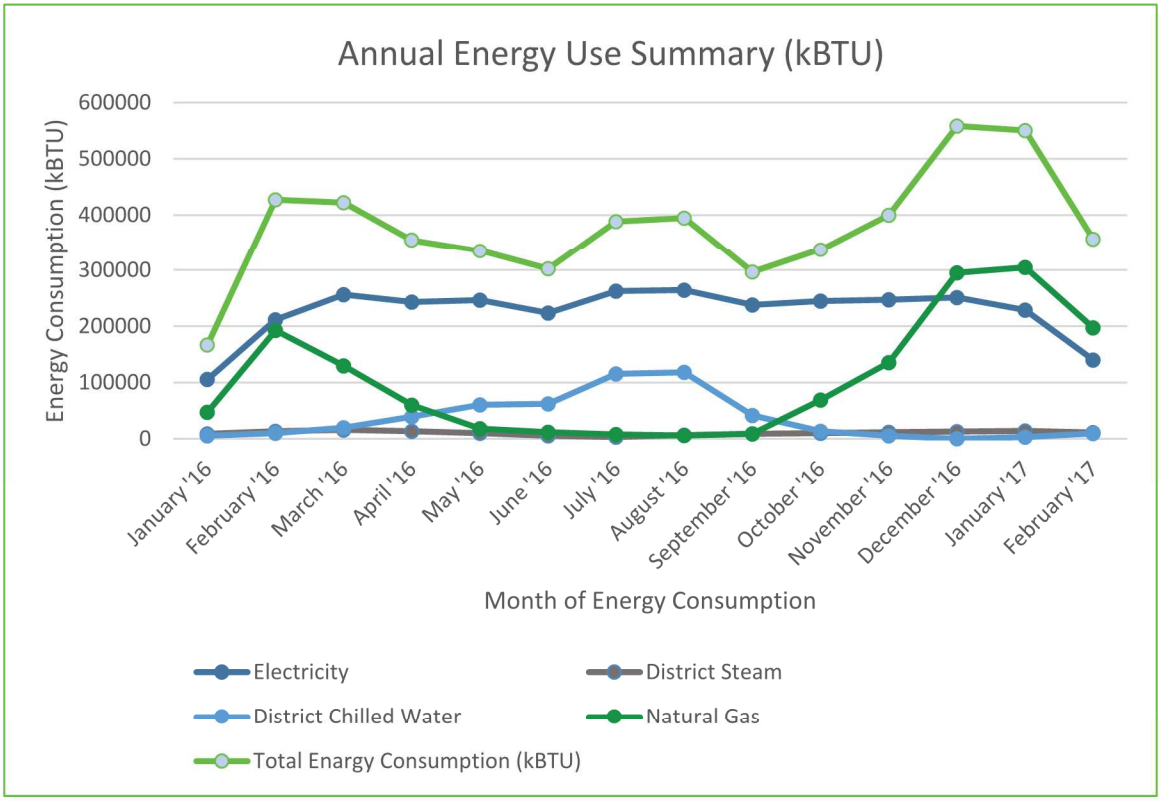


Figure 2.1

Lighting

The current lighting system relies heavily on T-8 and T-12 fluorescent lighting fixtures, which can be found in most common areas around the buildings, including the office space and classrooms. The lobby area primarily consists of incandescent downlights. There are currently no daylighting or occupancy control systems in place.

Mechanical

The main viewing auditorium, the Charlotte Martin Theatre, experiences significant fluctuations in ambient temperature due to occupant and lighting variability. During shows and rehearsals three different mechanical systems compete with each other in an effort to maintain a constant temperature.

The first system in use is a large air-handling unit that uses heated and chilled water from the Seattle Center's Central Utility Plant, which operates at constant volume set manually by the CUP's engineers.

The second is a large constant volume outside air unit that utilizes heating and cooling coils. This unit is zoned specifically to control the temperature of the Charlotte Martin Theatre stage area. Currently this unit can only operate at full capacity as the unit does not have any provisions for return air.

The third unit serving this space is a small constant volume unit with an airside economizer. This unit serves the control booth and operates simultaneously with the other two units described above.

The lobby is served by a single air-handling unit distributed by the Central Utility Plant. This system operates at constant volume and is scheduled to be on when either the lobby or the Charlotte Martin Theatre are occupied.

Inside the Technical Pavilion, the shop spaces are served by gas unit heaters and can only be cooled by air economizer cycles. A packaged rooftop VAV air conditioning unit and VAV boxes serve the office and rehearsal spaces in the upper floor of this building with electric heat in each zone.

A steam-to-water heat exchanger inside the Seattle Center Armory provides heating water to the building. The hot water pump operates at constant volume to provide hot water for the three way valves. Chilled water pumps are provided by a Variable Flow Damper that has two-way DP valves to decrease the chilled water supply as the load reduces.

Additionally a large boiler with radiators, is responsible for heating the basement of the office spaces. The pump inside the boiler operates at maximum capacity from Fall-Spring, regardless of occupancy and ambient temperature fluctuations. The boiler is manually turned off by CUP Engineers during the summer months.

EPA Portfolio Manager

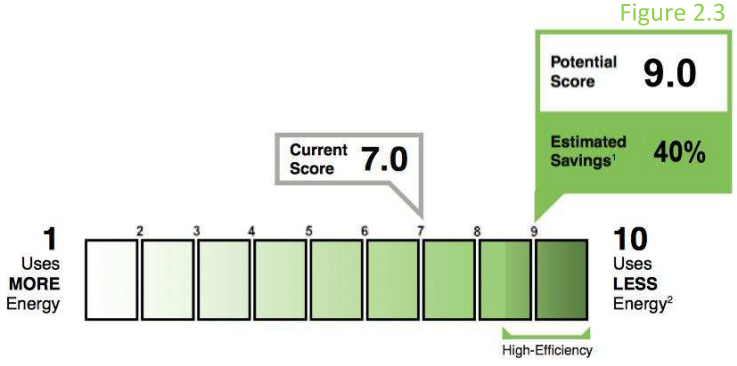
When analyzing the Seattle Children's Theater, Spark Electric utilized the Environmental Protection Agency Portfolio Manager Tool. Data is generated by inputting historical utility usage, building occupancy, existing building conditions, and average operating conditions. Unfortunately, the EPA Portfolio Manager Tool does not currently provide a baseline EPA score for theatrical spaces. As such, Spark Electric has analyzed the efficiency of the building in comparison to median national Source and Site EUI values. As shown in Figure 2.2, Seattle Children's Theatre utilizes twice the amount of energy as a typical building .

Building	EUI Site Score (kBtu/ft^2)	EUI Source Score (kBtu/ft^2)
National Median	45.3	85.1
Seattle Children's Theatre	74.0	172.1

Figure 2.2

DOE Building Asset Score

Figure 2.3



According to the DOE Building Asset Score tool an efficient building is considered to have a score of 8.5 or above. The Seattle Children's Theatre currently has a DOE Building Asset Score of 7.0. The energy efficient upgrades proposed by Spark Electric will elevate the DOE Building Score to 9.0.

Recommendations:

Lighting

In order to reduce the energy consumption of the current lighting system, Spark Electric proposes that all incandescent and fluorescent light fixtures be upgraded to LED in addition to integrated daylight and occupancy controls.

Please see the *Technical Analysis I: Lighting Analysis* for our proposed lighting design.

Mechanical

The energy costs associated with heating and cooling of the facility exceed $310,000 a year. In the future we recommend replacing all existing mechanical units with a modern VAV system. However, at this time, a system replacement of this magnitude would be cost and schedule prohibitive.

Spark Electric advises a full recommissioning of the existing mechanical systems. Recommissioning eliminates the need for costly capital improvements by optimizing the current building systems, enabling the mechanical units to operate at maximum efficiency. Furthermore, controls out of calibration and sequencing will be adjusted to eliminate simultaneous heating and cooling of competing systems. We anticipate that Seattle Children's Theatre will experience a **20%** reduction in annual energy consumption.

Annual Mechanical Systems Energy Consumption		
	kWh	Cost
Existing Systems	1,550,892 kWh	$ 310,178
Recommissioned Systems	1,240,716 kWh	$ 248,143.20
Annual Savings	**310,176 kWh**	**$ 62,034.20**

Figure 2.4

Solar Energy

Spark Electric is also recommending the installation of a 32kWh photovoltaic system to supply renewable energy to the building and further reduce annual energy costs. Please see *Technical Analysis III: Solar Energy Analysis* for detailed information.

Building Envelope

The windows surrounding the Seattle Children's Theatre are a combination of single and double-paned, uninsulated windows. A full glazing retrofit is costly and has a low ROI. As such, we are recommending SCT to install *Thinsulate* to the exterior curtain wall.

Thinsulate is a low emissivity window film that enhances the insulation of single and double pane windows, close to that of a triple-pane, for a fraction of the cost of glazing. The invisible film utilizes climate control technology to retain heat during the winter, while still blocking up to 99% of UV rays, protecting artwork and furniture inside the SCT.

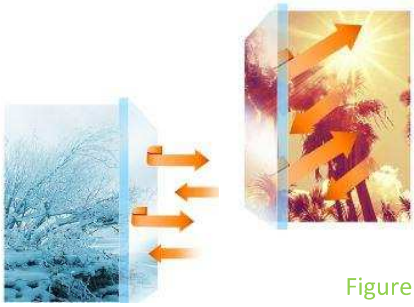


Figure 2.5

To analyze the exterior building envelope of the Seattle Children's Theater, Spark Electric's specially trained low voltage technicians performed infrared testing with a thermographic scanning device.

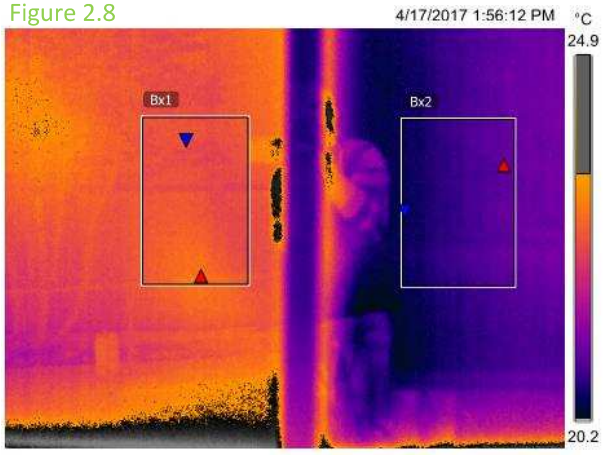
Figure 2.6

Figure 2.7

The thermal imaging of the northern façade within the Technical Pavilion, as shown in figures 2.6 and 2.7, depict the average heat loss throughout the building exterior.

Figure 2.8, illustrates the difference in heat loss between the existing glazing system and the addition of Thinsulate. The existing window appears to be cooler (purple) because there is less heat reflection and more thermal conductivity, thus more heat is escaping through the glass. The window with the *Thinsulate* application appears to be warmer (orange) because it is reflecting the outside temperature.

Figure 2.8



In addition to the *Thinsulate* installation, an elastomeric caulk will be applied to the edges of each window pane. Caulking provides an easily applied, waterproof seal that can expand and contract with the building envelope as external temperatures vary throughout the year.

We utilized the readings of the thermal imaging to analyze the energy loss through the existing building exterior. Please see figure 2.9 below for cost savings.

Figure 2.9

	Square Footage	U-Value	Annual BTU Loss	Annual Kw Loss	Annual Cost due to Heat Loss
Existing	3,700	0.78	563,734,784	162,215	$ 33,041
Thinsulate	3,700	0.48	326,467,680	95,678	$ 19,135
			Annual Savings		**$ 13,906**

Thinsulate and the Elastomeric Caulk application will reduce the amount of energy escaping through the windows by **43%** while decreasing annual energy costs by **$13,907.28.**

Spark Electric proposes that lighting upgrades be implemented in the Charlotte Martin Theatre, lobby area, office spaces, and the Technical Pavilion of the Seattle Children's Theatre. Included herein is a detailed design for both theatrical and architectural lighting systems upgrades, needed in order to provide the Seattle Children's Theatre (SCT) with enhanced lighting quality, controllability, and reliability.

Client Goals:

Illuminance Levels

High quality illumination within the workspace is paramount to the Seattle Children's Theatre since employees build all production sets in the wood and scene shops. Poor lighting levels at work can lead to eye-strain, fatigue, and accidents. On the other hand, too much light can cause problems, such as headaches and stress due to glare. Both can lead to mistakes at work, poor quality, and low production. Over-illumination also incurs unnecessary electrical costs.

Seattle Children's Theatre Illuminance (fc)			
Space	IES Recommended Illuminance Levels	Existing	Proposed
Lobby	20-30	14.4	25.1
Lounge/Breakroom	10-30	47.3	26.7
Office/Classroom	30-50	31.6	44.2
Workshop	30-75	48.9	70.3

Figure 3.1

Spark Electric Carefully analyzed the lumen output of all fixtures by inputting fixture data, reflective surfaces, fixture mounting heights, and ceiling heights into LightCalc software. In comparison to Illuminating Engineering Society recommendations, SCT experiences a combination of over-illuminance and insufficient lighting levels. Our proposed design will bring the lighting levels of all spaces up to current IES Illuminance standards, thus creating a more pleasant environment for the staff, students, and patrons of SCT.

Quality of Light

The CRI (color rendering index) measures the ability of a light source to accurately render all frequencies of the color spectrum when compared to a preferred reference light of a similar type. The closer the CRI is to 100, the better the quality, or "trueness", of light a lamp will emit.

Figure 3.2

For Seattle Children's Theatre, the color rendering ability of each lamp is vital for the crafting of all sets and props for the productions. We took this into high consideration, ensuring each proposed fixture had a CRI between 85-95.

Temperature of Light

The color temperature of a fixture describes how the light appears when the human eye looks directly at an illuminated lamp. The optimal color temperature for stage lighting is 3500K. It is imperative that the lighting temperature in the Technical Pavilion match the stage lighting in the Charlotte Martin Theatre.

In The past LED lights had limited temperature variabilities, and only illuminated cool, white light (5000K). As such, fluorescent lighting has been preferred in the Technical Pavilion. However, today's LED technology permits the light to illuminate temperatures between 2700K-8000K.

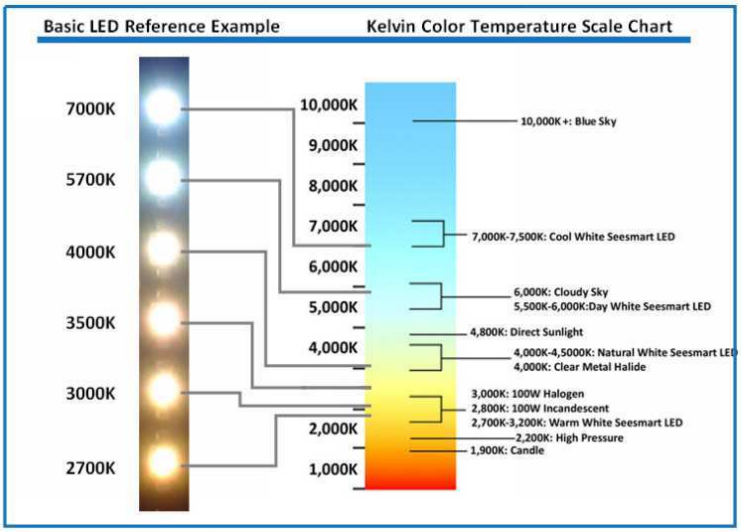


Figure 3.3

Recommendations:

Architectural Lighting

The Current lighting systems primarily consist of T-5 and T-8 fixtures in the Technical Pavilion and office spaces. These existing fixtures account for 331,873 kWh per year, equaling **$66,347** annually.

Seattle Children's Theatre expressed their wished to maintain the same layout of existing fixtures in their efforts to preserve the architectural design of the facility. Spark has developed a lighting package that includes a like-for-like replacement of the current fixtures to LED fixtures. Our proposed lighting design is **73%** more efficient and will save SCT **$48,218** per year in lighting energy costs.

Figure 3.4

Proposed Architectural Fixtures				
Proposed Fixtures	**Manufacturer**	**Description**	**Qty.**	**kWh/Year**
L1	RAB	LED Downlight	240	17,520
L2	RAB	2x4 Recessed LED Panel	108	15,768
L3	RAB	2x2 Recessed LED Panel	70	10,220
L4	RAB	LED Spotlight	12	788
L5	Ledalite	LED Lamp Replacement	12	723
L6	RAB	4' Wall Mount Emergency LED	23	2,938
L7	Lithonia	LED 4'-2L-32W-T8	155	23,762
L8	Lithonia	LED 8'-8L-32W-T8	85	18,615
X	Lithonia	LED Exit Sign	33	313
		Proposed Annual Energy		90,647
		Proposed Annual Energy Costs		**$ 18,129**

Architectural Lighting Controls

Light control within the SCT space is currently limited to manual switching. There are no existing automatic or programmable lighting controls in place. To maximize energy savings, Spark Electric proposes utlizing Lutron's *Quantum Vue Total Light Management*, a lighting control and energy management system that integrates lighting controls, sensors, digital ballasts, and LED drivers, all together under one software umbrella for total light management. Quantum Vue is ideal for retrofit applications, providng central control and monitoring for wired and wireless devices.

As shown in Figure 3.5. The Quantum Vue mangement control software simplifies ongoing building operations and reduces maintenance costs by allowing facility managers to control all lighting levels on any smart device. Reports and alerts generated by the software can identify energy abnormalities and bring attention to maintence or system issues. These alerts can identify the exact location and nature of a problem, so they can be quickly addressed. Additionally, the system promotes productivity and comfort by allowing personailized controls to the staff of the Seattle Children's Theatre.

Figure 3.5

The proposed dual technology occupance sensors utilize both Passive Infrared (PIR) and ultrasonic technology to minimze the number of false triggers that create unbalanced interior lighting conditions. Signals from the ultrasonic and infrared sensors are both required to switch the lights off, while only one is needed to keep the lights on. This will provide SCT the proper controls to minimze the use of electricty and provide energy savings in a more efficient manner.

Spark Electric proposes installing the following control devices.

Figure 3.6

Proposed Architectural Lighting Control Devices		
Manufacturer	Device	Quantity
Lutron	Pico Wired Control Switch	15
Lutron	Dual Technology Occupancy Sensor – Ceiling Mount	13
Lutron	Occupancy Sensor – Wall Mount	44
Lutron	Daylight Sensor	10
Lutron	PowPak	83
Lutron	Receptacle PowPak	29

Figure 3.7 illustrates the interconnections between the various wireless controls, occupancy sensors, and daylight sensors. PowPak dimming modules dim lighting loads in response to wireless sensors and controls mounted in the ceiling. The Pow Pak receptacle module switches receptacle loads on and off in response to wall mounted wireless occupancy sensors.

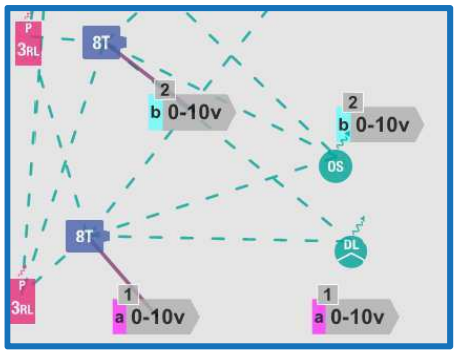


Figure 3.7

Spark Electric has determined that the integration of daylight and occpuancy controls within the lighting system will additionally reduce energy consumption of fixtures by 20%. Total annual lighting load energy savings are **$51,871**

Annual Lighting + Controls Energy Usage	
Existing Lighting Energy Usage (kWh)	331,873
Proposed Energy Lighting Energy Usage (kWh)	90,647
Less Proposed Savings w/Controls (kWh)	18,129
Total Proposed Energy Usage (kWh)	72,518
Existing Energy Costs	$ 66,375
Proposed Energy Costs	$ 14,504
Total Energy Cost Savings	**$ 51,871**

Figure 3.8

Theatrical Lighting and Controls

The main viewing auditorium, the Charlotte Martin Theater, is in need of a full theatrical lighting system upgrade. We have conducted a thorough lighting analysis of the theater, and assessed the energy efficiency and lifespan of the current theatrical lighting and control system. The existing Charlotte Martin theatrical system utilizes inefficient halogen fixtures, comprised of Ellipsoidal Lights, Wash Lights, and Cyclorama Lights.

