

**DIVISION E:
ADDITIONAL TECHNICAL
SPECIFICATIONS FOR THE PROJECT**

MODIFICATION

ITEM 100 - MOBILIZATION

This special specification modifies, amplifies, or amends the technical specifications and plans and takes precedence over them in the event of any discrepancy.

Amend MOBILIZATION, Paragraph MEASUREMENT, as follows:

Add the following:

Measurement of the item "Mobilization" will be by lump sum not to exceed 11% of the total bid amount.

Amend MOBILIZATION, Paragraph PAYMENTS, as follows:

Delete paragraphs in their entirety.

Add the following two paragraphs:

"Mobilization shall be included as a separate line item on the Contractor's Schedule of Values."

"Insurance and Bond shall be included as a separate line item on the Contractor's Schedule of Values."

Amend MOBILIZATION, Paragraph BID ITEMS as follows:

Delete both line items in their entirety.

ITEM 100
✕
MOBILIZATION

This item shall govern the mobilization of personnel, equipment and supplies at the project site in preparation for beginning work on other contract items. Mobilization shall include, but is not limited to, the movement of equipment, personnel, material, supplies, etc. to the project site and the establishment of office and other facilities necessary prior to beginning the work.

MEASUREMENT: Measurement of the Item, "Mobilization" as specified herein will be by the "Lump Sum", as the work progresses. Measurement of the item "Insurance and Bond" will be by lump sum not to exceed 3% of the total contract amount.

PAYMENTS: Partial payments of the "Lump Sum" bid for mobilization will be as follows: (The adjusted contract amount for construction items as used below is defined as the total contract amount less the lump sum bid for Mobilization.)

- 1) When 1% of the adjusted contract amount for construction items is earned, 50% of the mobilization lump sum bid or 5% of the total contract amount, whichever is less, will be paid.
- 2) When 5% of the adjusted contract amount for construction items is earned, 75% of the mobilization lump sum bid or 10% of the total contract amount,

whichever is less, will be deducted from the above amount.

- 3) When 10% of the adjusted contract amount for construction items is earned, 90% of the mobilization lump sum bid or 15% of the total contract amount, whichever is less, will be paid. Previous payments under this item will be deducted from the above amount.

Upon completion of all work under this contract, payment for the remainder of the lump sum bid for "Mobilization" will be made.

Insurance and Bond will be payed as a lump sum on the initial request for payment.

BID ITEMS:

- Item 100 - Mobilization - Lump Sum.
- Item 100.1 - Insurance and Bond - Lump Sum (3%)

MODIFICATION

ITEM 530 – BARRICADES, SIGNS, AND TRAFFIC HANDLING

This special specification modifies, amplifies, or amends the technical specifications and plans and takes precedence over them in the event of any discrepancy.

Amend BARRICADES, Paragraph MEASUREMENT, as follows:

Delete paragraph in its entirety.

Amend BARRICADES, Paragraph PAYMENTS, as follows:

Delete paragraph in its entirety.

Add the following paragraph:

“Barricades shall be included as a separate line item on the Contractor’s Schedule of Values.”

Amend BARRICADES, Paragraph BID ITEMS as follows:

Delete both line items in their entirety.

ITEM 530



BARRICADES, SIGNS, AND TRAFFIC HANDLING

This item shall govern for providing, installing, moving, repairing, maintaining, cleaning and removing upon completion of work, all barricades, signs, cones, lights and other such type devices and of handling traffic as indicated on the plans or as directed by the Engineer.

GUIDELINES FOR BARRICADING ON CITY RIGHT-OF-WAY:

The barricade contractor must locally maintain sufficient materials in stock to accommodate three or more construction phases per project. These will include all applicable traffic control sign types, trucks, trailers, arrow boards, and all other traffic control devices assigned to the Contractor's barricading operation.

The Texas Manual on Uniform Traffic Control Devices (TMUTCD), Section 6A-6, requires the appropriate training for all personnel who are involved in the selection, placement, and maintenance of traffic control devices on construction projects. The City of San Antonio requires that all personnel associated with barricading operations and traffic handling possess certificates from either of the two groups below. Each certificate will be valid for four years.

Barricading Training

Texas Engineering Extension Service	American Traffic Safety Service Association
Work Zone Traffic Control	Training Course for Worksite Traffic Supervisors

The Contractor shall have a minimum of one barricade supervisor and three persons who are responsible for construction work zone traffic control. These persons shall be based in the San Antonio metropolitan area and their sole tasks shall be implementing and maintaining construction work zone traffic control devices.

