



**COMMISSION
AGENDA MEMORANDUM**

Item No. 4b

ACTION ITEM

Date of Meeting September 26, 2017

DATE: September 18, 2017

TO: Dave Soike, Interim Executive Director

FROM: Jeffrey Brown, Director Aviation Facilities and Capital Programs
Wayne Grotheer, Director Aviation Project Management Group

SUBJECT: Arc Flash Mitigation (CIP #C800826)

Amount of this request: \$7,383,000

Total estimated project cost: \$7,533,000

ACTION REQUESTED

Request Commission authorization for the Executive Director to (1) prepare design and construction bid documents for the Arc Flash Mitigation project at Seattle-Tacoma International Airport; (2) advertise and award a major works construction contract; and (3) utilize Port of Seattle crews and small works contracts to perform construction work. The amount of this request is \$7,383,000 for a total estimated project cost of \$7,533,000.

EXECUTIVE SUMMARY

Recent changes to the National Electrical Code (NEC) require the study, determination and labeling of Arc Flash hazards present in electrical power distribution equipment and facilities. Arc Flash is a type of electrical explosion or uncontrolled discharge of energy that results from a low impedance connection through the air to ground or another phase of an electrical system. The Port's Arc Flash studies at the airport have shown that in some locations the arc flash hazards need to be reduced as they exceed levels which can be managed by use of personal protective equipment (PPE) worn by personnel working in the vicinity of the electrical equipment.

This project will mitigate all known arc flash hazards that exceed PPE limits within the Sea-Tac airport power distribution system. The reduction in arc flash energy levels will be achieved by replacing existing fuses with vacuum circuit breakers and by upgrading protective relays. The circuit breaker and protective relays provide adjustable and highly flexible "trip" settings allowing for greatly improved coordination between upstream and downstream protective devices within the power distribution network. The circuit breaker and protective relay combination can also be adjusted to minimize the energy that can be transmitted during an arc flash event.

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The arc flash evaluation studies are ongoing, and while additional severe arc flash hazard levels may be discovered, we do not anticipate that additional capital projects will be required. Aviation Facilities and Infrastructure expects to lower any new excessive arc flash hazard levels by adjusting equipment settings.

In addition to reducing arc flash hazards to an acceptable level; this project will install infrared (IR) inspection windows allowing for the annual inspection of electrical connections and potential hot spots without requiring human exposure to energized equipment. IR windows provide a safe method for inspection, eliminate the need for outages, and reduce the total time required to perform the inspection.

JUSTIFICATION

Improved power reliability avoids outages, equipment damage, failures and interruption of critical operations. This project maximizes system reliability by providing the Port of Seattle aviation maintenance staff with the safe working environment necessary to properly maintain and operate the Sea-Tac Airport electrical distribution system.

The Port's arc flash studies at the airport revealed arc flash incident energy levels to be as high as 120 calories per square centimeter (cal/cm^2) in some locations. The highest level set by the National Fire Protection Association (NFPA) is $40 \text{ cal}/\text{cm}^2$; this corresponds to the highest rated PPE. This project will reduce arc flash energy levels to approximately $25 \text{ cal}/\text{cm}^2$ in airport electrical equipment and facilities.

Electrical switchgear which exceeds the PPE limits cannot be serviced without power shut downs. The regular shutdown of Airport operations to allow for routine electrical maintenance and switching cannot be accommodated; therefore, essential system maintenance and functions will not be possible without the completion of this project.

DETAILS

This project is requesting a single authorization for both the design and construction phases of work. A single authorization reduces staff time, soft costs, and will minimize the time required to complete this project.

To more accurately estimate the total project cost and facilitate a single Commission authorization, the team took this project to 30% design completion during the project definition (Notebook) phase. The project cost estimate increased from the original concept approval primarily due to the actual cost of the fuse to breaker retrofit conversions, which were more complex than originally conceived.

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The project will phase all work to eliminate or minimize operational impacts. Cooling Tower power center work will be completed in the winter months to reduce or eliminate impacts to passenger comfort.

Scope of Work

This project will provide for the design and construction of all elements necessary to reduce and or mitigate arc flash hazards at power distribution switchgear located throughout Sea-Tac airport. The scope of work for this project has not increased from the original concept and cost estimate. The cost estimate to deliver this project has increased due to complexities with the fuse to breaker conversions.

New replacement equipment includes:

1. Replace fuses in Power Centers with Vacuum Circuit Breaker:
 - a. C1 Building Power Center
 - b. Concourse C Power Center
 - c. Parking Garage Electrical Room
 - d. Concourse D Power Center
 - e. Cooling Tower Power Centers #1 through #5.