Our aim is to provide the Seattle Children's Theatre with an intelligent lighting system, which has automated (moving-heads) and mechanical abilities beyond those of traditional, stationary systems.

Figure 3.9

Proposed Theatrical Lighting Fixture Savings		
Charlotte Martin Theatre	Existing Halogen Fixtures	LED Fixutre Upgrades
Quanity	256	150
Annual Fixture Use (hours)	780	780
Annual kWh	160, 583	29,123
Annual Energy Cost	$ 32,117	$ 5,825
Annual Maintenace and Operating Expenses	$ 22,500	$ 5,500
Annual Savings		**$ 43,292**

By drastically decreasing energy, maintenance, and operating costs, SCT will save **$43,292** annually. We have reduced fixture quantities by **58%** due to the higher lumen output of the LED fixtures and their remote color changing capabilities.

The intelligent LED fixtures can perform tasks which would otherwise require many conventional lights to accomplish. Traditional theatrical lighting systems produce white light and can only illuminate colors by inserting a polycarbonate filter in front of the lens of the fixture. At the flick of a switch, a few automated heads can change from a textured blue 'night' effect to a red 'fire' effect for the next scene. Attempting this transition with traditional lighting fixtures could require as many as 30 units. The automated and mechanical abilities of the proposed fixtures significantly reduce the quantity of lights needed in a rig.

Figure 3.10

In addition the hefty maintenance and operating costs currently incurred each year will drastically decrease. Operating time is reduced, as there is no need to climb a ladder or erect scaffolding to position a light unit in for productions. Furthermore, the automation of lighting systems under digital control increases the reliability of the lighting systems while relieving the burden on management and maintenance costs.

Hollywood lights will be providing the theatrical control system, which drives the proposed LED fixture. SCT's current control system will be replaced with (3) ETC Sensor3 Installation Racks with relay modules, and a Gio 2k light board.

The current fixtures were purchased over 25 years ago and have well surpassed their specified lifecycle of 15 years. The average lifespan for the LED replacement fixtures is 47 years per their specifications. Figure 3.11 depics the life cycle of our proposed theatrical lighting design.

Proposed Theatrical Light Fixtures Life Cycle			
Prposed Fixtures	**Lifecycle Hour Rating**	**Hours Used/Year**	**Lifespan in Years**
Source 4WRD Light Engine w/ Barrel	30,000	780	38
Series 2 Luster	20,000	780	25
D60 Lustr+	50,000	780	64
ColorForce II 72	50,000	780	64

Figure 3.11

Architectural Lighting Energy Savings Breakdown

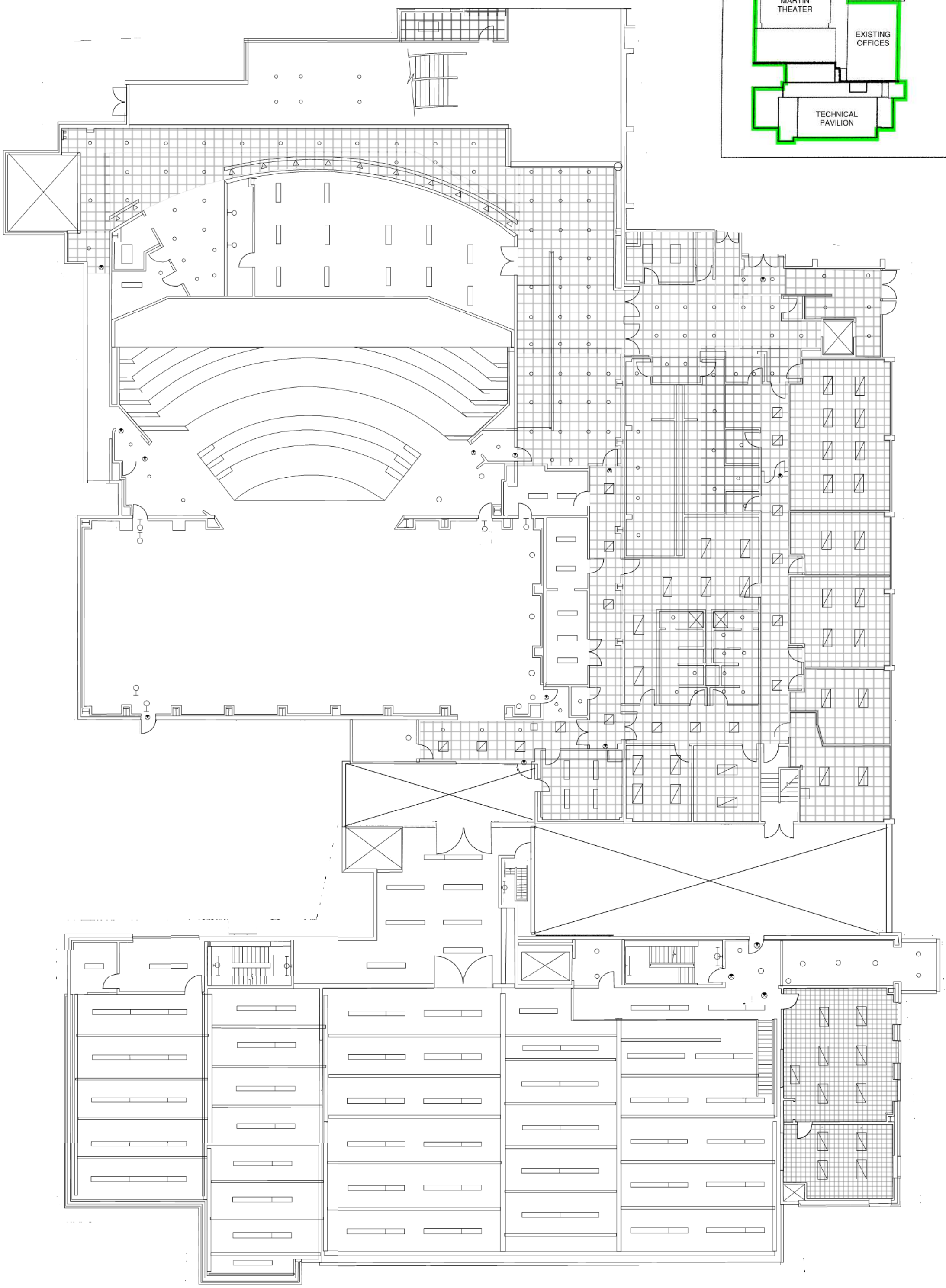
Project: **Seattle Children's Theatre**

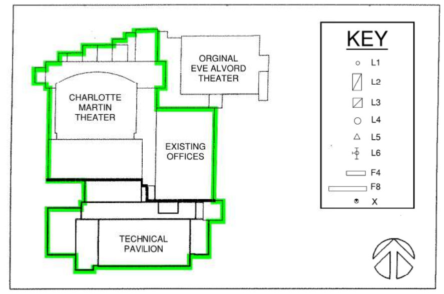
Responsible: **Spark Electric**

EXISTING FIXTURES									
Fixture Designation	Manufacturer	Description	Qty.	Wattage	Total W	kW	Hours/Year	kWh/year	Cost/Year
AB	Krilin	Incandescent	18	66	1188	1.2	3650	4336.2	$ 867
AC	Lithonia	2x2 Parabolic	13	68	204	0.2	3650	744.6	$ 149
B	Lithonia	2x4 3L	16	102	1632	1.6	3650	5956.8	$ 1,191
C	Lithonia	2x4 3L Parabolic	4	108	432	0.4	3650	1576.8	$ 315
CC	Lithonia	4' Industrial Fluorescent	12	1083	12996	13.0	3650	47435.4	$ 9,487
D	Lithonia	4'-FL-2L-32W-T8	12	68	816	0.8	3650	2978.4	$ 596
DD	Lithonia	4'-FL-2L-32W-T8 w/emergency backup	6	38	228	0.2	3650	832.2	$ 166
F	Lithonia	2x2 2U Lamp	12	68	816	0.8	3650	2978.4	$ 596
G	Lithonia	Track Light	12	100	1200	1.2	3650	4380	$ 876
GG	Lithonia	4'-FL-3L-32W-T8	10	130	1300	1.3	3650	4745	$ 949
H	Staff	Incandescent Downlight	12	100	1200	1.2	3650	4380	$ 876
L	Staff	10" Famter Downlight	151	66	9966	10.0	3650	36375.9	$ 7,275
LL	Bryant	Surface Lamp	9	150	1350	1.4	3650	4927.5	$ 986
J	Lithonia	Incandescent Downlight	2	75	150	0.2	3650	547.5	$ 110
K	Ledalite	4'-FL-5L-32W Recessed	26	218	5668	5.7	3650	20688.2	$ 4,138
NN	Hubbell	Knuckle Mounted Spot Light	6	55	330	0.3	3650	1204.5	$ 241
OO	Hubbell	Knuckle Mounted Spot Light	6	55	330	0.3	3650	1204.5	$ 241
PP	Halo	Recessed Incandescent	16	90	1440	1.4	3650	5256	$ 1,051
TT	Lithonia	4'-Fl-322W-T8 Surface Mounted	2	144	288	0.3	3650	1051.2	$ 210
XX	Prescolite	Exit Sign	6	20	120	0.1	3650	438	$ 88
W	Lithonia	Exit Sign	5	40	200	0.2	3650	730	$ 146
A1	Atermide	Recessed Downlight	5	100	500	0.5	3650	1825	$ 365
B1	Prescolite	8" Recessed Compact Fluorescent	22	46	1012	1.0	3650	3693.8	$ 739
B2	Prescolite	9" Recessed Compact Fluorescent	5	94	470	0.5	3650	1715.5	$ 343
C1	Columbia	2x2 Recessed FL-3-32W-T8	14	108	1512	1.5	3650	5518.8	$ 1,104
D1	Columbia	2x2 Recessed FL-3-32W-T8	4	74	296	0.3	3650	1080.4	$ 216
D1E	Columbia	2x2 Recessed FL-3-32W-T8 w/Emergency Backup	2	54	108	0.1	3650	394.2	$ 79
F1-4	Columbia	4'-FL-1L-32W-T8	26	74	1924	1.9	3650	7022.6	$ 1,405
F1-8	Columbia	8'-FL-4L-32W-T8	4	148	592	0.6	3650	2160.8	$ 432
F2-4	Columbia	4'-FL-2L-32W-T8	49	158	7742	7.7	3650	28258.3	$ 5,652
F2-8	Columbia	8'-FL-2L-32W-T8	81	240	19440	19.4	3650	70956	$ 14,191
F3	Columbia	2x2 Recessed FL-3-32W-T8	39	110	4290	4.3	3650	15658.5	$ 3,132
F4-4	Columbia	4'-FL-4L-32W-T8	3	74	222	0.2	3650	810.3	$ 162
F4-2	Columbia	4'-FL-2L-32W-T8	3	74	222	0.2	3650	810.3	$ 162
P1-E	Columbia	4'-FL-2L-32W-T8 - Stairwell Emergency Wall Mount	34	74	2516	2.5	3650	9183.4	$ 1,837
X1	Dualite	Exit Sign	22	40	880	0.9	3650	3212	$ 642

PROPOSED FIXTURES								
New Fixture Designation	Manufacturer	Description	Wattage	Total W	kW	kW/year	Cost/Year	
L1	RAB	LED Downlight	20	360	0.4	1,314	$	263
L3	RAB	2x2 LED Recessed Panel	40	520	0.5	1,898	$	380
L2	RAB	2x4 LED Recessed Panel	40	640	0.6	2,336	$	467
L2	RAB	2x4 LED Recessed Panel	40	160	0.2	584	$	117
F4	Lithonia	LED Strip light 4'-2L-32W-T8	42	504	0.5	1,840	$	368
F4	Lithonia	LED Strip light 4'-2L-32W-T8	42	504	0.5	1,840	$	368
F4	Lithonia	LED Strip light 4'-2L-32W-T8	42	252	0.3	920	$	184
L3	RAB	2x2 LED Recessed Panel	40	480	0.5	1,752	$	350
L5	Lithonia	LED Lamp Replacement	17	204	0.2	745	$	149
F4	Lithonia	LED Strip light 4'-2L-32W-T8	42	420	0.4	1,533	$	307
L1	RAB	LED Downlight	20	240	0.2	876	$	175
L1	RAB	LED Downlight	20	3020	3.0	11,023	$	2,205
L1	RAB	LED Downlight	20	180	0.2	657	$	131
L1	RAB	LED Downlight	20	40	0.0	146	$	29
F4	Lithonia	LED Strip light 4'-2L-32W-T8	42	1092	1.1	3,986	$	797
L4	Lithonia	LED Strip light 4'-2L-32W-T8	18	108	0.1	394	$	79
L4	Lithonia	LED Strip light 4'-2L-32W-T8	18	108	0.1	394	$	79
L1	RAB	LED Downlight	20	320	0.3	1,168	$	234
F4	Lithonia	LED Strip light 4'-2L-32W-T8	42	84	0.1	307	$	61
X	Lithonia	LED Exit Sign	3	18	0.0	66	$	13
X	Lithonia	LED Exit Sign	3	15	0.0	55	$	11
L1	RAB	LED Downlight	20	100	0.1	365	$	73
L1	RAB	LED Downlight	20	440	0.4	1,606	$	321
L1	RAB	LED Downlight	20	100	0.1	365	$	73
L2	RAB	2x4 LED Recessed Panel	40	560	0.6	2,044	$	409
L2	RAB	2x4 LED Recessed Panel	40	160	0.2	584	$	117
L2	RAB	2x4 LED Recessed Panel	40	80	0.1	292	$	58
F4	Lithonia	LED Strip light 4'-2L-32W-T8	42	1092	1.1	3,986	$	797
F8	Lithonia	LED Strip light 8'-3L-32W-T8	60	240	0.2	876	$	175
F4	Lithonia	LED Strip light 4'-2L-32W-T8	42	2058	2.1	7,512	$	1,502
F8	Lithonia	LED Strip light 8'-3L-32W-T8	60	4860	4.9	17,739	$	3,548
L3	RAB	2x2 LED Recessed Panel	40	1560	1.6	5,694	$	1,139
F4	Lithonia	LED Strip light 4'-2L-32W-T8	42	126	0.1	460	$	92
F4	Lithonia	LED Strip light 4'-2L-32W-T8	42	126	0.1	460	$	92
L6	RAB	4' Emergency Stairwell Wall Mounted LED	35	1190	1.2	4,344	$	869
X1	Lithonia	LED Exit Sign	3	66	0.1	241	$	48

Existing kWh/Year	331,873
Proposed kWh/Year	90,647
Annual kWh Savings	241,226
Annual Cost Savings	**$ 48,245**



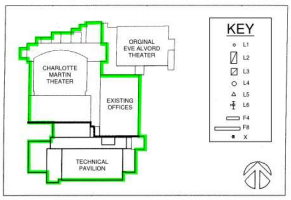


Level 1 - Proposed Lighting	
Project Number	89350
Date	5/1/2017
Drawn By	FMS
Checked By	WSP
E-1	
Scale	1/8" = 1'

UNIVERSITY OF WASHINGTON

SEATTLE CHILDREN"S THEATRE RENOVATION
SEATTLE, WASHINGTON 98109

No.	Description	Date



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SEATTLE CHILDREN"S THEATRE RENOVATION
SEATTLE, WASHINGTON 98109

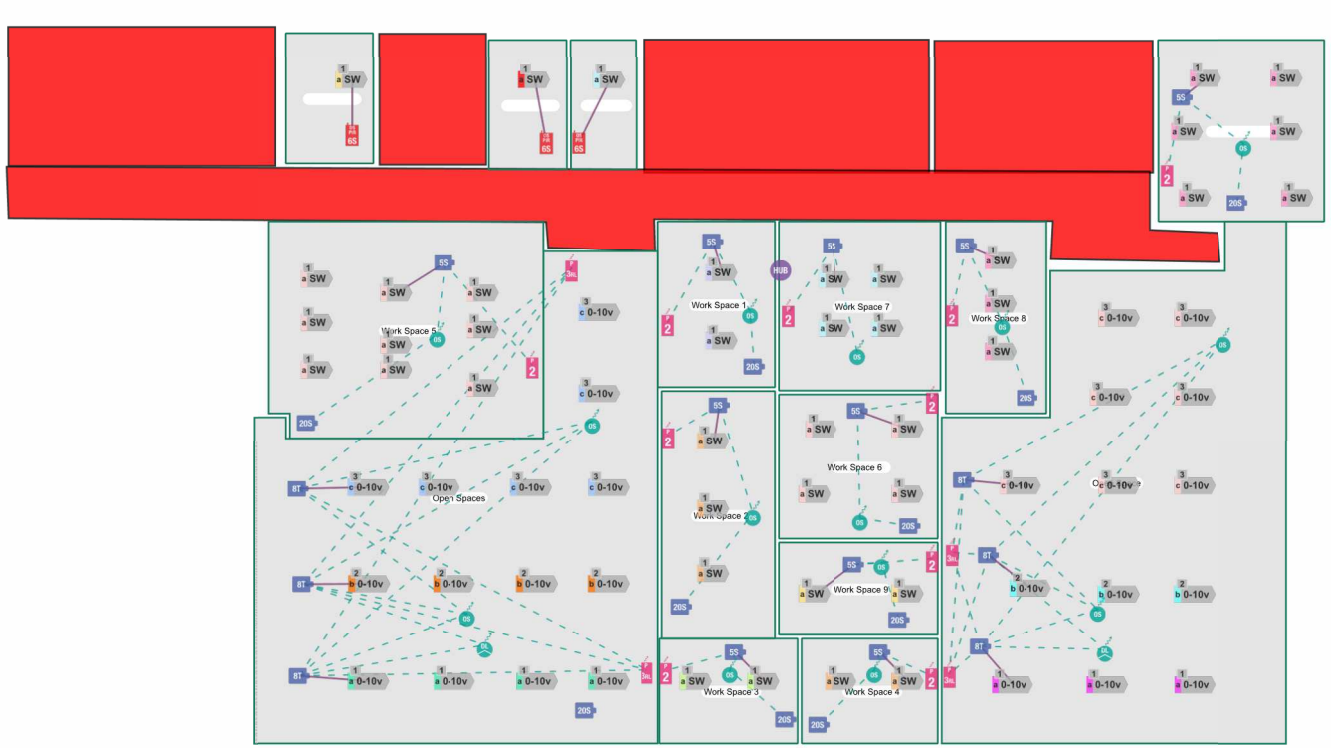
Level 2 - Proposed Lighting

E-2

Scale: 1/8" = 1'

Project Number: 870500
Date: 5/12/17
Drawn By: FMS
Checked By: WSP

No.	Description	Date



System Layout

General Notes

1. This layout is for system schematic purposes only. Contractor shall locate, install, and wire equipment according to Lutron installation and specification documents.
   1a. If the Lutron Sensor Layout and tuning service has been purchased, then daylight and occupancy sensors are placed by Lutron.
2. Verify shade design with Lutron.
3. See Cover Sheet and One-Lines for additional information.