The Contractor shall have a commercial telephone answering service during non-working hours. The contractor shall provide the City during working hours with an office telephone number, pager number, and cellular telephone number to contact the barricading supervisor. The contractor must be able

to respond to any call within two hours. The barricading contractor or General Contractor must possess liability insurance in the minimum amount of one million dollars. A copy of the liability policy must be sent to the City Traffic Engineer for approval 48 hours prior to starting barricading operations.

The contractor shall comply with all standards set forth in the plan barricade detail sheets. One non-compliance letter issued by the City to the Contractor in regard to construction work zone traffic control, and not corrected within 48 hours, will be cause for delay of payment for this item.

If the general contractor elects to do his own barricading, he must comply with all the foregoing requirements. Additionally, a general contractor will be required to submit a traffic plan at least 72 hours in advance (excluding weekends and holidays) of starting work in each construction phase. Upon satisfactory evidence of competent barricading expertise, this requirement for a traffic plan may be waived by the City Traffic Engineer.

CONSTRUCTION METHODS:

All barricades, signs, and other types of devices listed above shall conform to the requirements of the TMUTCD. It is the contractor's responsibility to see that all traffic control devices are properly installed and maintained at the job site. If it is determined by the Traffic Engineering Representative that the traffic control devices do not conform to the established standards, or are incorrectly placed to protect the general public, the Traffic Engineer shall have the option to stop the work, at no expense to the City, until the situation is corrected by the Contractor. If it is determined that additional temporary traffic control devices, special directional devices, and/or business name signs are required, they will be provided by the contractor at no additional cost. As work progresses, the location of temporary traffic control devices will be adjusted and modified as necessary by the Contractor.

All retro reflective traffic control devices such as barricades, vertical panels, signs, etc., shall be maintained by cleaning, replacing or a combination thereof such that during darkness and rain, the retro reflective characteristics shall equal or exceed the retro reflective characteristics of the standard reflective panels in the Inspector's possession.

The contractor shall contact the City of San Antonio Traffic Operations Section prior to removing any traffic signs or traffic signals. Prior to completion of the contract and removal of barricades, all applicable permanent traffic signs and signals must be in place and functioning properly. All permanent signs or traffic control devices missing or damaged during construction shall be replaced at the contractor's expense. Permanent pavement marking shall be applied prior to the opening of any street to traffic. Temporary short-term expendable pavement markings may be provided prior to application of permanent markings.

The contractor must maintain all streets open to through traffic by repairing trenches, potholes, etc., at no direct payment. The contractor shall provide reasonable access to residences and all businesses within all phases of the work, as well as providing suitable access accommodations for school children, pedestrians, garbage pick-up and mail delivery by the US Postal Service. Temporary pedestrian crossing will be determined in the field by the Police

Department School Services Unit. Temporary pedestrian crossings shall be 4 feet wide by 4 inches thick asphalt treated base and will be paid for under Item 206.

MEASUREMENT:

This item will be measured by "Lump Sum" as indicated on the plans.

PAYMENT:

This item will be paid for at the contract lump sum price bid for "barricades, signs, and traffic handling". This price shall be full compensation for furnishing all labor, materials, supplies, equipment and incidentals necessary. To complete the work as specified. The lump sum price will be pro-rated based on the number of workdays in the project contract. Failure to complete the work within time allowed in the project contract due to approving designs, testing, material shortages, closed construction season, curing periods, and testing periods will not qualify for additional compensation. When additional work is added by an approved field alteration or when work is suspended for the convenience of the City, through no fault of the contractor, additional compensation may be paid to the Contractors.

BID ITEMS:

Item 530: Barricades, Signs and Traffic Handling, "Lump Sum"

ITEM 700
✦
PROJECT SCHEDULES

This item shall govern the creation, maintenance, and delivery of Critical Path Method (CPM) project schedules.

CRITICAL PATH METHOD PROJECT SCHEDULE

The Contractor shall create and maintain a Critical Path Method (CPM) Project Schedule showing the manner of execution of work that the contractor intends to follow in order to complete the contract within the allotted time. The project schedule shall employ computerized CPM for the planning, scheduling and reporting of the work as described in this specification. The CPM project schedule shall be prepared using the Precedence Diagram Method (PDM). The Contractor shall create and maintain the schedule using Primavera Project Manager 5.x or above or Primavera Contractor 4.1 or above. For construction contracts under \$300K and project durations 90 days or less, the project schedule can be created and maintained in Microsoft Project software. The observance of the requirements herein is an essential part of the work to be done under the contract. No direct compensation will be allowed for fulfilling these requirements, as such work is considered subsidiary to the various bid items of the contract.