2. Upgrade/replace relays feeding the Central Terminal Power Center to adjustable relays with maintenance mode.
 - a. Set protective relays to minimize arc flash energy and coordinate with upstream and downstream devices.

3. Addition of infrared windows in existing Power Centers included in item #1.

Small Business

Although this project requires highly specialized contractors, the project management team is collaborating with the Port’s Small Business group to identify and outreach to, possible small businesses that would be able to compete for these opportunities within the above scope of work.

Schedule

Activity

Design start	2017 Quarter 3
Construction start	2018 Quarter 3
In-use date	2019 Quarter 4

Cost Breakdown

	This Request	Total Project
Design	\$1,224,000	\$1,274,000
Construction	\$6,278,000	\$6,278,000

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Total	\$7,383,000	\$7,533,000
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ALTERNATIVES AND IMPLICATIONS CONSIDERED**Alternative 1** – Do not install arc flash mitigation measuresCost Implications: \$150,000 (expense)Pros:

- (1) No additional investment required

Cons:

- (1) Equipment cannot be maintained without disruption to airport operations.
- (2) Maintenance staff will be unable to identify problem areas, which could lead to extended outages.
- (3) Preventative maintenance will not be possible at some locations, leading to shortened equipment life and reduction in power reliability
- (4) Poor response time for unplanned outages

This is not the recommended alternative.

Alternative 2 – Install new protective relays at all locations with “maintenance mode” feature on feeders in the terminal distribution power centers.

Maintenance mode is not equivalent to scope item #2 above, which is a permanent condition enhancing the operational efficiency of the Power Distribution system. Maintenance mode is a temporary condition that will diminish the capacity of the power distribution system while it is enabled.

Cost Implications: \$4.2M to \$5MPros:

- (1) Reduced capital cost
- (2) Reduces arc flash hazard levels to safe levels during maintenance mode

Cons:

- (1) Protective devices at Power Centers are not coordinated during maintenance mode leaving the power distribution system temporarily vulnerable to wide spread system outages
- (2) Requires system outages on double-ended switchboards prior to working on the equipment, significantly increasing the response time in the event of an unplanned outage
- (3) Requires installation of remote indicating device showing gear in maintenance mode
- (4) Requires planned outages to perform project installation work
- (5) Increase labor costs for maintenance and scheduled work

This is not the recommended alternative.

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Alternative 3 – Design, procure, and install Arc Flash Mitigation Measures at Power Centers C1.2, C2, D, parking garage electrical room and Cooling Tower #1, #2, #3, #4 and #5.

Cost Implications: \$7,533,000

Pros:

- (1) Reduces arc flash hazard to NFPA required levels
- (2) Permits compliance with NEC for annual visual infrared inspections
- (3) Adds selective power coordination, i.e. faults are isolated to the nearest upstream device eliminating unnecessary power outages
- (4) No impacts to airport operations
- (5) Minimizes response time in the event of an unplanned outage
- (6) Integrates with future SCADA project
- (7) Allows new construction to occur with fewer operational issues

Cons:

- (1) Highest cost solution

This is the recommended alternative.

FINANCIAL IMPLICATIONS

<i>Cost Estimate/Authorization Summary</i>	Capital	Expense	Total
COST ESTIMATE			
Original estimate	\$3,200,000	\$0	\$3,200,000
Current change	\$4,302,000	\$31,000	\$4,333,000
Revised estimate	\$7,502,000	\$31,000	\$7,533,000
AUTHORIZATION			
Previous authorizations	\$150,000	0	\$150,000
Current request for authorization	\$7,352,000	\$31,000	\$7,383,000
Total authorizations, including this request	\$7,502,000	\$31,000	\$7,533,000
Remaining amount to be authorized	\$0	\$0	\$0

Annual Budget Status and Source of Funds

This project was included in the 2017 – 2021 capital budget and plan of finance with a budget of \$3.2 million. The budget increase will be transferred from the Aeronautical Allowance CIP (C800753) resulting in no net change to the Aviation capital budget. The funding source will be the Airport Development Fund.

Financial Analysis and Summary

Project cost for analysis	\$7,533,000
Business Unit (BU)	Terminal Building

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Effect on business performance (NOI after depreciation)	NOI after depreciation will increase
IRR/NPV (if relevant)	N/A
CPE Impact	\$0.02 by 2021

Future Revenues and Expenses (Total cost of ownership)

This project supplements existing electrical distribution equipment and does not have a material impact on the current Aviation Maintenance O&M costs.

ATTACHMENTS TO THIS REQUEST

None

PREVIOUS COMMISSION ACTIONS OR BRIEFINGS

None