Legend

- PX-2BRL-GXX-I01 (8)
- PJ2-2B-GWH-L01 (CW-1-WH) (25)
- PJ2-3BRL-GWH-L01 (CW-1-WH) (3)
- LOS-CDT-1000-WH (6)
- LRF2-DCRB-WH (8)
- LRF2-OCR2B-P (18)
- HJS-1-FM (2)
- RMJS-20R-DV-B (10)
- RMJS-5R-DV-B (12)
- RMJS-8T-DV-B (27)
- PP-DV (4)

SEATTLE CHILDREN'S THEATRE

SPARK electric

No.	Description	Date

UNIVERSITY OF WASHINGTON

SEATTLE CHILDREN'S THEATRE RENOVATION
SEATTLE, WASHINGTON 98109

Level 3 - Proposed Controls

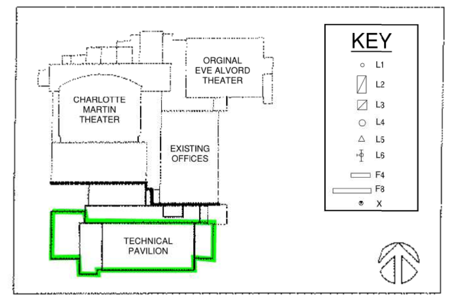
Project Number	89350
Date	5/1/2017
Drawn By	FMS
Checked By	WSP

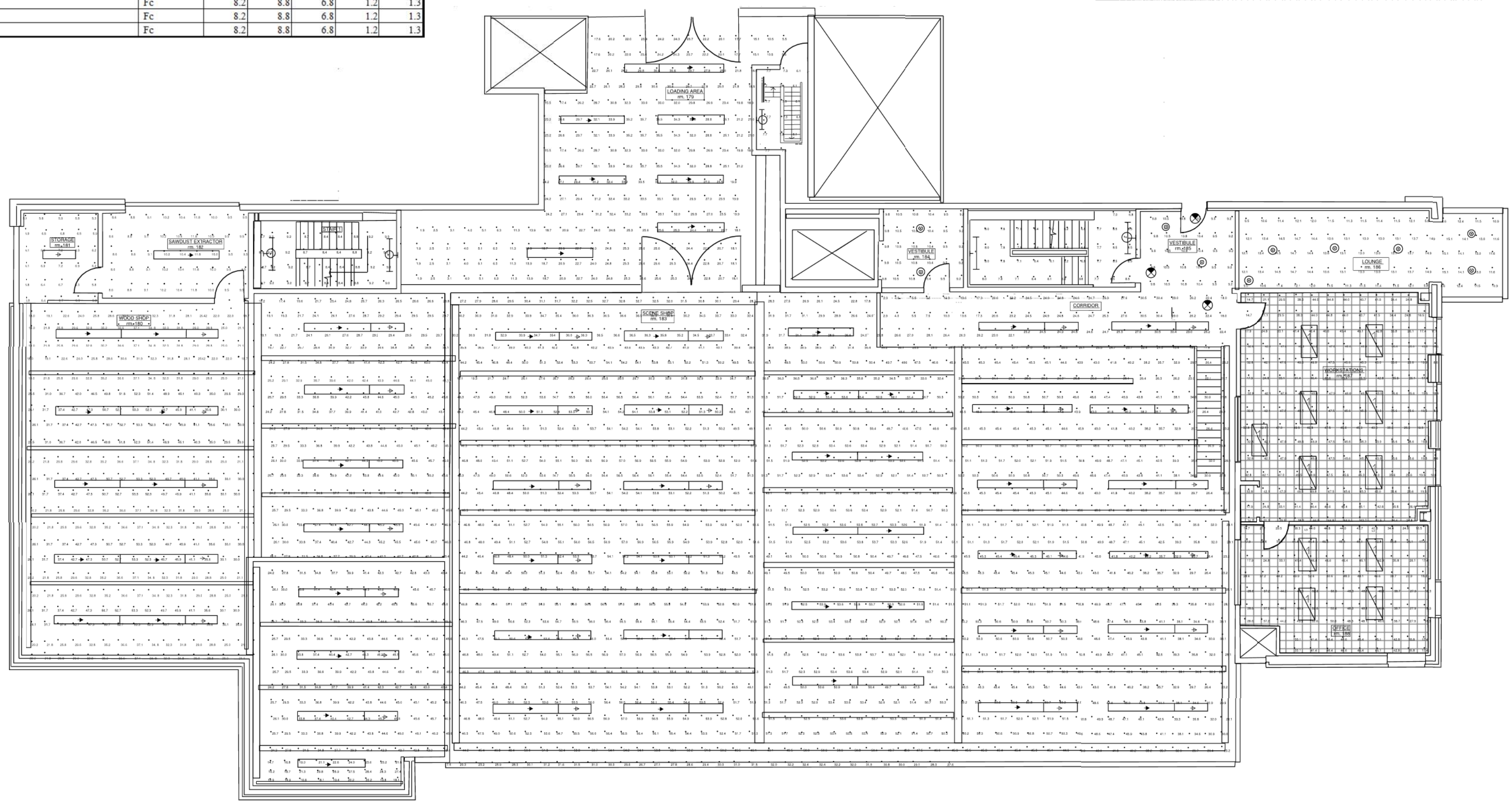
E-3

Not to Scale

Luminaire Schedule				
	Qty	Fixture	LLF	Description
	[illegible]	L1	1.000	[illegible]
	[illegible]	L2	1.000	[illegible]
	5	L6	1.000	[illegible]
	38	F4	1.000	[illegible]
	[illegible]	F8	1.000	[illegible]

Illuminance Calculation Summary							
Room #	Description	Units	Avg	Max	Min	Avg/Min	Max/Min
179	Loading Area	Fc	32.3	35.7	29.7	1.1	1.2
180	Wood Shop	Fc	72.8	74.8	68.6	1.1	1.1
181	Sawdust Extractor	Fc	10.6	12.3	9.1	1.2	1.4
182	Scene Shop	Fc	70.3	77.2	64.3	1.1	1.2
183	Vestibule 1	Fc	9.5	10.4	8.2	1.2	1.3
184	Vestibule 2	Fc	9.5	10.4	8.2	1.2	1.3
185	Work Stations	Fc	47.5	53.7	42.1	1.1	1.3
186	Work Stations	Fc	48.9	55.6	46.7	1.0	1.2
187	Offices	Fc	44.2	58.9	39.1	1.1	1.5
S-1	Stair 1	Fc	8.2	8.8	6.8	1.2	1.3
S-2	Stair 2	Fc	8.2	8.8	6.8	1.2	1.3
S-3	Stair 3	Fc	8.2	8.8	6.8	1.2	1.3





No.	Description	Date

UNIVERSITY OF WASHINGTON

SEATTLE CHILDREN"S THEATRE RENOVATION
SEATTLE, WASHINGTON 98109

Technical Pavilion
Level 1
Photometric
Analysis

Project Number	89350
Date	5/1/2017
Drawn By	FMS
Checked By	WSP

E-4

Photovoltaics in the Northwest

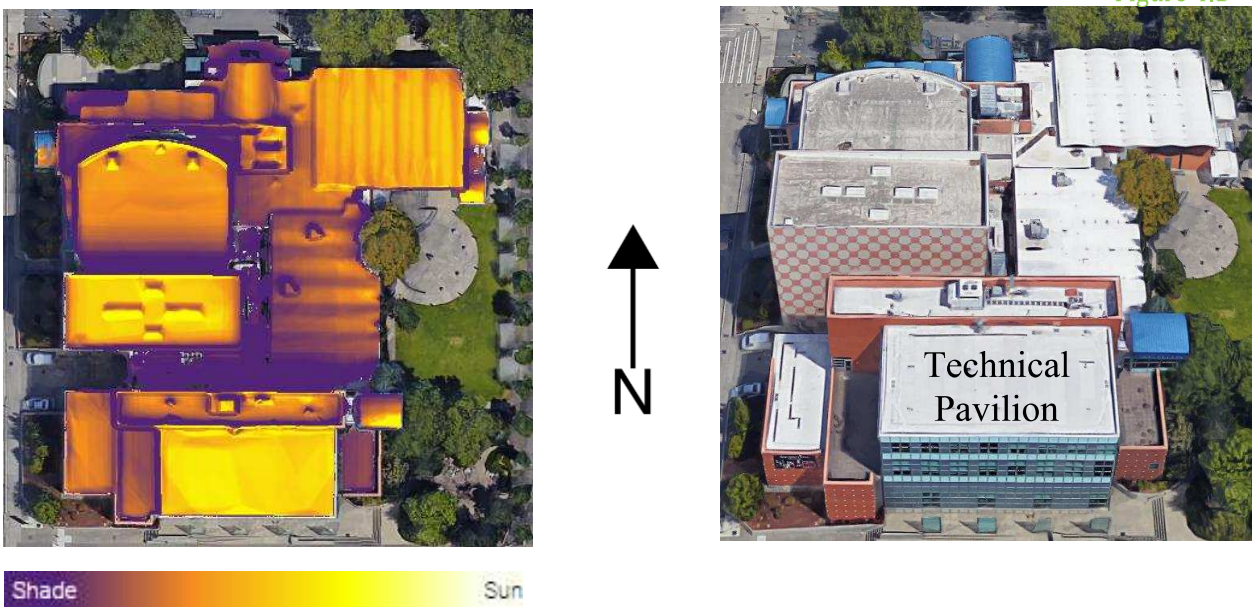
Seattle is a national leader in energy conservation, green energy production, and sustainable living. Solar panels operate with greater efficiency in moderate climates, making Seattle an excellent place for solar electric power. Even on cloudy, rainy days, Seattle experiences high levels of solar radiation that maximizes production of photovoltaic systems.

Existing Conditions

Shading is a major concern when considering site locations for PV installations, as shaded panels will diminish production. The only available ground location is a small lawn to the east of the building. However, this area is shaded by trees and is one of the only green areas of the facility. The theatre is located in an urban setting where land is in high demand. Therefore the best site for the system is the roof.

Spark electric has determined the most appropriate location for a photovoltaic array is on the southernmost roof of the facilities' Technical Pavilion. A shading analysis, as shown below, illustrates the maximum sunlight available to the proposed location, showing little to no shading interferences.

Figure 4.1



The roof structure of Seattle Children's Theatre varies in shape and size. There are mechanical equipment and curved roofs that restrict placement of the system on other roofs. Additionally, a roof access hatch provides easy access for install and maintenance of the system on the Technical Pavilion.

The Technical Pavilion roof permits 2,600 square feet of unobstructed area for an array layout. Our designed system weights roughly 9 psf. The roof was built under Seattle Building Code to withstand 25psf snow load, thus indicating minimal impact by installing a PV system. The roof design is able to easily support this load. The roof is flat with a ¼"to 1' slope to aid water runoff.

Recommendations

Spark Electric has designed a 31.2 kWh PV system for Seattle Children's Theatre including the following;

- 104 Panels manufactured by *Itek Solar* - 300 SE Module
- 104 Micro inverters manufactured by *Enphase* – M250-60-2LL-S22
- Ballasted Racking system manufactured by *Panel Claw* - Polar Bear III HD

Panels

Itek's solar panels are manufactured with newest technology in the industry backed by a 25-year warranty. The solar glass features an anti-glare prismatic sub-surface texture, capturing the most light possible. This is ideal for both sun and diffused low-light conditions that Seattle weather experiences. These panels are rated PID free meaning there will be no degradation in production due to age. Panels will be installed in 8 rows of 13 panels.

Figure 4.2

Microinverters

Micro inverters, individually attached to the underside of each panel, convert DC power to AC power directly at each panel. Each inverter operates independently of one another, allowing maximum production of energy. If one panel is obstructed it will not affect the rest of the string. The productivity data generated at each inverter is integrated within the Quantum View Building Management System, enabling facility managers to monitor each unit.

Mounting

We recommend a ballasted mounted system rather than a sun tracking photovoltaic system. Sun tracking units have a high initial cost and high maintenance costs. A sun tracking system is most efficient when exposed to direct rays. In overcast skies, light is diffused into a broader spectrum, making a sun tracking unit not viable or worth the associated costs. However, a fixed PV system still produces renewable energy in overcast skies. This is the most practical system with Seattle's weather.

The racking will provide a 10 degree tilt to the south. The panels are secured by a ballast frame, preventing penetration to the roof membrane. This installation method ensures there will be no leaks or damage to the roof structure and costs less than other systems.

Batteries

We have determined a battery energy storage system is not financially feasible for the Seattle Children's Theatre.

The main viewing auditorium, the Charlotte Martin Theatre, experiences a fluctuation in heating and cooling needs based on occupancy level during productions. Peak solar hours occur during mid-day, but most productions occur later in the afternoon and evening. In this scenario, battery packs would bridge the gap of energy needs, however their high cost outweighs these benefits. Instead, Spark Electric recommends programming HVAC controls.

All lighting and HVAC loads can be managed and monitored using Quantum Management Software. Features also allow facility managers to control heating and lighting levels, room-by-room within the facility.

During peak solar hours, lighting loads also decrease due to daylighting controls. Quantum software can use data collected by micro inverters in combination with data of scheduled shows, to direct solar energy to heat or cool the Charlotte Martin Theatre in anticipation of a show. This eliminates the needs for costly battery systems.

Cost Analysis

Artisan Electric will supply and install our proposed photovoltaic system. The system provides Seattle Children's Theatre 36,138 kWh and save **$7,228** per year.

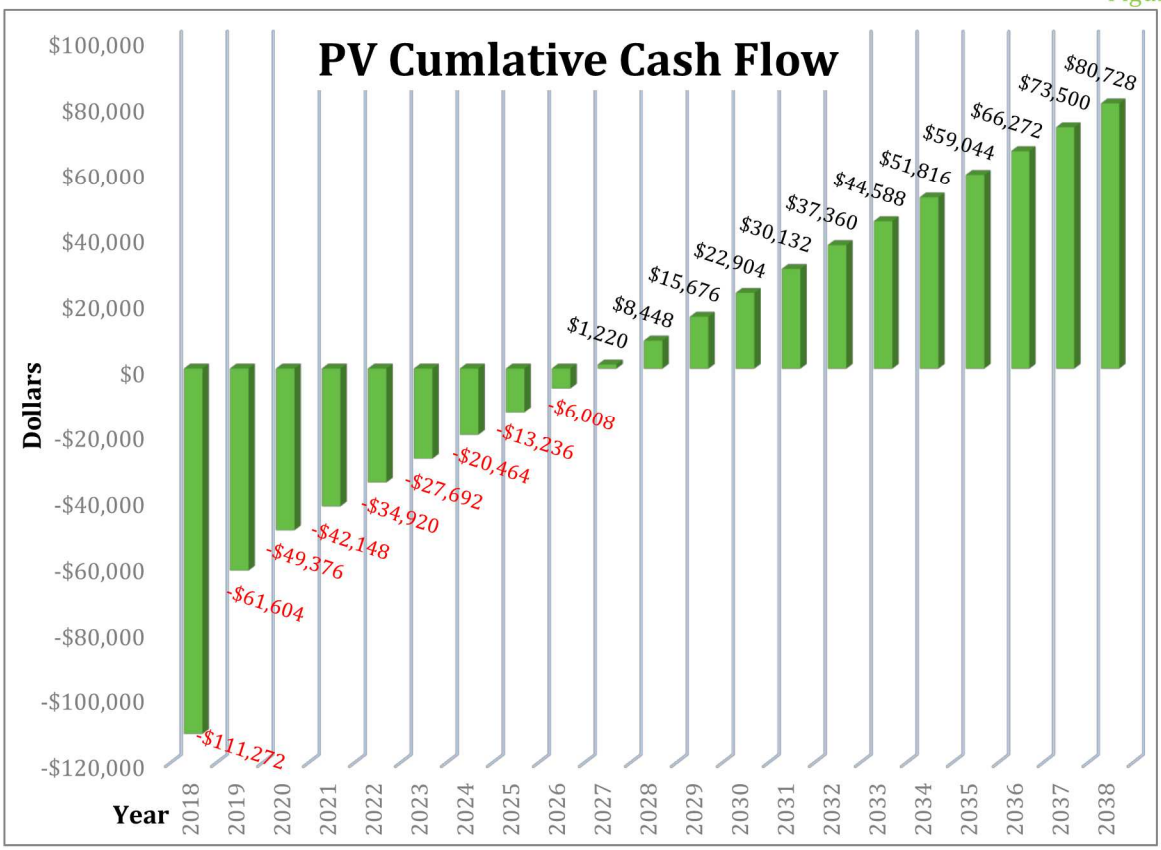
Photovoltaic System Savings	
Annual Energy Produced (kWh)	36,138
Annual Savings	$ 7,228
Installation Cost	$ 124,000
Less Incentives	52,940
Total Project Cost	**$ 71,060**
Payback Period (years)	9.75

Figure 4.3

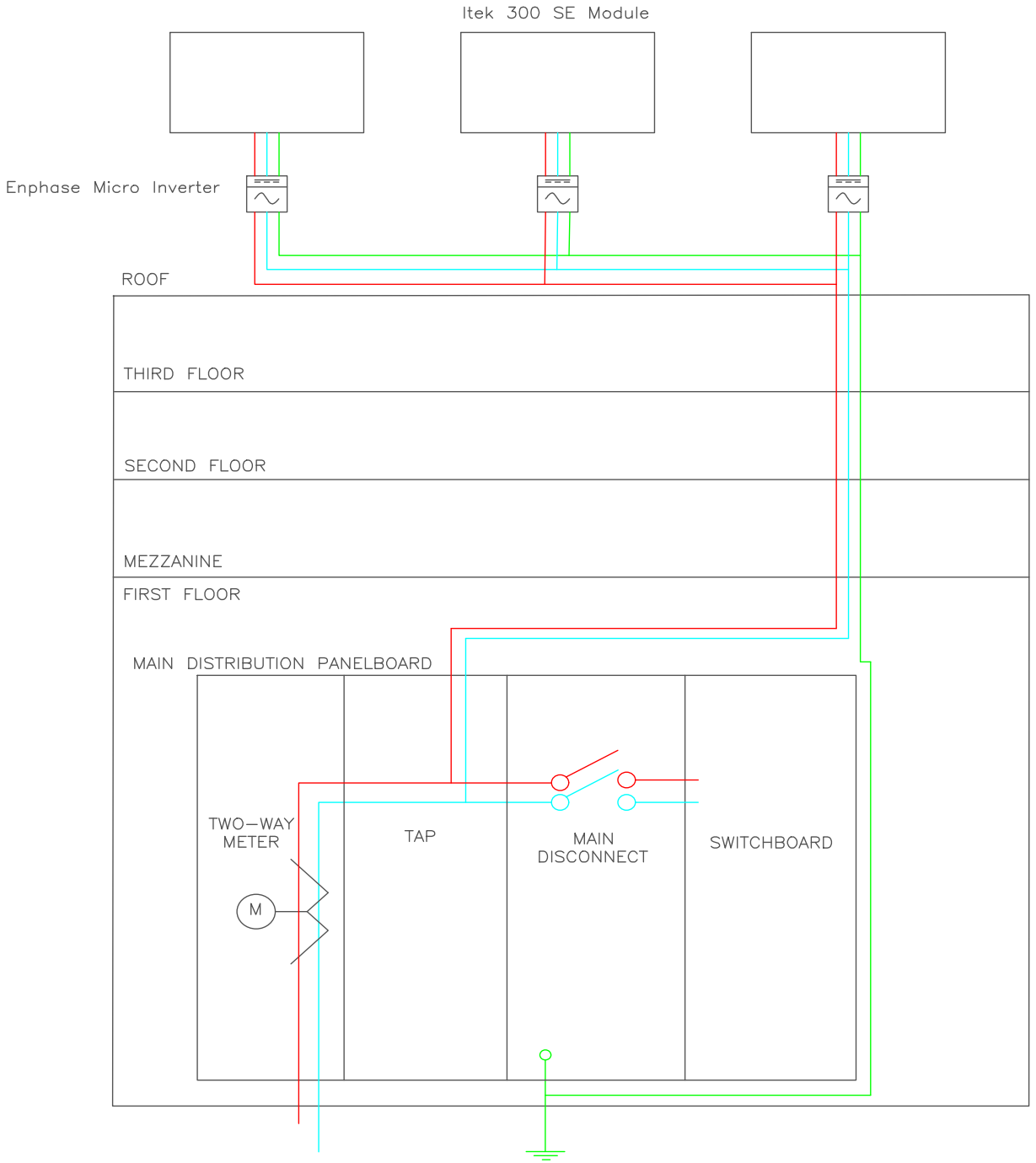
At the current cost of technology, photovoltaic systems are not affordable without incentives typically carrying payback periods longer than the expected lifetime of the system. In efforts to promote renewable energy systems, the city of Seattle offers various rebates and subsidies to offset installation costs. Additionally, PV systems are exempt from sales tax in WA.The Local Incentive Breakdown is included in the financing section.