PERSONNEL

The Contractor shall provide an individual, referred to hereafter as the Scheduler, to create and maintain the Project Schedule. The Scheduler shall be proficient in Critical Path Method (CPM) analysis as demonstrated through certification from Project Management Institute (PMI), Association for the Advancement of Cost Engineering (AACE) or possess sufficient experience to be

able to perform required tasks on the specified software and be able to prepare and interpret reports from the software. The Scheduler shall be made available for discussion or meetings when requested by the City.

PROJECT SCHEDULE

1. GENERAL:

At least twenty (20) calendar days prior to the pre-construction conference, the Contractor shall submit a Project Schedule, which shall show the sequence and interdependence of activities required for complete performance of the work. All schedule submittals shall be in the electronic form to include PDF plots of the schedule, a PDF plot defining the Critical Path and two week look-ahead, and include the native Primavera file format. The Contractor shall submit the schedule to the Web-portal and Project Manager via electronic mail, CD-Rom, floppy disc, or any other electronic media acceptable to the City. The City will review the Project Schedule within twenty (20) calendar days for compliance with the specifications and notify the Contractor at the pre-construction conference of its acceptability. No work shall begin until the City has accepted the Project Schedule.

2. SEQUENCE:

The Project Schedule shall show the sequence and interdependence of activities required for complete performance of the work. The Contractor shall be responsible for assuring all work sequences are logical and show a coordinated plan of the work. The purpose of

the City requiring the Project Schedule shall be to:

- a. Ensure adequate planning during the execution and progress of the work in accordance with the allowable number of calendar days and all milestones.
- b. Assure coordination of the efforts of the Contractor, City, Utilities and others that may be involved in the project and that activities are included in the schedule highlighting coordination points with others,
- c. Assist the Contractor and City in monitoring the progress of the work and evaluating proposed changes to the contract, and
- d. Assist the City in administering the contract time requirements.

3. ACTIVITIES:

Each activity on the Project Schedule shall include:

- a. An activity number utilizing an alphanumeric designation system that is agreeable to the City;
- b. Concise description of the work represented by the activity; and
- c. Activity durations in whole work days with a maximum of twenty (20) work days. Durations greater than twenty (20) work days may be used for non-construction activities (mobilization, submittal preparation, curing, etc.), and other activities mutually agreeable between the City and Contractor.

The Contractor shall provide to the City a legend for all abbreviations. The activities shall be coded so that organized plots of the

Project Schedule may be produced. Typical activity coding includes traffic control phase, location and work type. Show an estimated production rate per working day for each work activity. Activity durations shall be based on production rates shown.

4. WORK DURATION AND RESOURCES:

The schedule layout shall be grouped by Project and then by Work Breakdown Structure (WBS) for organizational purposes. The original and remaining duration shall be displayed. The grouping band will, by default, report work days planned. One additional level of effort activity shall be added to the schedule as a "time calculator" with a seven-day calendar without holidays. The calculation of their days will show up in the duration columns in Primavera.

If specified by general note, the Contractor shall plan and incorporate major resources into the Project Schedule. Major resources are defined as crews and equipment that constrain the Contractor from pursuing available work. The resources shall accurately represent the Contractor's planned equipment and manpower to achieve the productivity rates specified above.

Work shall be scheduled based upon the Contractor's standard work week utilizing the appropriate calendar assignments in Primavera software. If the Contractor's initial baseline plan is to perform the Work on a six or seven-day work week, then the appropriate calendar in Primavera must be used and the Engineer must be notified in writing through the Submittal process. This does not affect the total calendar days allotted by the contract.

Assign working calendars for the days you plan to work. Designate all City holidays (12) as non-working days (holidays). For dates beyond the current calendar year assume that

the City holidays are the same as the current calendar year.

Seasonal weather conditions shall be considered and included in the Project Schedule for all work influenced by temperature and/or precipitation. Seasonal weather conditions shall be determined by an assessment of average historical climatic conditions. Average historical weather data is available through the National Oceanic and Atmospheric Administration (NOAA). These effects will be simulated through the use of work calendars for each major work type (i.e., earthwork, concrete paving, structures, asphalt, drainage, etc.). Project and work calendars should be updated each month to show days actually able to work on the various work activities.