Spark Electric has assumed a 20-year life expectancy, however this system is warranted for 25 years.

Figure 4.4



Seattle Children's Theatre will experience a return on investments at year 10, at which the Theatre will have a positive cumulative cash flow. By year 2038 SCT will earn **$80,728**.



No.	Description	Date

UNIVERSITY OF WASHINGTON

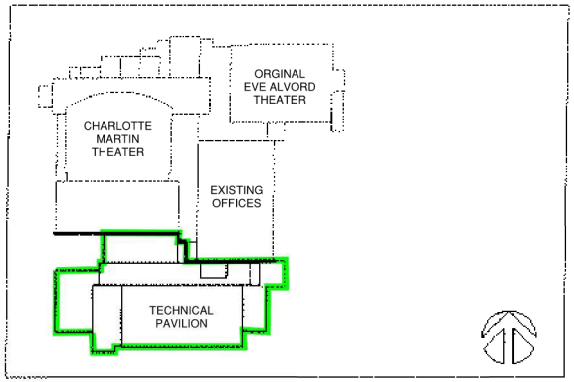
SEATTLE CHILDREN"S THEATRE RENOVATION
SEATTLE, WASHINGTON 98109

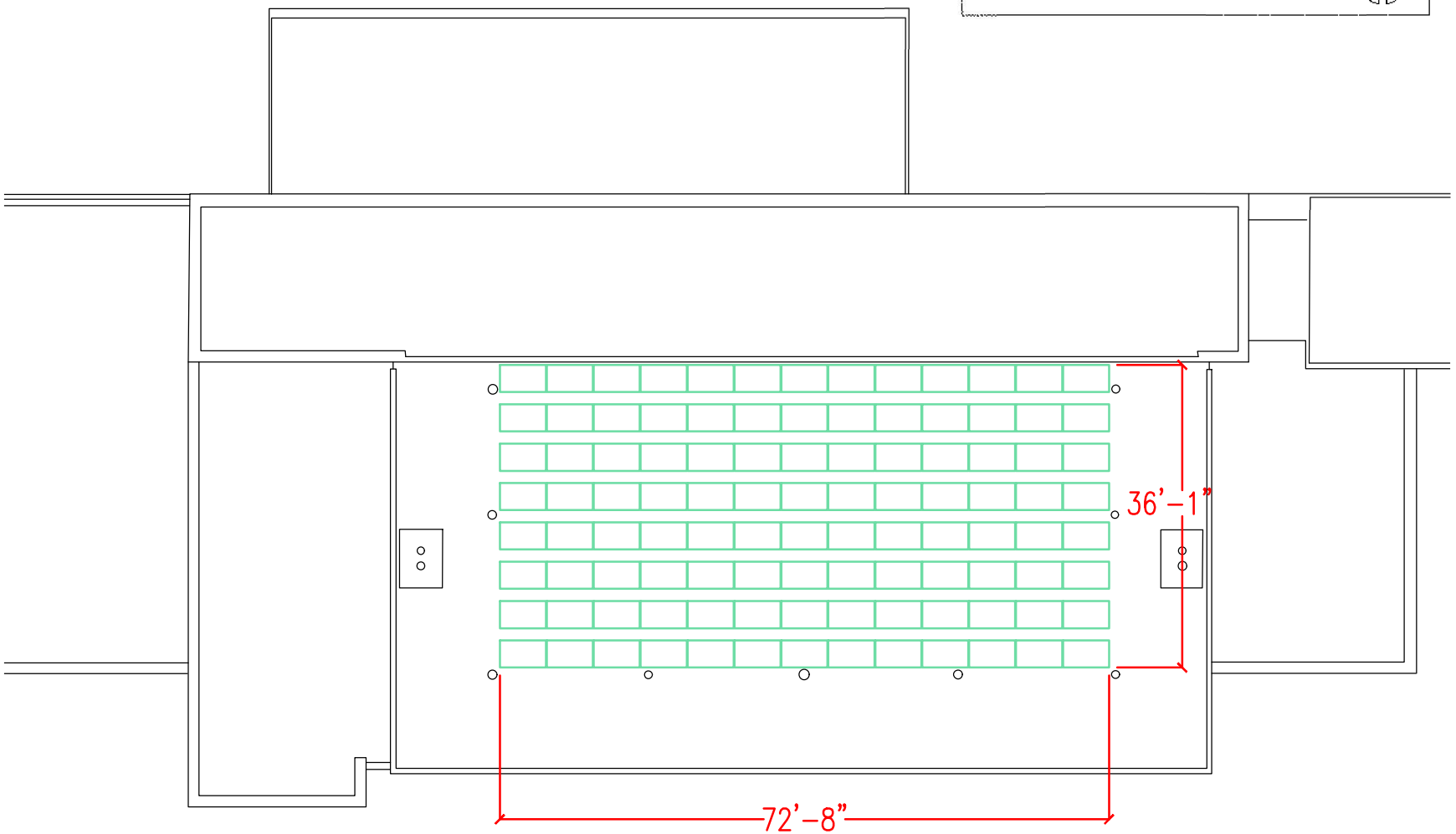
Three Line Diagram - Photovoltaic System

Project Number	89350
Date	5/1/2017
Drawn By	FMS
Checked By	WSP

E-5

Scale N/A





No.	Description	Date

UNIVERSITY OF WASHINGTON

SEATTLE CHILDREN'S THEATRE RENOVATION
SEATTLE, WASHINGTON 98109

Photovoltaic System Roof Design

Project Number	89350
Date	5/1/2017
Drawn By	FMS
Checked By	WSP

E-6

Scale N/A

Estimate Summary

Spark Electric thoroughly investigated all available upgrade options to minimize costs for Seattle Children's Theatre. The estimate breakdown includes a full lighting upgrade, implementation of an alternative energy production system, centralized lighting and HVAC controls, mechanical system recommissioning, and a complete building envelope insulation treatment. The estimate includes all materials, labor, permits, fees, burden, overhead tax, sales tax, and a suggested 2% construction contingency.

Figure 5.1

GENERAL CONDITIONS

Project: **Seattle Children's Theatre**

Responsible: **Spark Electric**

Indirect Labor

	Hours	Cost Rate	Cost Extension
Project Manager	40	$ 90	$ 3,600
Project Engineer	80	$ 55	$ 4,400
Electrical Engineer	50	$ 125	$ 6,250
Alternative Energy Specialist	40	$ 95	$ 3,800
Lighting Designer	40	$ 75	$ 3,000
Financial Coordinator	10	$ 45	$ 450
Administration	16	$ 40	$ 640
Safety Manager	8	$ 55	$ 440
Indirect Labor Subtotal	**284**		**$ 22,580**

General Expenses

	Duration/Qty.	Cost Rate	Cost Extension
Pick-up Truck (Mo)	2.5	$ 871	$ 2,178
20' Elec. Scissor lift (wk.)	2	$ 295	$ 590
Communications	2.5	$ 50	$ 125
Electrical Permit: City of Seattle	1	$ 1,010	$ 1,010
Recycling	2.5	$ 150	$ 375
General Expense Subtotal:			**$ 4,278**
General Conditions Subtotal:			**$ 26,858**

Spark Electric utilized the 2016-2017 NECA Labor Units Manual as a basis for all labor units. Material prices were gathered through estimates provided by local suppliers.

Crew composition consists of a working Forman and a Journeyman Electrician. We assumed all labor would be performed by the International Brotherhood of Electrical Workers, Local 46.

Total calculations for the applicable rebates and incentives are presented under the Finance Plan.

Bid Summary

Seattle Children's Theatre

Description	Budget	Direct Labor Hours	Direct Labor Cost	Supervision (20% FRM)	Material & Small Tools	Subcontract	General Conditions	Subtotal	Fee	B&O Tax	Contingency	WSSTX
									9%	0.703%	2%	10.1%
Architectural Lighting and Controls	$ 274,813	888	$ 68,268	$ 14,656	$ 133,383	$ -	$ 6,629	$ 222,936	$ 20,064.24	$ 1,708	$ 4,894	$ 25,210
Theatrical Lighting and Controls	$ 655,957					$ 516,309	$ 15,822	$ 532,131	$ 47,891.80	$ 4,078	$ 11,682	$ 60,174
Photovoltaic System	$ 144,010					$ 124,800	$ 3,824	$ 128,624	$ 11,576.20	$ 986	$ 2,824	Exempt
Thinsulate Installation	$ 18,803					$ 14,800	$ 454	$ 15,254	$ 1,372.82	$ 117	$ 335	$ 1,725
Mechanical Recommissioning	$ 5,336					$ 4,200	$ 129	$ 4,329	$ 389.58	$ 33	$ 95	$ 489
Project Total	**$ 1,098,918**	888	$ 68,268	$ 14,656	$ 133,383	$ 660,109	$ 26,858	**$ 903,274**	**$ 81,295**	**$ 6,922**	**$ 19,830**	**$ 87,598**
Less Instant Rebates & Incentives	$ 107,592											
Proposed Project Total	**$ 991,326**											
Annual Energy Savings	$ 161,333											
Return on Investment (Years)	**6.1**											

Direct Labor Breakdown

Project: **Seattle Children's Theatre**
Scope: **Architectural Lighting & Controls**

Cost Code	Description	Qty	Unit	Direct Labor				Direct Material			Item Total
				UMH	Man Hours	Wage Rate	Total Labor Cost	Small Tools on Field Labor	Unit Cost	Total Material Cost	TOTAL
26 05 05	Downlight fixture Demo and Removal	240	E	0.5	120	$ 76.92	$ 9,230.40	$ 156.00	$ -	$ -	$ 9,386
26 05 05	2x4 Recessed Panel Demo and Removal	108	E	0.6	64.8	$ 76.92	$ 4,984.42	$ 84.24	$ -	$ -	$ 5,069
26 05 05	2x2 Recessed Panel Demo and Removal	70	E	0.5	35	$ 76.92	$ 2,692.20	$ 45.50	$ -	$ -	$ 2,738
26 05 05	Spotlight Demo and Removal	12	E	0.5	6	$ 76.92	$ 461.52	$ 7.80	$ -	$ -	$ 469
26 05 05	Stair well 4' wall mounted Demo and Removal	23	E	0.3	6.9	$ 76.92	$ 530.75	$ 8.97	$ -	$ -	$ 540
26 05 05	4' striplight Demo and Removal	155	E	0.3	46.5	$ 76.92	$ 3,576.78	$ 60.45	$ -	$ -	$ 3,637
26 05 05	8' striplight Demo and Removal	85	E	0.5	42.5	$ 76.92	$ 3,269.10	$ 55.25	$ -	$ -	$ 3,324
26 05 05	Exit Sign Demo and Removal	33	E	0.8	26.4	$ 76.92	$ 2,030.69	$ 34.32	$ -	$ -	$ 2,065
26 05 05	L1 Install - RAB downlight fixture	240	E	0.6	144	$ 76.92	$ 11,076.48	$ 187.20	$171.43	$ 41,142.96	$ 52,407
26 05 05	L2 Install - RAB 2x4 Recessed Panel	108	E	0.7	75.6	$ 76.92	$ 5,815.15	$ 98.28	$115.39	$ 12,461.58	$ 18,375
26 05 05	L3 Install - RAB 2x2 Recessed Panel	70	E	0.6	42	$ 76.92	$ 3,230.64	$ 54.60	$ 76.92	$ 5,384.40	$ 8,670
26 05 05	L4 Install - RAB Bullet Shape LED Spotlight	12	E	0.55	6.6	$ 76.92	$ 507.67	$ 8.58	$135.17	$ 1,621.98	$ 2,138
26 05 05	L5 Removal and Replacement - LED Lamp	12	E	0.02	0.24	$ 76.92	$ 18.46	$ 0.31	$ 27.47	$ 329.64	$ 348
26 05 05	L6 Install - RAB 4' emergency stairwell Wall Mounted LED	23	E	0.4	9.2	$ 76.92	$ 707.66	$ 11.96	$339.56	$ 7,809.88	$ 8,530
26 05 05	F4 Install - ZL1N LED Striplight 4'-2L-32W-T8	155	E	0.4	62	$ 76.92	$ 4,769.04	$ 80.60	$ 98.90	$ 15,329.66	$ 20,179
26 05 05	F8 Install - ZL1N LED Striplight 8'-3L-32W-T8	85	E	0.6	51	$ 76.92	$ 3,922.92	$ 66.30	$197.80	$ 16,813.17	$ 20,802
26 05 05	X1 Install - Lithonia LED Exit Sign	33	E	1	33	$ 76.92	$ 2,538.36	$ 42.90	$115.39	$ 3,807.71	$ 6,389
26 51 13	Pico Wired Switch	15	E	1.894	28.41	$ 76.92	$ 2,185.30	$ 36.93	$ -	$ -	$ 2,222
26 51 13	Dual Technology Occupancy Sensor	10	E	1.323	13.23	$ 76.92	$ 1,017.65	$ 17.20	$ -	$ -	$ 1,035
26 51 13	Daylight Sensor	13	E	0.275	3.575	$ 76.92	$ 274.99	$ 4.65	$ -	$ -	$ 280
26 51 13	Occupancy Sensor	44	E	0.275	12.1	$ 76.92	$ 930.73	$ 15.73	$ -	$ -	$ 946
26 51 13	Low Voltage PowPack	112	E	0.522	58.464	$ 76.92	$ 4,497.05	$ 76.00	$ -	$ -	$ 4,573
26 51 13	Lutron Controls Package (all material included in Controls Package)	1	E	0	0	$ 76.92	$ -	$ -	$ -	$ 27,528.09	$ 27,528
TOTAL					**887.52**	**$ 76.92**	**$ 68,267.96**	**$ 1,153.77**		**$ 132,229.06**	**$ 201,651**

Key Milestones

- Notice to Proceed on March 5, 2018
- Mobilization occurs on June 4, 2018
- Substantial Completion on September 26, 2018

General Parameters

- Theatre productions occur October-May
- Children Summer camps occur June-August
- Working hours are Monday-Friday, 6 a.m. – 2:30 p.m.

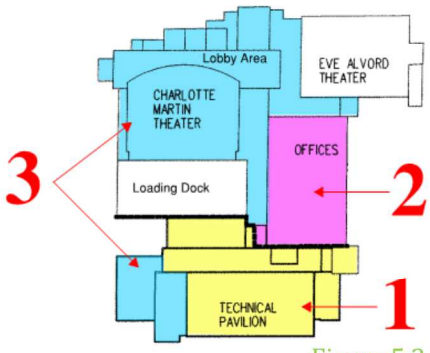


Figure 5.2

The schedule of the energy retrofit of the Seattle Children's Theater is 205 calendar days from the start of design to completion. Since we will be working in an occupied, fully functioning theater, phasing of all construction activities has been carefully planned to accommodate the daily operations of schedule of the theater to provide minimal disturbance to the staff, students, and patrons of the theater.

Phase 1: Technical Pavilion Workshops and Rehearsal Halls

- Lighting installation : 12 days

The workshops and rehearsal halls will be unoccupied as construction commences in the beginning of June. Construction activities will have no impact on SCT staff or patrons.

Phase 2: Administrative Offices Upgrade, PV Installation, Thinsulate Installation

- Administrative Lighting Upgrade : 20 days
- PV Installation: 15 days
- Thinsulate Installation : 5 Days
- Utility Shutdown for solar panel building integration: Monday, July 23rd – 7:30 a.m.

These activities occur concurrently from July-August. In order to minimize noise, dust, and overall disturbance to the staff of the SCT, we will sequence demolition, removal, and fixture replacement room-by-room in a counter-clockwise rotation.

Phase 3: Classrooms and Main Theater:

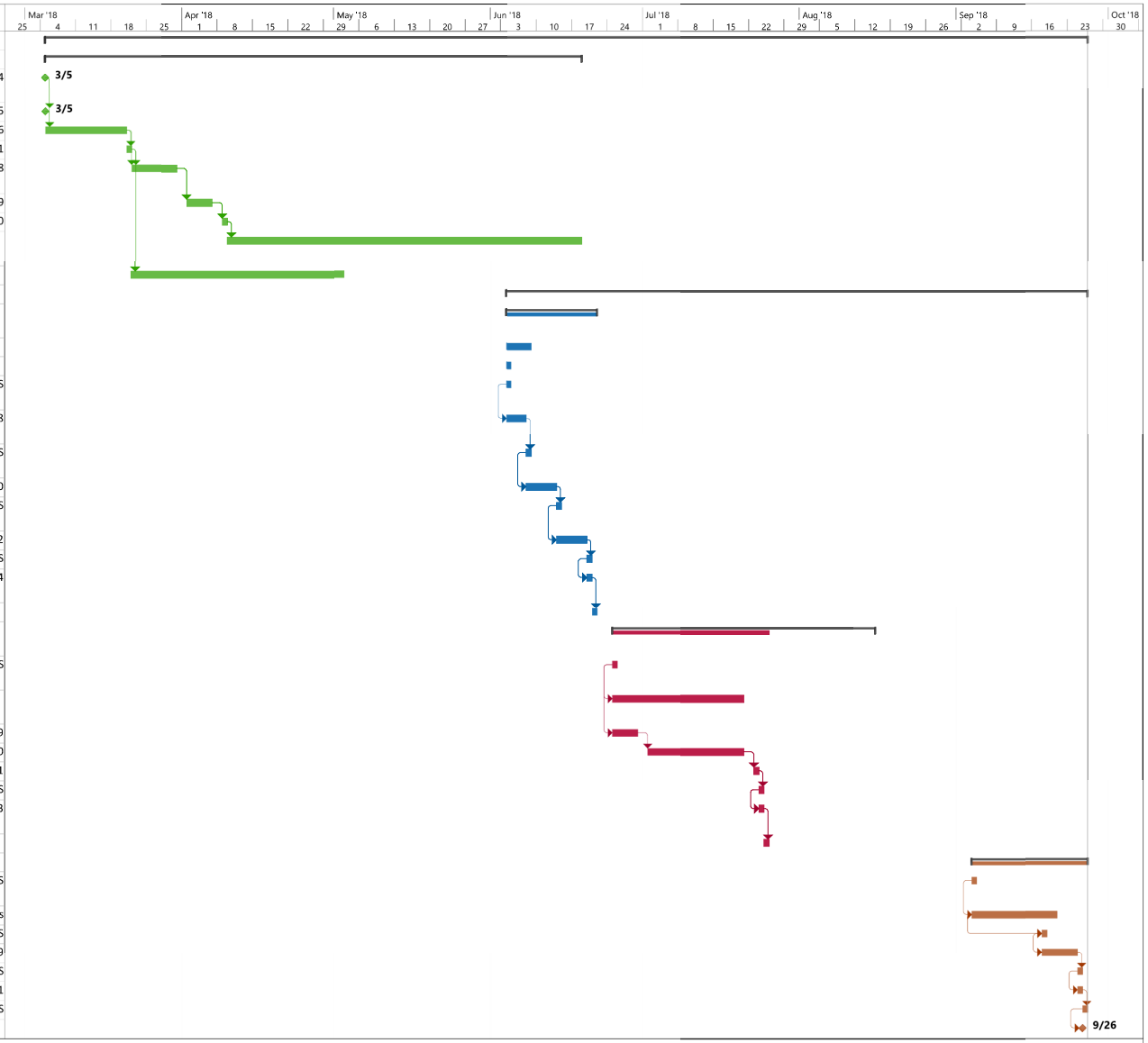
- Classroom Lighting Upgrade: 13 days
- Lobby Lighting Upgrade: 5 days
- Theatrical Lighting Package Supplied to SCT's In-house electricians: September 18th

These construction activities will commence in September. There are no labor hours associated with the theatrical lighting package. Spark Electric is only providing the materials for theatrical lighting and controls.