Total float is defined as the amount of time between the early start date and the late start date, or the early finish date and the late finish date, for each and every activity in the schedule. Float time in the Project Schedule is a shared commodity between the City and the Contractor.

Only City responsible delays in activities that affect milestone dates or the contract completion date, as determined by CPM analysis, will be considered for a time extension.

5. OTHER REQUIREMENTS:

Code and organize all work by Work Breakdown Structure (WBS). An example WBS will be provided by the City.

Percent complete type shall be Duration Percent Complete.

Duration type shall be Fixed Units

Submittals shall be included in the schedule with a logical tie to what each drives.

Proposed Change Orders shall be added the schedule identifying it as a Proposed Change Order. This task must be linked to the schedule with logical ties and approved by the City. Upon approval of Change Order, task will be renamed identifying work performed and Change Order number and resources will be added to the task.

Constraints are limited to project start, project finish, material delivery, and use on Submittals. If a schedule requires additional constraints, then an explanation shall accompany the schedule Submittal.

The schedule shall include activity milestones for material delivery.

Default progress is disallowed.

If work is performed out of sequence, then an explanation must be included in the project narrative.

JOINT REVIEW, REVISION AND ACCEPTANCE

Within twenty (20) calendar days of receipt of the Contractor's proposed Project Schedule, the City shall evaluate the schedule for compliance with this specification, and notify the Contractor of its findings. If the City requests a revision or justification, the Contractor shall provide a satisfactory revision or adequate justification to the satisfaction of the City within seven (7) calendar days. If the Contractor submits a Project Schedule for acceptance, which is based on a sequence of work not shown in the plans, then the Contractor shall notify the City in writing, separate from the schedule submittal.

The City's review and acceptance of the Contractor's Project Schedule is for conformance to the requirements of the

contract documents only. Review and acceptance by the City of the Contractor's Project Schedule does not relieve the Contractor of any of its responsibility for the Project Schedule or of the Contractor's ability to meet interim milestone dates (if specified) and the contract completion date, nor does such review and acceptance expressly or by implication warrant, acknowledge or admit the reasonableness of the logic, durations, manpower or equipment loading of the Contractor's Project Schedule. In the event the Contractor fails to define any element of work, activity or logic and the City review does not detect this omission or error, such omission or error, when discovered by the Contractor or City shall be corrected by the Contractor at the next monthly schedule update and shall not affect the project completion date.

Acceptance by the City of a Baseline or project update schedule that exceeds contractual time does not alleviate the Contractor from meeting the contractual completion date.

Payment may be delayed until acceptable baseline or updated schedule is received and accepted by the City.

UPDATES

The Project Schedule shall be updated on a monthly basis. The Project Schedule update shall be submitted one week prior to the pay application submittal. The Contractor shall meet with the City each month at a scheduled update meeting to review actual progress made through the Data Date of the schedule update as determined by the Project Manager. The review of progress will include dates activities actually started and/or completed, the percentage of work completed, the remaining duration of each activity started and/or completed, and the amount of work to complete with an analysis of the relationship

between the remaining duration of the activity and the quantity of material to install over that given period of time with a citation of past productivity. The monthly schedule update shall include a progress narrative explaining progress, identifying progress made out of sequence, defining the Critical Path, identification of any potential delays, etc. The Project Schedule Narrative template will be required for the narrative.

The project schedule update layout shall be grouped by Project, then WBS. The layout shall include the following columns:

- a. Activity ID
- b. Activity Description
- c. Original Durations
- d. Remaining Durations
- e. Start and Finish Dates
- f. Baseline Start and Finish Dates
- g. Total Float
- h. Performance Percent Complete
- i. Display logic and target bars in the Gantt bar chart view

PROJECT SCHEDULE REVISIONS

If the Contractor desires to make major changes in the Project Schedule, the Contractor shall notify the City in writing and submit the proposed schedule revision. The written notification shall include the reason for the proposed revision, what the revision is comprised of, and how the revision was incorporated into the schedule. Major changes are hereby defined as those that may affect compliance with the contract requirements or those that change the critical path. All other changes may be accomplished through the monthly updating process without written notification.

TIME IMPACT ANALYSIS

The Contractor shall notify the City when an impact may justify an extension of contract time or adjustment of milestone dates. This notice shall be made in writing as soon as

possible, but no later than the end of the next estimate period after the commencement of an impact or the notice for a change is given to the Contractor. Not providing notice to the City within twenty (20) calendar days after receipt will indicate the Contractor's approval of the time charges as shown on that time statement. Future consideration of that statement will not be permitted and the Contractor forfeits his right to subsequently request a time extension or time suspension unless the circumstances are such that the Contractor could not reasonably have knowledge of the impact by the end of the next estimate period.

When changes are initiated or impacts are experienced, the Contractor shall submit to the City a written time impact analysis describing the influence of each change or impact. A "time impact analysis" is an evaluation of the effects of changes in the construction sequence, contract, plans, or site conditions on the Contractor's plan for constructing the project, as represented by the schedule. The purpose of the time impact analysis is to determine if the overall project has been delayed, and if necessary, to provide the Contractor and the City a basis for making adjustments to the contract.

A time impact analysis shall consist of one or all of the steps listed below:

1. Establish the status of the project before the impact using the most recent project schedule update prior to the impact occurrence.
2. Predict the effect of the impact on the most recent project schedule update prior to the impact occurrence. This requires estimating the duration of the impact and inserting the impact into the schedule update. Any other changes made to the schedule including modifications to the

calendars or constraints shall be noted.

3. Track the effects of the impact on the schedule during its occurrence. Note any changes in sequencing, and mitigation efforts.
4. Compare the status of the work prior to the impact (Step 1) to the prediction of the effect of the impact (Step 2), and to the status of the work during and after the effects of the impact are over (Step 3). Note that if an impact causes a lack of access to a portion of the project, the effects of the impact may extend to include a reasonable period for remobilization.

The time impact analysis shall be electronically submitted to the City. If the Project Schedule is revised after the submittal of a time impact analysis but prior to its approval, the Contractor shall promptly indicate in writing to the City the need for any modification to its time impact analysis. One (1) copy of each time impact analysis shall be submitted within fourteen (14) calendar days after the completion of an impact. The City may require Step 1 and Step 2 of the time impact analysis be submitted at the commencement of the impact, if needed to make a decision regarding the suspension of contract time. Approval or rejection of each time impact analysis by the City shall be made within fourteen (14) calendar days after receipt unless subsequent meetings and negotiations are necessary.

MEASUREMENT and PAYMENT

Project Schedule will not be measured or paid for directly, but shall be included in the unit price bid for the items of construction in which the operations occur.

PROJECT SCHEDULE NARRATIVE

PROJECT NAME:	
CONTRACTOR NAME:	
PERIOD ENDING:	
SUBMITTAL DATE:	
PREPARED BY:	

Evaluation Summary	
NTP:	
Data Date:	
Contractual Completion Date:	
Current Scheduled Completion Date:	
Previous Period Scheduled Completion Date:	
Contract Calendar Days:	

Yes	No	
		Contractor has included both a hard copy (pdf) and the native Primavera file format?
		Project calendars have been updated to reflect actual charged working days for the progress period, according to the contract time statement?
		Schedule update reflects approved change orders for the progress period?
		Have any major changes been made to the schedule? <i>(A major change is defined as those that may affect compliance with the contract requirements or those that change the critical path. If yes, written notification is required to include the reason for the proposed revision, what the revision is comprised of, and how the revision was incorporated into the schedule.)</i> If yes, provide details in Section 3 & 5 below.
		Are any delays included in this schedule submittal for which the Contractor intends to submit a Time Impact Analysis (TIA) for a claim delay? If yes, provide details in Section 6 below.

<p>1. Identify general progress for the update period.</p>
<p>2. Identify work performed out of sequence and provide an explanation for the reason.</p>

3. Describe any changes made to the project's logic and the reason for the change(s).
4. Identify any new constraints used and provide an explanation for their use.
5. Define the critical path of the project, including any changes from the previous update.
6. Identify any delays that have occurred for the progress period, the reason for the delay, and current status.
7. Identify any potential delays and possible mitigation efforts.
8. Other comments.

SECTION 16740 - VOICE AND DATA COMMUNICATION CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes wire, cable, connecting devices, installation, and testing for wiring systems to be used as signal pathways for voice and high-speed data transmission.

1.3 DEFINITIONS

- EMI: Electromagnetic interference.
- IDC: Insulation displacement connector.
- LAN: Local area network.
- PVC: Polyvinyl chloride.
- STP: Shielded twisted pair.
- UTP: Unshielded twisted pair.