Mobilization

Spark Electric will not be providing a crew trailer. Per union labor agreements, a crew area, unoccupied by students and staff, will be coordinated with Seattle Children's Theatre for storage of small tools. To ensure quality control, our suppliers have included storage in our material prices. All just-in-time material deliveries will be coordinated before 7am to minimize potential public hazards.

ID	Task Name	Duration	Start	Finish	Predecessors	Successors
1	**Seattle Children's Theatre Energy Retrofit**	**148 days**	**Mon 3/5/18**	**Wed 9/26/18**		
2	**Pre-Construction**	**76 days**	**Mon 3/5/18**	**Mon 6/18/18**		
3	Notice to Proceed and Owner Contract	0 days	Mon 3/5/18	Mon 3/5/18		5,4
4	Pre-Construction Meeting	0 days	Mon 3/5/18	Mon 3/5/18	3	5
5	Pre-Construction Engineering & Design	12 days	Mon 3/5/18	Tue 3/20/18	3,4	7,6
6	Issue Contract Drawings	1 day	Wed 3/21/18	Wed 3/21/18	5	7,11
7	Sub-Contractor Shop Drawings And Submittals	7 days	Thu 3/22/18	Fri 3/30/18	5,6	8
8	Review Submittals	5 days	Mon 4/2/18	Fri 4/6/18	7	9
9	Owner Approval	1 day	Mon 4/9/18	Mon 4/9/18	8	10
10	Procurement: Lighting Fixtures, Lamps, Photovoltaic Equipment	50 days	Tue 4/10/18	Mon 6/18/18	9	
11	Permit Procurement	30 days	Thu 3/22/18	Wed 5/2/18	6	
12	**Construction**	**83 days**	**Mon 6/4/18**	**Wed 9/26/18**		
13	**Phase 1: Technical Pavilion Shops and Rehearsal Halls**	**14 days**	**Mon 6/4/18**	**Thu 6/21/18**		
14	Mechanical Commisioning	5 days	Mon 6/4/18	Fri 6/8/18		
15	Mobilization	1 day	Mon 6/4/18	Mon 6/4/18		
16	Protect Finished Surfaces In Metal/Wood Shops	1 day	Mon 6/4/18	Mon 6/4/18		17SS
17	Retrofit Fixtures in Metal/Wood Shops	4 days	Mon 6/4/18	Thu 6/7/18	16SS	18
18	Protect Finished Surfaces in Scene Shop	1 day	Fri 6/8/18	Fri 6/8/18	17	19SS
19	Retrofit Fixtures in Scene Shop	4 days	Fri 6/8/18	Wed 6/13/18	18SS	20
20	Protect Finished Surfaces in Rehearsal Hall	1 day	Thu 6/14/18	Thu 6/14/18	19	21SS
21	Retrofit Fixtures in Rehearsal Hall	4 days	Thu 6/14/18	Tue 6/19/18	20SS	22
22	Inspections	1 day	Wed 6/20/18	Wed 6/20/18	21	23SS
23	Clean-up and Remove Floor Protection	1 day	Wed 6/20/18	Wed 6/20/18	22SS	24
24	Punchlist/Owner Walkthrough	1 day	Thu 6/21/18	Thu 6/21/18	23	
25	**Phase 2: Administrative Offices, PV, Glazing**	**38 days**	**Mon 6/25/18**	**Wed 8/15/18**		
26	Protect Finished Surfaces in Office Space	1 day	Mon 6/25/18	Mon 6/25/18		27SS,28SS
27	Retrofit Fixtures in Office Space Room by Room	20 days	Mon 6/25/18	Fri 7/20/18	26SS	
28	Thinsulate Sub Installation	5 days	Mon 6/25/18	Fri 6/29/18	26SS	29
29	Solar Panel Installation	15 days	Mon 7/2/18	Fri 7/20/18	28	30
30	Wiring Panels into System	1 day	Mon 7/23/18	Mon 7/23/18	29	31
31	Inspections	1 day	Tue 7/24/18	Tue 7/24/18	30	32SS
32	Clean-up and Remove Floor Protection	1 day	Tue 7/24/18	Tue 7/24/18	31SS	33
33	Punchlist/Owner Walkthrough	1 day	Wed 7/25/18	Wed 7/25/18	32	
34	**Phase 3: Classrooms and Lobby**	**17 days**	**Tue 9/4/18**	**Wed 9/26/18**		
35	Protect Finished Surfaces in Classrooms	1 day	Tue 9/4/18	Tue 9/4/18		36SS
36	Retrofit Fixtures in Classrooms	13 days	Tue 9/4/18	Thu 9/20/18	35SS	37SS+10 days
37	Protect Finished Surfaces in Lobby	1 day	Tue 9/18/18	Tue 9/18/18	36SS+10 days	38SS
38	Retrofit Fixtures in Lobby	5 days	Tue 9/18/18	Mon 9/24/18	37SS	39
39	Final Inspection	1 day	Tue 9/25/18	Tue 9/25/18	38	40SS
40	Final Clean-up	1 day	Tue 9/25/18	Tue 9/25/18	39SS	41
41	Punchlist/Owner Walkthrough	1 day	Wed 9/26/18	Wed 9/26/18	40	42SS
42	Transfer to Owner	0 days	Wed 9/26/18	Wed 9/26/18	41SS	



Project: Schedule 0005 April 18
Date: Sun 4/30/17

Task | Split | Milestone | Summary | Project Summary | Inactive Task | Inactive Milestone | Inactive Summary | Manual Task | Duration-only | Manual Summary Rollup | Manual Summary | Start-only | Finish-only | External Tasks | External Milestone | Deadline | Progress | Manual Progress

Seattle Capital Improvement Plan Funding

The Capital Improvement Plan budget for the Seattle Center which was adopted by Seattle City Council for 2017-2019 is $20.4 million. Funding for campus improvements prioritizes projects that will significantly reduce operating costs. Our proposed energy upgrades will save the Seattle Children's Theatre $161,333 annually in energy costs. With a 52% reduction in operating costs, SCT is an ideal candidate for Capital Improvement Plan Funds.

Funding is based on the mix and extent of financial resources available to the City, as illustrated in Figure 5.3. Seattle's CIP budget will cover total project costs for Seattle Children's Theatre; therefore, no bond-backed loan will be needed.

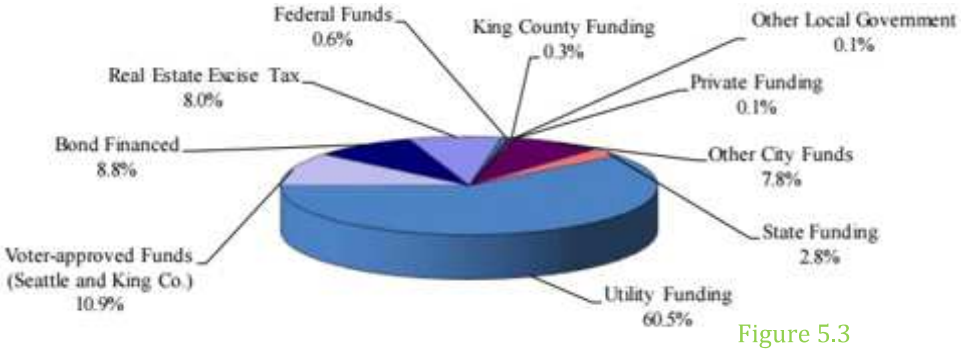


Figure 5.3

Cash Analysis

Even though Seattle Children's Theatre is not funding facility renovations with a bank loan, Spark Electric has created a cash flow diagram to further solidify the magnitude of savings our proposal will generate. All calculations of energy consumption and savings were based on an electricity rate of $0.20/kWh.

The total project cost for the Seattle Children's Theatre is estimated at $1,098,918. We have calculated the instant rebates and grants to be $107,592. The Seattle Children's Theatre also qualifies for a 30% Federal Tax Credit, saving an additional $37,440 to be applied the same tax year as the photovoltaic system is installed. These savings contribute to a total payback period of **6.1 years.** Figure 5.4 displays a positive cash flow of over $2.2 million by 2038.

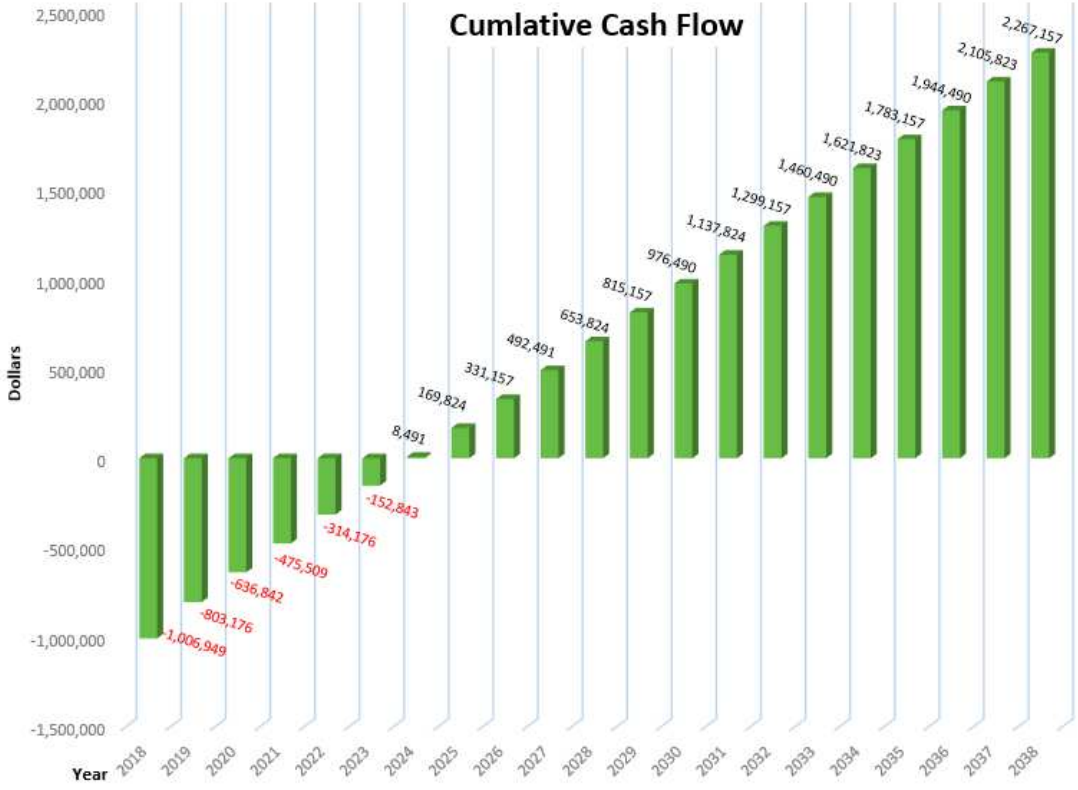


Figure 5.4

Local Incentives Breakdown

Project: **Seattle Children's Theatre**

Responsible: **Spark Electric**

Lighting & Controls Upgrade

Incentive: **Seattle City Light**

Energy Efficiency Rebate program - **Up to 70% of Installation Cost**

Summary

Applicable Incentives		Incentive Amounts	Unit	Qty	Projected Savings
Architectural Lighting	LED Hard-Wired Upgrade	$ 0.23	Per kWh saved	236,714	$ 54,444
	Exit Sign Hard-Wired Upgrade	$ 0.17	Per kWh saved	855	$ 145
	LED Lamp-only Upgrades	$ 0.17	Per kWh saved	3,657	$ 622
	4'-T8-3L Fluorescent Upgrade to 4'T8-2L Tubular	$ 75.00	Per Unit	155	$ 11,625
	4'T8-3L Fluorescent t Upgrade to 2'x2' LED Panel	$ 75.00	Per Unit	70	$ 5,250
	Fluorescent Exit Sing Upgrade to LED	$ 33.00	Per Unit	10	$ 330
	CFL,13-23W Upgrade to LED Lamp Only	$ 5.00	Per Unit	24	$ 120
	Incandescent Upgrade to LED	$ 15.00	Per Unit	240	$ 3,600
Architectural Controls	Central Lighting Controls (Quantum View)	$ 0.23	Per kWh saved	18,129	$ 4,170
	Occupancy Sensors- Wall Mount	$ 30	Per Unit	44	$ 1,320
	Occupancy Sensors- Ceiling Mount	$ 90	Per Unit	23	$ 2,070
Theatrical Lighting Retrofit	Fixture Removals	$ 0.11	Per kWh saved	65,864	$ 7,245
	LED Lamp-only Upgrades	$ 0.17	Per kWh saved	65,596	$ 11,151
Instant Savings Offered by Seattle City Light					**$ 102,092**
Maximum Incentive: **70% of Installation Cost**					$ 502,572

Requirements

Seattle City Light Funding is calculated based on the annual kWh savings multiplied by the incentive amounts above, and limited to 70% of the Energy Conservation Measure (ECM) Installation Cost. All incentives must be approved before installation.

Alternative Energy: Photovoltaic

Incentive: **Seattle City Light**

Washington State Renewable Energy Production Incentive- **Up to $5,000 per year**

Summary

Customer-Using:	Economic Development Factor	Incentive Payment Rate per kohl	Qty. kWh Produced	Projected Savings
Solar Modules Manufactures in WA State	$ 2.40	$ 0.36	36,138	$ 13,010
Total First Year Savings Offered By Seattle City Light				$ 5,000
Maximum Annual Incentive: **$5,000**				$ 5,000
Maximum Incentive: **$5,000 per Year Until June 2020**				**$ 15,000**

* Incentive Payment Rate=($0.15kWh/kWh)(Economic Development Factor)

Incentive: **IBEW**

Maximum Incentive: **$500**

Summary

Installation of 5kWh or larger PV System with use of Union Electricians		Projected Savings
Maximum Inventive		**$ 500**

Incentive: **Federal Tax Credit**

The Renewable Energy Tax Credit - **30% of PV Cost**

Summary

Applicable System	Total PV Cost	Incentive Amount	Projected Savings
PV Installation	$ 124,800	30%	$ 37,440
Total First year Savings			$ 37,440
Maximum Incentive: **30% of PV Cost**			**$ 37,400**

Requirements

The Renewable Energy Tax Credit is a credit, not a deduction. This tax credit allows you to recoup 30% of the full install cost of solar. The system must be installed by December 31st of the same tax year the owner plans to use the credit

The Seattle Children's Theater thrives on community engagement as stated in their mission statement, ***"to provide children of all age's access to professional theatre, with a focus on new works, and theatre education".*** As the Theater heads into its 42nd consecutive season, it continues to provide free workshops for over 400 schools in an effort to expose young minds to the world of performing arts. Classroom spaces host numerous camps, drama schools, and theater focused daycare services throughout the year.

Figure 6.1

Volunteering

The nonprofit theater relies heavily on the support of volunteers to run the daily tasks of operating the organization. Spark Electric has contributed over 100 hours of volunteering at the theater, split between two productions; *Seed folks* and *Fire Station 7*. Team members contributed their time by taking tickets, ushering guests, passing out play programs, stage watching, and helping with post production clean-up. Engaging with the productions staff and the general public who enjoy the work produced by the SCT, allowed team members to interact with the direct beneficiaries of the energy retrofit.

LED Lightbulb Exchange

Figure 6.2

The team at Spark Electric reached out to the families of Seattle Children's Theater. Via email, families were encouraged to bring in old lightbulbs that Spark Electric would then exchange for LED lightbulbs. This email also provided a link to a Facebook page set up to be shared with friends. The families could then bring the bulbs of their friends, or the friends could bring lightbulbs to any of the classes and a Spark Electric team member would be there to provide a replacement LED lightbulb

After weeks of advertising, Spark Electric donated a total of 150 LED Lightbulbs to participants.

Teaching the Spark

To further establish energy awareness, Spark Electric visited Seattle Children's Theatre classrooms to present energy efficient practices to the younger members of the SCT. During the classroom visits, members of the Spark Electric team defined energy and electricity in simple terms for the young actors. Key ways to explain these terms to children include analogies that linked food to energy and explaining basic energy conservation practices, like turning off the lights.

Figure 6.3

Figure 6.4

To keep the event high paced, we chose to include a game that would both demonstrate the properties of electricity as well as remain fun and entertaining for the children.
We begin by dividing the children into groups and placing them in a circle. Once giving each child a bouncy ball to hold in their right hand, we then explain that a wire conductor is full of Electrons ("bouncy balls"). Students are told that the circle represents a circuit (from the Latin word circuits, meaning "to go around"). The students are reminded that all batteries have a positive end, represented by the hand with no ball, and a negative end, your right hand with the ball. Then the students pass their "electrons" (bouncy balls) to the student on their right and they continue to do this in a circle. Then the students are told that because electrons share the same negative charge, they repel one another, keeping the current moving along in the same direction. The groups of students then did a challenge amongst the class to see who could pass the balls around the fastest without losing an "electron".

Figure 6.5

Conclusion/Takeaway

These experiments are meant to relate to one another and in the end, teach the students about the new lighting for the theater. The current game is meant to help educate the students exactly how energy flows. The game also got the children excited to put in new lightbulbs with their families. Feedback was received saying that when one of the kids' parents put in lightbulbs, their child got them in a circle and used the game to teach them about efficiency. Another parent also reached out to us to let us know that at night their child asks his mother to make sure that the lights and I-pad are turned off in the house.

Seattle Children's Theatre
Courtney Sale, Artistic Director **Karen Sharp**, Managing Director

26 April 2017

Re: University of Washington Green Energy Challenge Project

To the Green Energy Challenge Project Review Board:

We would like to thank the University of Washington NECA Green Energy Challenge team for all of their hard work. It is a daunting project to study our complex mix of offices, classrooms, theatres, production support spaces, and fabrication shops for scenery, properties and costumes. We look forward to integrating into our facility program their recommendations to decrease energy use, utility costs, and maintenance time.

In the course of the study, the UW NECA team has been thorough, professional, resourceful, and creative. To understand our existing systems, upgrade needs, and the daily, seasonal, and annual use patterns, they toured the facility making effective use of our time with thoughtful questions. We provided access to all areas including mechanical and utility spaces and the roof. The team was respectful and professional in all interactions with staff, patrons, and students. They reached out to contractors and vendors to develop practical energy solutions and followed up with us to clarify the complicated interface between architectural and theatrical systems in the spaces where those interact. They gathered and analyzed our utility records, and, to solve the absence of digital architectural files, they scanned blueprints and provided us copies of those files to assist us with building our digital facilities archive.

They have also been valuable volunteers who assisted our patrons during our public performances. They have donated approximately 100 hours of service at this point. Their outreach efforts have educated our staff as well as some of our students. They did a great job of adapting their energy curriculum to our preschool-aged students. Providing the families of these students with energy-saving lightbulbs was also an effective way to allow an actual comparison between standard lightbulbs and the newer, more energy-efficient versions. We look forward to continuing our outreach partnership with other classes as our schedules allow.

Overall, this has been a very positive interaction between our two organizations. We hope to learn even more as the process goes forward.

Sincerely,

Michael Wellborn, Production Manager
Tammy Hase, Volunteer Coordinator

http://www.dailyuw.com/news/article_4cd6af44-2639-11e7-9d85-2befa200cf00.html

UW's NECA competition team looks to bring victory back to Seattle

Eilish McLean Apr 21, 2017 Updated Apr 22, 2017

Next October will see the National Electrical Contractors Association (NECA) Convention come to Seattle. Invitations to attend the event and compete for a cash prize will be extended to the top three teams placing in NECA and ELECTRI International's Green Energy Challenge — a feat the UW NECA competition team hasn't managed since the last time Seattle hosted the event in 2009.

Courtesy photo

This year's team, called Spark Energy and captained by Kelli Desrosier, is determined to make the cut.

The Green Energy Challenge is an annual competition in which teams from around the country participate in mock remodels, putting together an energy upgrade proposal for a local building as if they were a real construction company. This year it was required that the selected building offer a community service to others. The UW team chose The Seattle Children's Theater.

"The convention is in Seattle this year," Desrosier said. "We really wanted to pick a facility that showcased Seattle's character."

They also wanted to pick a building that would test their abilities.

"It was built in three sections," team member Charles Malone said. "One part was built around the same time as the Space Needle for the World['s] Fair, and other sections were added later. There's a lot of variation in structure."

The team's proposal will cover almost every part of the building, including one of the theaters, the shop area where the sets are made, and office spaces.

The team has had to take into account the additional challenges derived from the building's function as a theater. Lighting a stage requires specific equipment, and that equipment needs to meet the high standards necessary to produce a live performance.

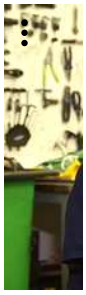
"It's definitely a challenge," Malone said. "But it's doable."

That challenge is made more difficult due to the fact that the team is essentially self-taught. While they may have covered some of the basics of electrical construction in previous classes, most of their knowledge has been gained by speaking with industry professionals.

The cash prize is certainly something worth competing for, but according to Malone, it's not the top prize of the competition.

"Finishing in the top three and going to the convention is almost more important than winning," Malone said. "It's a chance to network with top industry professionals, which in this field is huge."

The convention isn't the only thing that has the team excited about the project. The Seattle Children's Theater is part of the Seattle Center Campus, and as such is included in the city's Capital Improvement Plan.



"The electrical systems are actually going to be remodeled," Desrosier said. "There's a chance that our designs might be used."

"It comes at a good time for us," said Michael Wellborn, the Seattle Children's Theater production manager. "We're at an age as a facility where we need to think about remodeling."

The competition also includes a community involvement aspect which the UW team is in the process of completing. They've been working with students of different age groups at the Seattle Children's Theater in order to teach them more about electricity and energy efficiency. They will also be hosting a light bulb drive in which the students will be able to bring in their old bulbs from home and exchange them for more efficient LED bulbs.

"It's a lot," Desrosier said. "But it's worth it."

DAILY JOURNAL OF COMMERCE
SEATTLE
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Construction Industry Spotlight

April 27, 2017

UW students help Seattle Children's Theatre as part of the 2017 Green Energy Challenge

- ***SCT hopes to use the students' energy-efficiency proposal to help with budgeting, scheduling and other planning issues.***

By JON SILVER
Journal Staff Reporter

The Seattle Children's Theatre is regarded as one of the nation's top children's theater companies. Its home at Seattle Center was completed in the mid-1990s and a pavilion was added in 2000.

But the building, part of which was originally built in 1956, is not as energy efficient as it could be. The theater has been looking into making improvements, but hasn't settled on a scope or budget.

So it was a happy coincidence when a team of six University of Washington construction management majors contacted SCT earlier this year and asked if they could work with the theater as part of a contest to design an energy upgrade.

Photo courtesy of Kelli Desrosier [enlarge]

A six-member UW team will compete in NECA's Green Energy Challenge. Shown here, from left, are Jacob Thackray, Kelli Desrosier, Sean McMahon, Zach Shoopman and Hank Dickinson.

The competition is called the 2017 Green Energy Challenge, sponsored by the National Electrical Contractors Association (NECA) and Electri International. Student NECA chapters in the U.S. and Canada must work with local electrical contractors to respond to a request for proposals prepared by the contest organizers.

The rules this year require students to craft their proposals to meet the needs of a local facility that provides community services.

UW team captain Kelli Desrosier, a junior, said that with the 2017 NECA convention set to be held in Seattle, her team wanted to choose a facility that would showcase the city's culture and character.

They decided on Seattle Children's Theatre, she said, since it's a cool building that has played a rich part in Seattle's history, and has a positive effect on the lives of young people.

The other UW team members are Hank Dickinson, Charles Malone, Sean McMahon, Zach Shoopman and Jacob Thackray.

The student teams received their RFPs in February and have until May 1 to submit their proposals.

The contest requires students to respond with detailed technical proposals for their energy upgrades. Their to-do list includes drafting plans for a lighting retrofit with integrated window

treatments/controls, a 4-5 kilowatt photovoltaic system, and an energy-efficiency upgrade that responds to the needs of the building and local climate.

The students' submittals can run 40 pages — 50 with appendices, according to the rules. They're evaluated on the quality of their project summaries, technical analyses, schematic estimates, schedules and finance plans. Points are also awarded for community service, outreach and work with local NECA contractors.

Teams can even earn points for publicizing the contest in a newspaper. (We're happy to help.)

Good timing

Michael Wellborn, production manager for SCT, said the students got in touch with the theater “at a very timely window for us.”

SCT is in need of a variety of updates, he said, such as significant HVAC and energy conservation measures. Some of the those needs are a result of years of wear and tear, and others are because of technological advancements.

“We're definitely looking forward to the output that the student team put together,” Wellborn said.

The students in their project summary said they conducted an energy audit of the building and will make recommendations on how to reduce its overall energy use.

Their work includes developing a lighting retrofit package of new fixtures and creating a new floor plan that reflects the design of the new lights.

One of SCT's main concerns was to ensure the saturation temperature of the lights in the shop areas matched that of the stage so the props don't look different during productions. So the students accounted for this in their design.

Other tasks included designing a window glazing/insulation system and a photovoltaic system. In each case, the students worked to show how much energy the new system would save.

They also had to develop a construction schedule and staffing plan, taking into account real-world issues such as site logistics, safety, traffic plans, site deliveries, and staging and storage. From there, they prepared a full estimate that included financing plans and a cash-flow/payback plan for SCT.

Desrosier said her team split up the work as they prepared their proposal. She was the chief estimator and also focused on lighting. Other students took on roles focusing on lighting design, energy analysis, alternative energy, scheduling and outreach/volunteer coordination.

The team has received advice along the way from a number of contractors, including North Coast Electric, Sequoyah Electric, Cochran and Lutron.

That's music to the ears of Chris Reigelsperger, director of services for NECA's Puget Sound chapter.

“We've had a pretty close partnership with the University of Washington for many years,” he said.

The chapter's 50-plus contractors make themselves available to answer the students' questions, provide feedback on their proposal, and even take students to walk around projects.

“It exposes students to some of the real leaders of the industry,” he said.

The exposure goes both ways: Contractors get to meet with students who have already committed themselves to their field.

“There are students in the competition (in previous years) who have gone on to work for our contractors,” Reigelsperger said.

Learning experience

Team members earn a school credit for their participation, but the real value is “you learn so much from these projects,” Desrosier said.

Not only is she learning new construction management skills, she said, but she's “trying to make deals with actual suppliers, going out there and building relationships and organizing these projects like you would in the real world.”

The contest doesn't require anyone to actually build the project, but Wellborn at SCT said he hopes to use the students' proposal to help with budgeting, timeline and other planning issues. He'd also like to be able to share it with vendors.

The student proposals will be evaluated by a jury made up of contractors and manufacturers. The top three teams will be invited to the annual NECA convention in October to give an oral presentation and receive a grilling from the judging panel.

Desrosier and her teammates will find out in July whether they made the cut.

They're following in the footsteps of other UW teams that have found success in the annual contest. UW last won in 2013, but has been among the top three finalists five other times since the contest's launch in 2009. UW won that year, too.

Desrosier said she was an alternate on last year's team, which finished second to Iowa State, and is ready to do even better this year.

“I'm really competitive,” she said. “I really like to win.”

Regardless of how the team fares, she has her eye on a bigger prize: a career as a full-fledged project engineer. Maybe even returning to renovate Seattle Children's Theatre for real, she said.

Jon Silver can be reached by email or by phone at (206) 622-8272.

Previous columns:

- AP investigation: Oroville Dam managers made questionable decisions as spillway nearly failed, 04-20-2017
- Industry dispels the ‘college for all' notion with new ways to make construction cool, 04-13-2017
- Larger buildings face mandatory ‘tune-ups' under new efficiency program for Seattle, 04-06-2017
- Oregon woodworker can make anything — from funeral urns to treasure chests to Chinese doors, 03-30-2017
- US Forest Service OKs proposal for more logging and burning to lower risk of wildfires, 03-23-2017
- Old businesses pushed out as industrial areas become trendy hotspots, 03-16-2017
- Mentoring program at Oregon high school pairs wood shop students with fourth-graders, 03-09-2017
- Local engineers test VR's potential to make towers less costly and easier to build, 03-02-2017

NECA Interaction

The local Puget Sound NECA Chapter offered Spark Electric endless support in our efforts to create an energy efficient retrofit design for Seattle Children's Theatre. As a team we were able to present our project at a board meeting and have board members review our content.

Cochran Inc., was extremely helpful throughout the entire proposal, mentoring and offering feedback on each section. Cochran also generously donated the LED lightbulbs for our 'Lightbulb Exchange'.

Sequoyah electric helped us determine what fixtures to use for our fixture replacement design. They also provided input regarding glazing systems, providing us with thermal imaging of the Theatre that we used in our calculations to determine energy loss through the existing glazing systems.

Prime aided us in using the software to develop our construction schedule. They additionally offered advice on how to phase construction activities.

Representatives from the following companies met with team members and provided us quotes, bill of materials, and suggestions in developing the most appropriate design for Seattle Children's Theatre.

SITE SPECIFIC SAFETY PLAN

Project: **Seattle Children's Theatre**
Responsible: **Spark Electric**

Operation	Danger	Preventive Measures
Operating scissor lift.	Fall hazard from an elevated workspace.	Personal fall arrest systems are required when working on a scissor lift.
Construction during occupancy.	Possible injury due to construction activites.	Multi-phased construction. SCT staff will be notified of construction areas.
Heavy equipment and material traffic during construction.	Injury caused from scissor lift or heavy material transportation on site.	Construction crews will wear high visibility safety vests and close off areas of scissor lift work.
Sharp tools and material handling.	Lacerations to hands and arms.	Gloves and forearm protection required when handling sharp materials.
Working overhead.	Falling objects, materials, or tools causing injury to head.	Hard hats required on site to prevent head injury from falling objects.
Uneven walking surfaces and underfoot debris.	Trip and fall hazard.	Closed-toe boots are required by jobsite personnel.
Drilling, cutting, hammering, etc.	Eye injury caused by projectile debris.	Safety glasses are required on site.
Lifting heavy equipment or materials.	Back injury from heavy lifting.	Proper lifting techniques will be reviewed at morning stretch and flex.

EMR Rating: 0.7
Spark Electric prepares a safety plan for every project, detailing the specific hazards of the site and recommending ways to minimize them. We provide specialized training for unique hazards such as confined spaces, heights, and energized equipment. Our focus on accident prevention, combined with comprehensive safety policies and programs, has earned Spark Electric one of the lowest Experience Modification Rates (EMR) in the industry.

Construction Pre-Task Plan

Foreman Name: _____

Date: _____

Job # & Name: _____

Task Description: _____

List All the Steps of the Job (Use additional paper if nedded)	Identify All Specific Hazards Found	How Will *You* Control the Hazards?

Use the Back of this Form to List Any Additional Steps and Other Information

Hazard Identification Tips

What permits are required for this task?

Confined Space Hot Work Lockout/Tagout

Other _____

Will the removal of an existing guardrail or means of fall protection be required for this work?

Is there a potential fire, explosion, toxic or radioactive release hazard?

Yes No

Are there any MSDS's that might need reviewed for hazardous substances that might be present on the job site?

Hazardous Evaluation Tips

Use the following categories to assist you in a proper evaluation of all the hazards that have been identified. Can any of he following conditions occur with the hazards that have been identified?

Contacting Temperature Extremes
Contacting Electrical Current
Environmental/Airborne Release
Moving Object/Equipment
Hazardous Substance
Obstruction/Interference
Struck By
Struck Against
Fall/Slip/Trip
Caught In/Between
Material Handling
Other

Hazard Control Tips

Use the following categories to assist you in determniing the proper control methods for all the hazards that have been identified and evaluated.

Ventilation of exposure area
Isloation of hazard from worker
Personal protective equipment
Elimination of hazard
Change of work methods
Good work practices
Substitution of hazard with less severe one
Other

Housekeeping

Was site cleaned up and secuted after work?

Yes No

Evacuation Route

What is your evacuation route and assembly point?

Emergency Numbers

Emergency Phone: _____

Emergency Radio: _____

Fire: _____

Other: _____

Yes No

Signatures

Use the back of this form if additional signatures are required.

Superintendent:

Foreman: _____

General Foreman: _____

Crew Members: _____

Quantum Vue software

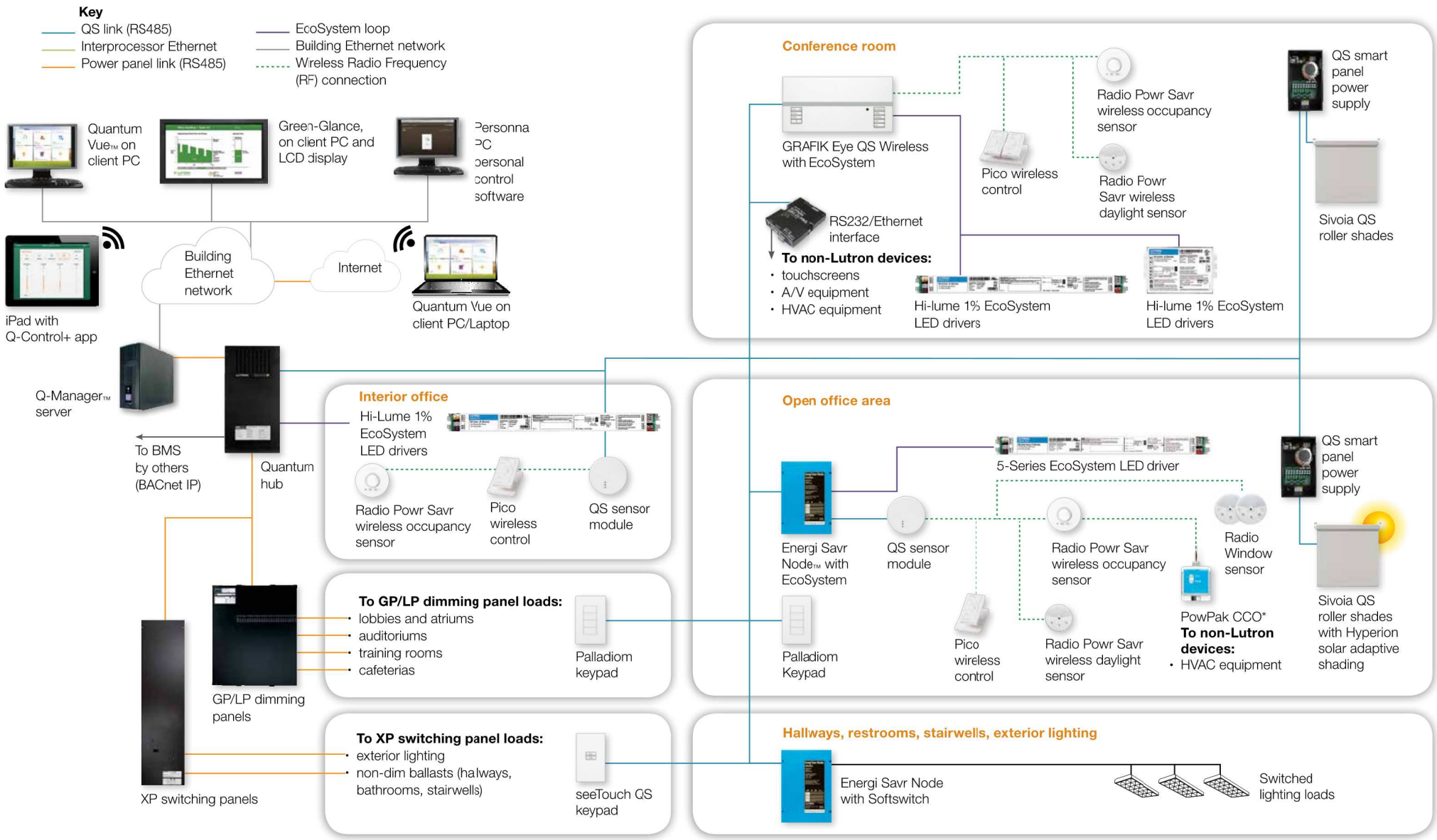
Quantum Total Light Management

Architectural Lighting Control, Shading, and Energy-Saving Solutions

LUTRON®

save energy with Lutron™ ®

How the components connect together



*Cannot be activated from Quantum software.

F4
F8

LITHONIA LIGHTING®

FEATURES & SPECIFICATIONS

INTENDED USE — Built on the compact, low-profile Z strip channel, this LED strip offers long maintenance-free life, several color temperatures, lumen outputs and lengths. Ideal for new construction and retrofit applications in T5 and T8 lengths. Ideal for uplight and downlight in commercial, retail, manufacturing, warehouse, cove and display applications. **Certain airborne contaminants can diminish the integrity of acrylic and/or polycarbonate. Click here for Acrylic-Polycarbonate Compatibility table for suitable uses.**

CONSTRUCTION — Compact-design channel and cover are formed from code-gauge cold-rolled steel. Easy to install row aligner included for continuous row mounting.

Finish: Paint options include high-gloss, baked white enamel (WH), galvanized (GALV), matte black (MB) and smoke gray (SKGY). Five-stage iron phosphate pre-treatment ensures superior paint adhesion and rust resistance.

OPTICS — Standard diffuse snap on/snap off lens eliminates pixels, improves uniformity and minimizes glare. L/LENS option available.

ELECTRICAL — Utilizes high-output LEDs integrated on a two-layer circuit board, ensuring cool-running operation. Optional internal pluggable wiring harness for reduced labor cost in row mounting applications. (See PLR_ ordering information on page 3.) Electronic LED driver is rated for 75 input watts maximum (see Operational Data on page two for actual wattage consumption), **multi-volt input and 0-10V dimming standard.** This fixture is designed to withstand a maximum line surge of 1.5kV at 0.75kA combination wave for indoor locations, for applications requiring higher level of protection additional surge protection must be provided.

LEDs provide nominal 80 CRI at 3000 K, 3500 K, 4000 K, or 5000 K.

Lumen output up to 2,000 lumens per foot. In 86°F (30°C) ambient environments. Luminaire should be installed in applications where ambient temperatures do not exceed 86°F (30°C).

INSTALLATION — Tool-less channel cover for easy installation.

Fixture may be surface mounted (with or without ZSPRG hanger), pendant or stem mounted with appropriate mounting options. Three-point aligner locks in place for easy continuous row mounting.

LISTINGS — CSA certified to US and Canadian safety standards. For use in damp locations between -4°F (-20°C) and 86°F (30°C).

DesignLights Consortium® (DLC) qualified product. Not all versions of this product may be DLC qualified. Please check the DLC Qualified Products List at www.designlights.org to confirm which versions are qualified.

WARRANTY — 5-year limited warranty. Complete warranty terms located at www.acuitybrands.com/CustomerResources/Terms_and_conditions.aspx

Note: Actual performance may differ as a result of end-user environment and application.

All values are design or typical values, measured under laboratory conditions at 25 °C.

Specifications subject to change without notice.

LED Striplight

ZL1N

24", 48" and 96" Lengths

PRODUCT INFORMATION

A standard occupancy time delay is also present to ensure lights turn off (once minimum on timer has also elapsed) if no occupancy is detected.

This timer is factory set at 10 minutes to promote energy savings, but is adjustable between 30 seconds and 30 minutes. These adjustments may be done through the unit's push-button.

FEATURES

- Four interchangeable lenses - high mount 360°, low mount 360°, high mount aisleway, and small motion 360°.
- Integrated mounting bracket drops lens down 3" from chase nipple - no bracket accessory required.
- 100% digital PIR detection - provides excellent RF immunity

Note: Specifications subject to change without notice.

Passive Infrared Indoor Occupancy Sensor

LSXR

Single Relay

ORDERING INFORMATION Lead times will vary depending on options selected. Consult with your sales representative.

Example: LSXR 10 ADC HVOLT 30M

LSXR							
Series		**Lens option**				**Dimming/photocell**	
LSXR	Passive Infrared Indoor Occupancy Sensor	(blank)	No lens	610	High and low mount 360°	(blank)	None
		6	High mount, 360°	650	High mount 360° and aisleway	HL	High/low occupancy operation
		10	Low mount, 360°	3PK	High and low mount 360° and aisleway	P	Switching photocell (on/off)
		50	High mount aisleway	4PK	All lenses	ADC	Dimming and switching photocell
		9	Small motion, 360°			ANL	Dimming and switching photocell with high/low occupancy operation

Voltage		**Max dim level**		**Min dim level**		**Lead length**		**Temp humidity**		**Default time delay**	
(blank)	120–277 VAC (MVOLT)	(blank)	10 VDC	(blank)	Minimum dimming level of ballast	(blank)	14"	(blank)	None	(blank)	10 minutes (with minimum 15 minutes on time)
HVOLT	347–480 VAC	9H	9 VDC	1V	1 VDC	42L	42"	LT	Low temperature	5M	5 minutes (LED only)
		8H	8 VDC	2V	2 VDC					15M	15 minutes
		7H	7 VDC	3V	3 VDC					20M	20 minutes
				4V	4 VDC					30M	30 minutes
				5V	5 VDC						
				6V	6 VDC						

ZL1N LED Striplight

OPERATIONAL DATA

	Nominal lumen package	Length (inches)	Delivered lumens 3000 K CCT @ 77°F (25°C) ambient temperature	Delivered lumens 3500 K CCT @ 77°F (25°C) ambient temperature	Delivered lumens 4000 K CCT @ 77°F (25°C) ambient temperature	Delivered lumens 5000 K CCT @ 77°F (25°C) ambient temperature	Wattage @120V	Comparable light source
Lensed	1,500LM	24	1,753	1,777	1,806	1,890	18W	1-lamp 17W T8
	2,500LM	24	2,365	2,413	2,478	2,500	22W	1-lamp 17W T8
	3,500LM	24	3,716	3,792	3,895	3,928	39W	1-lamp 32W T8, 1-lamp 54W T5HO, 50W HID
	3,000LM	46 or 48	3,302	3,381	3,438	3,596	33W	1-lamp 32W T8, 1-lamp 54W T5HO, 50W HID
	5,000LM	46 or 48	4,630	4,725	4,853	4,894	42W	2-lamp 32W T8, 1-lamp 54W T5HO, 70W HID
	7,000LM	46 or 48	6,535	6,668	6,849	6,907	67W	3-lamp 32W T8, 2-lamp 54W T5HO, 100W HID
	6,000LM	92 or 96	6,560	6,717	6,830	7,144	60W	3-lamp 32W T8, 2-lamp 54W T5HO, 100W HID
	10,000LM	92 or 96	9,230	9,418	9,673	9,756	83W	4-lamp 32W T8, 2-lamp 54W T5HO, 100W HID
	14,000LM	92 or 96	13,177	13,446	13,810	13,923	134W	4-lamp 32W T8, 3-lamp 54W T5HO, 150W HID
Unlensed	1,500LM	24	1,883	1,928	1,960	2,051	18W	1-lamp 17W T8
	2,500LM	24	2,566	2,618	2,689	2,712	22W	1-lamp 17W T8
	3,500LM	24	4,032	4,114	4,226	4,262	39W	1-lamp 32W T8, 1-lamp 54W T5HO, 50W HID
	3,000LM	46 or 48	3,582	3,668	3,730	3,901	33W	1-lamp 32W T8, 1-lamp 54W T5HO, 50W HID
	5,000LM	46 or 48	5,024	5,126	5,265	5,310	42W	2-lamp 32W T8, 1-lamp 54W T5HO, 70W HID
	7,000LM	46 or 48	7,090	7,235	7,431	7,494	67W	3-lamp 32W T8, 2-lamp 54W T5HO, 100W HID
	6,000LM	92 or 96	7,118	7,288	7,410	7,751	60W	3-lamp 32W T8, 2-lamp 54W T5HO, 100W HID
	10,000LM	92 or 96	10,015	10,218	10,495	10,585	83W	4-lamp 32W T8, 2-lamp 54W T5HO, 100W HID
	14,000LM	92 or 96	14,297	14,588	14,984	15,112	134W	4-lamp 32W T8, 3-lamp 54W T5HO, 150W HID

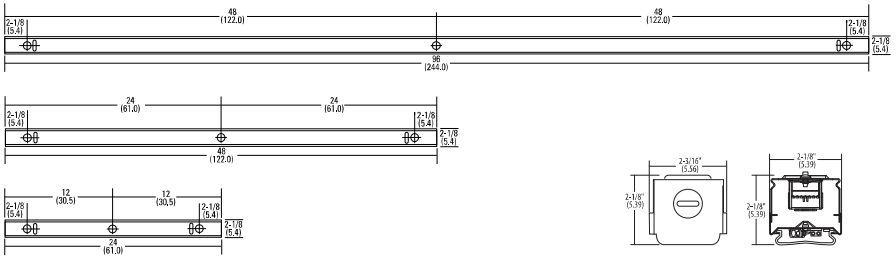
DIMENSIONS

All dimensions are shown in inches (centimeters) unless otherwise noted.

Specifications subject to change without notice.

PALLET DIMENSIONS

Length	Approximate weight	Fixtures per pallet	Approximate pallet dimensions (L x W x H)
L24	7 lbs.	408	46" X 51" X 32 11/16"
L46	11 lbs.	176	46" X 51" X 32 1/16"
L48	12 lbs.	176	46" X 51" X 31 3/8"
L92	22 lbs.	176	46" X 98 1/2" X 31 1/16"
L96	24 lbs.	176	46" X 98 1/2" X 31 1/16"



NORTH COAST ELECTRIC COMPANY
CONSTRUCTION GROUP

Expiration Date: 05/18/17

Quotation

TO:
Spark Electric
12500 AURORA AVE N
SEATTLE, WA 98133-1518

Project Info:

Project:	UW SEATTLE CHILDRENS NECA
Job #:	#Li-041817-26174
Bid Date:	04/18/17
Bid Time:	02:00 PM PDT
Quoter:	Matt Hansen

Type	Quantity	Vendor	Description	Unit or Lot#	Unit Price	Ext Price
			SUBJECT TO APPROVAL FACTORY STD FINISH LAMPS INCLUDED SPARES/EM/DIM/CONTROLS ARE NOT INCLUDED UNLESS NOTED FREIGHT ALLOWED			
	1		LOT LUTRON PER ATTACHED	Unit	27,528.090/EA	27,528.09

Quotations are Net without written consent of North Coast Electric Co. Quotations are valid for the day of quote unless modified by authorized representative of Seller below.
The price offered in this bid reflects Seller being awarded an order for the complete bid package. Purchaser's failure to award a complete order may result in the Seller withdrawing this bid or adjusting the price and other terms.
North Coast Electric reserves the right to consolidate shipments to best comply with Manufacturer's prepaid terms. Any requirement to "Split Ship" may result in additional freight charges at Purchaser's expense.
Payment: NET 30 DAYS
FOB: FOB SHIP POINT
Freight: No Freight allowed unless noted otherwise
Deliveries may include Fuel Surcharge
Some Items may include sales tax
Acceptance of this quote in any manner indicates buyer's acceptance of all terms contained in this quote and NCEC Standard Terms of Sale (NC055) http://www.northcoastelectric.com/NC055.pdf

From:
110 NORTH COAST ELECTRIC
MAIN PHONE 206-436-4444
2424 - 8TH AVENUE S.
P.O. BOX 80566 (98108)
SEATTLE, WA 98134-2005
Printed By: Matt Hansen

Total	27,528.09

Notes

ETC®

Source 4WRD LED

White-Light LED Retrofit

120V

SPECIFICATIONS

PHYSICAL
- Rugged, die cast aluminum construction
- Can be fitted to any Source Four fixture body (not for Source Four ParNel, Fresnel or jr.)
- Seven segment display for simple DMX setup
- Two button user interface
- Easy mounting with single screw attachment
- Replaces Source Four burner assembly
- Available in black, white, silver and custom color
- IP20 rating for indoor use only
- UL and cUL Listed
  - S4WRD: UL1598C
  - S4WRDFB: UL1573
- US patents issued and pending
- Three-year warranty

ELECTRICAL
- 114-125V, 60Hz
- 155 watt draw at full (182 watt theoretical max. draw)
- 30,000 hour L70 Rating (ETC estimate)
  - Life testing under way. Results pending
- DMX in and thru via RJ45 connector
  - DMX is not self terminating
- One-meter power cord
- AC and DMX dimmable (see 'Dimming Performance' note)
- Two fixtures per circuit (D20 Module) when using AC dimming (recommended)
- 14 fixtures per non-dim circuit (R20 Module) when using DMX dimming
- Inrush: 30A (First half-cycle) at 120V
- Typical Power Consumption at 120V
  - Idle Power / Current:
    - DMX Mode: 1.2W/.046A
    - AC Mode: 0W
  - Full Intensity Power / Current: 155.7W/1.35A

OPTICAL
- Tool free field adjustment
- LED lamp consisting of four CREE LED Modules
  - LED lamp is fragile and should not be touched
- Two LED arrays to choose from
  - 3000K, 80+ CRI output
  - 3000K, 90+ CRI output (Gallery version)
- Uses the Source Four ellipsoidal's existing reflector and optical system

THERMAL
- 5-40° C (41-104° F) operating range
  - Fixture must be above freezing temperatures for one hour before being energized.
- Quiet fan cooling
- Fixture is designed for continuous operation up to 104° F (40°C) ambient temperature and requires free flow of air around fixture housing

SPECIFICATIONS

DIMMING PERFORMANCE
- Source 4WRD LED is capable of being both DMX or line-dimmed by a conventional SCR dimmer. In AC dimming mode, performance can vary based on the dimmer used and its control settings. For this reason, AC dimming is best suited for level setting or traditional LED quality dimming situations. When high-performance dimming is required, DMX mode should be used. We recommend testing Source 4WRD LED on existing dimmers you may wish to use.

PHOTOMETRICS

For full Source 4WRD photometry data, please view the Source 4WRD Photometry Guide at www.etcconnect.com

DEG	S4WRD LED LUMENS	S4WRD LED GALLERY LUMENS	HPL 575W/120X LUMENS	HPL 750W/115V LUMENS
5	6,577	4,938	5,247	9,370
10	7,482	5,617	6,678	11,925
14	7,696	5,778	7,196	12,850
19	6,818	5,119	6,261	11,180
19 EDLT	8,008	6,012	7,287	13,012
26	7,597	5,704	7,666	13,690
26 EDLT	9,502	7,134	8,631	15,412
36	8,959	6,726	7,974	14,240
36 EDLT	9,006	6,762	7,992	14,271
50	8,652	6,496	7,829	13,980
50 EDLT	8,446	6,341	8,085	14,437
70	9,909	7,440	9,033	16,130
90	9,843	7,390	7,395	13,205

ETC®

D60

Desire Series

SPECIFICATIONS

GENERAL
- 60-LED color mixing wash fixture
- ETL Listed to UL 1573 – the standard for stage and studio lighting units
- IP20-rated for indoor use
- Power and DMX in/thru connections for easy setup
- User-friendly control interface with multiple modes and fixture settings

PHYSICAL
- Rugged die-cast all-metal housing
- Easy access slots for secondary lenses and accessories
- Uses 8-7/8"/225mm lenses and accessories
- Available in black (standard), white or silver (optional) or custom colors (contact factory)
- Hanging yoke standard. Optional yoke/floor stand available

ELECTRICAL
- 100VAC to 240VAC 50/60Hz universal power input
- Neutrik power in and thru connections
- Up to nine fixtures (15A max) may be linked via power thru connector (10 fixtures total per circuit) when used with R20 Relay Module or Unison Echo Relay Panel. Consult breaker trip curves when used with other equipment
- Requires power from a non-dim source
- Inrush
  - 120V: 15A (First half-cycle)
  - 240V: 40A (First half-cycle)

LED*
- 50,000-hour LED life (50,000 hours to 70% intensity)
- 60 Luxeon® Rebel LED emitters

*See additional LED notes on page three

COLOR
- Exclusive *x7 Color System*™ seven-color LED arrays
- Beautifully illuminates skin tones and other objects for natural appearance and high color rendering
- Broad spectrum color interacts seamlessly with conventional sources
- Exclusive red-shift option emulates tungsten dimming performance
- Variable color temperature from 2700K-6500K

OPTICAL
- Primary field angle of 17° and beam angle of 8°
- Secondary lenses available for multiple beam-spread options
- Each fixture ships with a Verry Narrow lens; additional lenses must be ordered separately
- Refer to accessory charts for lenses available

CONTROL
- DMX512 in and thru via five-pin XLR connectors
- Multiple control options including RGB, strobe, and console-free Master/Slave mode
- See DMX Control Table for additional information
- 15-bit virtual dimming engine provides smooth, high-quality theatrical fades and minimizes color-shift during dimming
- RDM functionality for address and setting changes

THERMAL
- Ambient operating temperature of -4° to 104°F (-20° to 40°C)
- Active electronic thermal management for droop-free operation
- Low-noise fan cooling
- Fixture is designed for continuous operation up to 104°F (40°C) ambient temperature and requires free flow of air around fixture housing

ADDITIONAL ORDERING INFORMATION

Power Input Cables

Use information below to order 5' power input leads with factory-fitted connectors

MODEL	DESCRIPTION
DPA-A	5' PowerCon™ to parallel blade U-ground (Edison) connector
DPA-B	5' PowerCon to 20A two-pin and ground (stage pin) connector
DPA-C	5' PowerCon to grounded 20A twistlock connector
DPA-X	5' PowerCon to bare-end power input lead

Power Thru Jumpers

Note: Power thru jumpers connect to fixture's output (thru) connector to provide to successive fixtures

MODEL	DESCRIPTION
DPJ-5	5' PowerCon to PowerCon fixture to fixture jumper
DPJ-10	10' PowerCon to PowerCon fixture to fixture jumper

Fixture Accessories

MODEL	DESCRIPTION
SELD60FSY	D60 floor stand yoke combo
490BD	Barn door (Use only as a flexible top hat to diminish aperture glare. Not for beam shaping)
490CF	Color Frame (use for round and oblong lenses)
490L	Egg Crate Louver
490PTH3	Top Hat 3" Tube
490PTH6	Top Hat 6" Tube
490PHH	Half Hat 6" Tube
400CC	C-Clamp (does not ship with fixture)
400SC	Safety Cable (32")
DPSJ-25	25' PowerCon-to-Edison input power cable with inline switch

ETC®

Source Four LED Series 2

Source Four LED Series

SPECIFICATIONS

GENERAL
- 60-LED array
- ETL listed to UL1573 – the standard for stage and studio lighting units
- IP20-rated for indoor use
- Power and DMX in/thru connections for easy setup
- User-friendly control interface with multiple modes and fixture settings

PHYSICAL
- Rugged die-cast all-metal housing
- Available in black (standard), white or silver gray or custom colors (contact factory)
- C-clamp
- Positive-locking double-clutch fixture body
- Slot for glass or stainless steel patterns and soft-focus diffuser
- Wide accessory slot with sliding cover for motorized pattern devices or optional iris
- Hanging yoke standard. Optional yoke/floor-stand available

ELECTRICAL
- 100VAC to 240VAC 50/60Hz universal power input
- Neutrik power in and thru connections
- Up to nine Lustr or seven Daylight HD/Tungsten HD luminaires (15A max) may be linked via power thru connector (10 Lustr or 8 Daylight HD/Tungsten HD fixtures total per circuit) when used with R20 Relay Module or Unison® Echo™ Relay Panel
  - Consult breaker-trip curves when used with other equipment. Requires power from a non-dim source
- Inrush
  - 120V: 50A (First half-cycle)
  - 240V: 107A (First half-cycle)

LED*
- 20,000-hour LED life (20,000 hours to 70% intensity)
- 60 Luxeon® Rebel LED emitters

*See additional LED notes on page four

COLOR
- Exclusive x7 Color System seven-color LED array (Lustr)
- Selection from the x7 Color System to provide high quality, variable-white light
  - Tungsten HD (2700K-4000K)
  - Daylight HD (4000K-6500K)
- Beautifully illuminates skin tones and other objects for natural appearance and high color rendering
- Broad-spectrum color interacts seamlessly with conventional sources
- Exclusive optional red-shift option emulates tungsten dimming performance

OPTICAL
- Use the included soft-focus diffuser for creating washes or soft light
- Best performance using ETC's EDLT lens tubes
- Can use all ETC Source Four interchangeable lens barrels: 5°, 10°, 14°, 19°, 26°, 36°, 50°, 70°, and 90° field angles, as well as 19°, 26°, 36°, and 50° EDLT lenses
- For better performance, use the LED 50° barrel

CONTROL
- DMX512 in and thru via five-pin XLR connectors
- Multiple control options, including RGB, strobe, and console-free Master/Slave mode
- See DMX Control Table for additional information

SPECIFICATIONS

CONTROL
- 15-bit virtual dimming engine provides smooth, high-quality theatrical fades and minimizes color shift during dimming
- RDM functionality for address and setting changes

THERMAL
- Ambient operating temperature of 32° to 104°F (0° to 40°C)
- Active electronic thermal management for droop-free operation
- Quiet fan cooling
- Fixture is designed for continuous operation up to 104°F (40°C) ambient temperature and requires free flow of air around fixture housing

ADDITIONAL ORDERING INFORMATION

Power Input Cables

Use information below to order 5' power input leads with factory-fitted connectors

MODEL	DESCRIPTION
DPA-A	5' PowerCon to parallel blade U-ground (Edison) connector
DPA-B	5' PowerCon to 20A two-pin and ground (stage pin) connector
DPA-C	5' PowerCon to grounded 20A twistlock connector
DPA-X	5' PowerCon to bare-end power input lead

Power Thru Jumpers

Note: Power thru jumpers connect to fixture's output (thru) connector to provide link to successive fixtures

MODEL	DESCRIPTION
DPJ-5	5' PowerCon-to-PowerCon fixture-to-fixture jumper
DPJ-10	10' PowerCon-to-PowerCon fixture-to-fixture jumper

Diffusers

MODEL	DESCRIPTION
S4LED-SFD	Source Four LED - Soft Focus Diffuser (included)
S4LED-SWD6	Source Four LED - Smooth Wash Diffuser for 6.25" gel frame slots
S4LED-SWD7	Source Four LED - Smooth Wash Diffuser for 7.5" gel frame slots
S4LED-SWD12	Source Four LED - Smooth Wash Diffuser for 10" lens tubes
S4LED-SWD14	Source Four LED - Smooth Wash Diffuser for 5° lens tubes

The Soft Focus Diffuser fits into a standard A-size pattern holder and delivers beautiful homogenized light when not in sharp focus. Also, use with patterns for dappled and soft-edge projections.

The Smooth Wash Diffuser is used when extra-smooth blending of multiple Source Four LED fixtures is required. The smooth wash diffuser is placed into the gel-frame slot of the lens tube.

Chroma-Q®
BRILLIANT SOLUTIONS

Specification Sheet - Version: 1.0
Chroma-Q® Color Force II 72 RGBA
Part No: CHCF272RGBA

DESCRIPTION

The Chroma-Q® Color Force II 72™ is part of the next-generation of solutions which take performance to an all-new level.

Using the very latest fully homogenised optics found in the popular Chroma-Q Color One 100™ product range, the Color Force II fixtures' output is a single, clean and pure beam of light, delivering a superior colour blend with no unsightly colour mixing shadows.

The homogenised optics and improved Chroma-Q technology provide even higher quality saturates and pastels, and a purer white with no skittles – all from a single source.

Factory calibration ensures all Color Force II units are colour matched, so side by side they will be outputting the exact same colour.

The new models also provide more creative control, with twice as many light engines accommodated within the same fixture lengths – providing independently controllable cells every 3 inches.

FEATURES

- Up to 18,600 lumens – at least 50% more output compared to predecessors
- Homogenised output – superior colour blend & no unsightly colour-mixing shadows
- Even more creative control – twice as many light engines
- Theatrical grade dimming
- Practical, user friendly design
- Superior unit-to-unit consistency
- Optional internal LumenRadio
- Chroma-Q's proven LED performance
- Touchscreen user interface

ORDERING INFORMATION

CHCF272RGBA: Chroma-Q Color Force II 72 RGBA
CHCF272RGBALR: Chroma-Q Color Force II 72 RGBA w LumenRadio Installed

ACCESSORIES

CHCFBL72: Chroma-Q Border lens for Color Force 72
CHCFCL72: Chroma-Q Cyc lens for Color Force 72

OVERALL SPECIFICATIONS

Net Dimensions (without fixings):	Length: 1,759mm / 69.25" Width: 165mm / 6.5" Height: 191mm / 7.5"
Net Weight:	24kg / 53lb
Shipping Dimensions:	Length: 1,855mm / 73" Width: 305mm / 12" Height: 320mm / 12.5"
Shipping Weight:	27 kg / 59 lbs
Power Supply:	Built-in
Power Input Rating:	100-240V AC 50-60Hz 800VA
Power Factor:	0.96 @ 120V AC, 0.99 @ 240V AC
Power Consumption:	800W @ 120V AC, 800W @ 240V AC
Inrush Current:	80A @ 120V AC
Idle Power Consumption:	29W @ 120V AC, 32W @ 240V AC
Typical Power & Current:	Measurements done with all LEDs at maximum intensity. Measurements made at nominal voltage. Allow for a deviation of +/- 10%
Power Connectors In/Out:	Neutrik powerCON TRUE1
Data Connectors In/Out:	Neutrik XLR 5-pin
Max Fixtures in Series:	2 x fixtures @110V, 4 x Fixtures @220V
Control Protocol:	ANSI E1.11 USITT DMX 512-A
Cooling System:	Forced
Operating Temperature:	0°C to 40°C
Construction:	Anodised aluminium extrusion
Colour:	Black
Built-In Hardware:	Quick release lever for tilt adjustment
IP Rating:	IP20
Control Modes:	Strobe Options, RGBA, RGB, HSI, x1, x2, x3, x4, x6, x8, x12, x24, Look Select, Master, Odd / Even, Skip2, Skip3, Skip6
Dimming Curve:	Theatrical
Variable Effects Engine:	Strobe, Strobe on Top, Strobe Random
Hot Lumen Output (Combined):	18,600 lm
Optics:	Fully homogenised lenses
Beam Angle:	22° (approx.)
Beam Distribution:	Asymmetrical direct illumination
CCT:	Adjustable 1,000 - 10,000K
Colour Gamut:	Performance enhanced
CRI:	92
Lamp Life:	L70 at 50,000 hours
Approvals:	CISPR 22 :2006/EN55022 :2006 & CISPR 24 :1997/EN55024 :1998, ICES-003 :2004 & FCC Part 15 Subpart B: 2007, CSA C22, No, 166-M1983:R2008 UL 1573:2003; UL 8750

Patents pending

Equipment Sales Estimate

Prepared By: Nadav Hirsh
Location: Seattle, WA
Date: 04/13/17

Reference # :

CLIENT: **Zach Shoopman**
UW / Cochran Electrical
206-371-4152
zshoopman@gmail.com

JOB NAME	CLIENT PO
NECA GEC	

Version 3

ESTIMATE ONLY-should not be considered a price quote.

QTY	DESCRIPTION	EACH	TOTAL
	LED Replacements for all theatrical fixtures		
	Quantities per client request. Additional design recommended for complete system.		
44	*Source 4WRD Light Engine w/ Barrel, Black*	$849.00	$37,356.00
44	*RJ45 to Female XLR adapter*	$10.00	$440.00
44	*RJ45 to Male XLR adapter*	$10.00	$440.00
0	*70º Lens tube with lens installed*	$350.00	
10	*50º EDLT Lens tube with lens installed*	$298.00	$2,980.00
10	*36º EDLT Lens tube with lens installed*	$298.00	$2,980.00
19	*26º EDLT Lens tube with lens installed*	$298.00	$5,662.00
10	*19º EDLT Lens tube with lens installed*	$298.00	$2,980.00
0	*10º Lens tube with lens installed*	$380.00	
5	*Source Four 15-30 Zoom*	$556.00	$2,780.00
4	*Source Four 25-50 Zoom*	$556.00	$2,224.00
47	*Series 2 Lustr*	$2,420.00	$113,740.00
15	*36º EDLT Lens tube with lens installed*	$298.00	$4,470.00
8	*26º EDLT Lens tube with lens installed*	$298.00	$2,384.00
8	*10º Lens tube with lens installed*	$380.00	$3,040.00
8	*50º EDLT Lens tube with lens installed*	$298.00	$2,384.00
8	*Source Four 25-50 Zoom*	$556.00	$4,448.00
50	*D60 Lustr+*	$2,215.00	$110,750.00
300	*D60 Diffuser*	$50.00	$15,000.00
9	*ColorForce II 72*	$4,400.00	$39,600.00
	Shipping and Handling Estimate	To Be Determined	

TOTAL PRICE:

TOTAL :	$353,658.00	**$387,609.17**
SEATTLE SALES TAX :	$33,951.17	

Tax is the responsibility of the buyer if they are not exempt

PLEASE REVIEW BELOW REQUIREMENTS AND SIGN TO ACCEPT PROPOSAL

- **Payment in full is required.**
- **All orders are subject to shipping charges. Shipping estimate is subject to change based on actual shipping charges.**
- **All returns, including special and non-stocked orders, are determined on case-by-case basis and at the sole discretion of Hollywood** Lights, Inc. All potential returns must be accompanied by a Hollywood Lights receipt or invoice and be made within 30 days of purchase/delivery. Acceptable returns are subject to a 20% re-stocking fee. Shipping or freight charges on the original order will not refunded or exchanged. No returns or exchanges will be issued for makeup, cut goods, or custom manufactured items.

I accept this proposal and I understand and agree to all terms and conditions outlined therein.
please sign below and fax to: 206-215-9370

Customer Signature_____ Date_____ Version 3

Signing person warrants that he/she is authorized to bind above customer and that customer shall be bound by this signature.

We offer solar modules of unsurpassed quality that exceed performance expectations at an affordable price.

- High-efficiency monocrystalline silicon PERC cells
- Certified PID-free above and beyond the industry standard
- Full quality check of every module along the production line
- Impact-resistant, anti-glare solar glass
- 25-year power output warranty
  10-year workmanship warranty

Connect with us:
www.itekenergy.com | info@itekenergy.com

MADE IN AMERICA OF U.S. AND IMPORTED PARTS

ARRA, BAA, and TAA Solar Project Compliant

Intertek UL Listing 1703

itek ENERGY
Building Solar | Powering The Future

Itek SE Solar Module

Design & Engineering Data

GENERAL DATA

Cell Type	• 60 high-efficiency monocrystalline p-type cells • 6 x 10 cell matrix
Solar Glass	• Ultra-clear anti-reflective treatment • Tempered, with low iron content • Anti-glare prismatic subsurface texture
Backsheet	• Multi-layered • Engineered adhesion for maximum weather protection
Frame	• High-strength corrosion-resistant anodized aluminum • Compatible with standard racking, accommodating both top-down clamps and bottom-flange mounting
Cable	• 42" 90°C 12AWG PV wire
Junction Box	• 3 bypass diodes • 1000 VDC MC4 connectors
Grounding	• Certified for Wiley Electronics WEEB™ grounding clips • Eight standard grounding locations per module for reduced ground wire length

QUALIFICATIONS

UL Listing	UL 1703
Fire Rating	Type 2
PID Free	500+ hours
ARRA, BAA, and TAA Compliant	

ELECTRICAL DATA*

	280 SE	285 SE	290 SE	295 SE	300 SE
Maximum Power - Pmax (Wp)	280	285	290	295	300
Maximum Power Voltage - Vmp (V)	32.3	32.4	32.6	32.8	32.9
Maximum Power Current - Imp (A)	8.6	8.7	8.8	8.9	9.0
Open Circuit Voltage - Voc (V)	39.2	39.3	39.5	39.7	39.8
Short Circuit Current - Isc (A)	9.3	9.4	9.5	9.6	9.7
Module Efficiency	16.70%	16.99%	17.29%	17.59%	17.89%

MECHANICAL DATA

Dimensions	1001mm X 1675mm X 50mm
Weight	43 lbs

MAXIMUM RATINGS

Operational Temperature	-40...+ 90°C
Maximum System Voltage	1000 VDC
Design Load (UL 1703)	Up to 113 lbs/ft²
Maximum Load (UL 1703)	551 kg/m² (5400 Pa)
Maximum Wind Load	113 lbs/ft²
Max Series Fuse Rating	15A
Max Reverse Current	15A

TEMPERATURE RATINGS

Nominal Operating Cell Temperature (NOCT)	45.01°C
Temperature Coefficient of Pmax	-0.39%/°C
Temperature Coefficient of Voc	-0.29%/°C
Temperature Coefficient of Isc	+0.04%/°C
Temperature Coefficient of Vmp	-0.38%/°C

*Electrical characteristics may vary within ±2% of the indicated values at Standard Test Conditions (STC): Irradiance of 1,000W/m², AM 1.5 spectrum, cell temperature at 25°C.

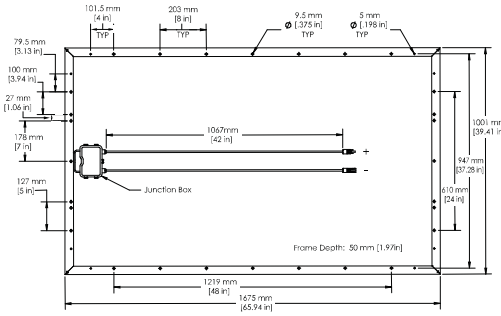
NOTE: SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

MADE IN AMERICA OF U.S. AND IMPORTED PARTS

CERTIFIED MADE IN WASHINGTON

CERTIFIED MADE IN MINNESOTA

ARRA, BAA, and TAA Solar Project Compliant



Intertek

Manufacturing Facilities: 3886 Hammer Drive, Bellingham, WA 98226 | 2746 31st Avenue South, Minneapolis, MN 55406
Sales Offices: WA: (360) 647-9531 | MN: (612) 318-6384 | CA: (360) 393-0178
info@itekenergy.com | www.itekenergy.com

V1.16.17

Enphase M250 Microinverter

INPUT DATA (DC)	MODELS: M250-60-2LL-S22, M250-60-2LL-S25	MODELS: M250-72-2LL-S22, M250-72-2LL-S25
Commonly used module pairings[1]	210 - 350+ W	210 - 350+ W
Compatibility	60-cell PV modules	60-cell and 72-cell PV modules
Maximum input DC voltage	48 V	62 V
Peak power tracking voltage	27 V - 39 V	27 V - 48 V
Operating range	16 V - 48 V	16 V - 60V
Min/Max start voltage	22 V / 48 V	22 V / 48 V
Max DC short circuit current	15 A	15 A
OUTPUT DATA (AC)		
Peak output power	250 W	
Maximum continuous output power	240 W	
Nominal output current	1.15 A @ 208 VAC 1.0 A @ 240 VAC	
Nominal voltage/range	208 V / 183-229 V @ 208 VAC 240 V / 211-264 V @ 240 VAC	
Nominal frequency/range	60.0 / 57-61 Hz	
Extended frequency range[2]	57-62.5 Hz	
Power factor	>0.95	
Maximum units per 20 A branch circuit	24 (three-phase 208 VAC) 16 (single phase 240 VAC)	
Maximum output fault current	850 mA rms for 6 cycles	
EFFICIENCY		
CEC weighted efficiency	96.5%	
Peak inverter efficiency	96.5%	
Static MPPT efficiency (weighted, reference EN50530)	99.4%	
Night time power consumption	65 mW max	
MECHANICAL DATA		
Ambient temperature range	-40°C to +65°C	
Dimensions (WxHxD)	171 mm x 173 mm x 30 mm (without mounting bracket)	
Weight	1.6 kg (3.4 lbs)	
Cooling	Natural convection - No fans	
Enclosure environmental rating	Outdoor - NEMA 6	
Connector type	MC4: M250-60-2LL-S22 and M250-72-2LL-S22 Amphenol H4: M250-60-2LL-S25 and M250-72-2LL-S25	
FEATURES		
Communication	Power line	
Integrated ground	The DC circuit meets the requirements for ungrounded PV arrays in NEC 690.35. Equipment ground is provided in the Engage Cable. No additional GEC or ground is required. Ground fault protection (GFP) is integrated into the microinverter.	
Monitoring	Enlighten Manager and MyEnlighten monitoring options	
Transformer design	High frequency transformers, galvanically isolated	
Compliance	UL 2703 recognized, UL1741/IEEE1547, FCC Part 15 Class B, CAN/CSA-C22.2 NO. 0-M91, 0.4-04, and 107.1-01 This product is UL Listed as PV Rapid Shut Down Equipment and conforms with NEC-2014 and NEC-2017 section 690.12 and C22.1-2015 Rule 64-218 Rapid Shutdown of PV Systems, for AC and DC conductors, when installed according manufacturer's instructions.	

1. No enforced DC/AC ratio. See the compatibility calculator at enphase.com/en-us/support/module-compatibility.
2. Frequency ranges can be extended beyond nominal if required by the utility.

To learn more about Enphase offerings, visit enphase.com

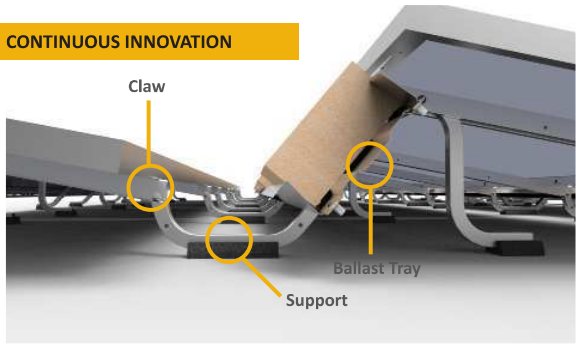
2017-01-19

ENPHASE.

Polar Bear III HD
10 Degree Flat Roof Mounting System

panelclaw®

CONTINUOUS INNOVATION



Trusted Roof Integrity

Polar Bear® III HD protects the roof with fully captured ballast, integrated recycled rubber roof protection pads and a system design that allows for free water flow.

Accelerated Construction

The engineered design emphasizes built-in features for construction efficiency:

- Three major components that are light-weight and easy to move
- Pre-installed bolts to quickly mount Ballast Trays
- Single-module tilt-up feature
- Enhanced wire management options

Safety and Reliability

PanelClaw's industry-leading reliability track record in the flat roof space is the result of our investment in an extensive test program that goes beyond existing codes and standards. We maintain long term partnerships with third party test laboratories and codes and standards bodies throughout the industry.

Three Components

Support

- Easy-to-handle components that weigh less than 2.5 pounds
- Integrated recycled rubber roof protection pads
- Pre-drilled holes for wire management cabling options

Ballast Tray

- Angled fit with locking end-tab to fully capture ballast blocks
- Hemmed edges and chamfered corners prevent wiring from coming into contact with sharp edges

Claw

- Attachment to module using standard module mounting holes
- UL 2703 certified for electrical bonding and grounding
- Two energy density mounting options
- Pre-drilled for E/W module-to-module wire management

Applications
Flat roof (max slope 5°)

Fully ballasted or mechanically attached

Module Tilt Angle
10° nominal

North/South Module to Module Repeat
52" or 56"

Platform Load
~1.9psf - 8 psf

Module Orientation
Landscape

Module Attachment
Standard module mounting holes

Basic Wind Speed
Up to 150 mph (>150 mph by approval)

Wind Exposure Category
B and C (D by approval)

Seismic Compatibility
C, D, E and F

Material
G90 steel with stainless steel fastener

Warranty
25 years

Listings and Certifications
ANSI/UL 2703-2015 listed

UL 2703 System Fire Rating: Class A with Type 1 and Type 2 modules

(978) 688.4900 | sales@panelclaw.com

System Layout

General Notes

1. This layout is for system schematic purposes only. Contractor shall locate, install, and wire equipment according to Lutron installation and specification documents.
   1a. If the Lutron Sensor Layout and tuning service has been purchased, then daylight and occupancy sensors are placed by Lutron.
2. Verify shade design with Lutron.
3. See Cover Sheet and One-Lines for additional information.

Legend

- PX-2BRL-GXX-I01 (8)
- PJ2-2B-GWH-L01 (CW-1-WH) (25)
- PJ2-3BRL-GWH-L01 (CW-1-WH) (3)
- LOS-CDT-1000-WH (6)
- LRF2-DCRB-WH (8)
- LRF2-OCR2B-P (18)
- HJS-1-FM (2)
- RMJS-20R-DV-B (10)
- RMJS-5R-DV-B (12)
- RMJS-8T-DV-B (27)
- PP-DV (4)

UNIVERSITY OF WASHINGTON

SEATTLE CHILDREN"S THEATRE RENOVATION
SEATTLE, WASHINGTON 98109

No.	Description	Date

Level 1 - Proposed Controls

Project Number 69350
Date 3.13.2017
Drawn By SMS
Checked By JWP

E-7

Not to Scale