1.4 SUBMITTALS

- A. Product Data: Include data on features, ratings, and performance for each component specified.
- B. Shop Drawings: Include dimensioned plan and elevation views of each individual component. Show equipment assemblies, method of field assembly, workspace requirements, and access for cable connections.
 - 1. System labeling schedules, including electronic copy of labeling schedules, as specified in Part 3, in software and format selected by Owner.
 - 2. Wiring diagrams. Show typical wiring schematics including the following:
 - a. Workstation outlets, jacks, and jack assemblies.
 - b. Patch cords.
 - c. Patch panels.
 - d. Fiber-optic boxes.
- C. Cable Administration Drawings: As specified in Part 3.
- D. Samples: For workstation outlets, jacks, jack assemblies, and faceplates for color selection and evaluation of technical features.

- E. Product Certificates: For each type of cable, connector, and terminal equipment, signed by product manufacturer.
- F. Qualification Data: For Installer and testing agency.
- G. Field quality-control test reports.
- H. Operation and Maintenance Data: For voice and data communication cabling to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: System installer shall have at least three years experience in the installation of fiber optic cables and terminations of the type, size, and ratings of the products to be installed.
- B. Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the testing indicated, that is a member company of the International Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
 - 1. Testing Agency's Field Supervisor: Person currently certified by the International Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
- C. Source Limitations: Obtain all products except twisted-pair and fiber-optic cables through one source from a single manufacturer.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- E. Comply with NFPA 70.

1.6 COORDINATION

- A. Coordinate layout and installation of voice and data communication cabling with Owner's telecommunications and LAN equipment suppliers. Coordinate service entrance arrangement with local exchange carrier.
 - 1. Meet jointly with telecommunications and LAN equipment suppliers, local exchange carrier representatives, and Owner to exchange information and agree on details of equipment arrangements and installation interfaces.
 - 2. Record agreements reached in meetings and distribute to other participants.
 - 3. Adjust arrangements and locations of distribution frames and cross-connect and patch panels in equipment rooms and wiring closets to accommodate and optimize arrangement and space requirements of telephone switch and LAN equipment.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fiber modem unit: One of each type for every 10 installed, but no fewer than one.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cable:
 - a. Almo Wire and Cable.
 - b. Lucent Technologies; Global Service Provider.
 - c. Superior Essex; Superior Telecommunications Inc.
 - 2. Terminal and Connector Components and Distribution Racks:
 - a. AMP Incorporated; a Tyco International Ltd. Company.
 - b. Hubbell Premise Wiring.
 - c. Leviton Telecom.
 - d. Lucent Technologies; Global Service Provider.

2.2 SYSTEM REQUIREMENTS

- A. General: Coordinate the features of materials and equipment so they form an integrated system. Match components and interconnections for optimum future performance.
- B. Expansion Capability: Unless otherwise indicated, provide spare fibers and conductor pairs in cables, positions in cross-connect and patch panels, and terminal strips to accommodate 20 percent future increase in active workstations.

2.3 MOUNTING ELEMENTS

- A. Backboards: 3/4-inch (19-mm), interior-grade, fire-retardant-treated plywood.
- B. Distribution Racks: Freestanding and wall-mounting, modular-steel units designed for telecommunications terminal support and coordinated with dimensions of units to be supported.
 - 1. Approximate Module Dimensions: 84 inches (2130 mm) high by 22 inches (560 mm) wide.
 - 2. Finish: Baked-polyester powder coat.

2.4 TWISTED-PAIR CABLES, CONNECTORS, AND TERMINAL EQUIPMENT

- A. Cables: Listed as complying with Category 5e of TIA/EIA-568-A.
- B. Conductors: Solid copper.
- C. UTP Cable: Comply with TIA/EIA-568-A. Four, thermoplastic-insulated, individually twisted pairs of conductors; No. 24 AWG, color-coded; enclosed in PVC jacket.
- D. STP Workstation Cable: Comply with TIA/EIA-568-A. Two, thermoplastic-insulated, individually twisted pairs of conductors; No. 22 AWG, color-coded, overall aluminum and polyester shield and No. 22 AWG, tinned-copper drain wire; enclosed in PVC jacket.
- E. UTP and STP Plenum Cable: Listed for use in air-handling spaces. Features are as specified for cables, conductors, UTP cable, and STP workstation cable except materials are modified as required for listing.
- F. UTP Cable Connecting Hardware: Comply with TIA/EIA-568-A. IDC type, using modules designed for punch-down caps or tools.
 - 1. IDC Terminal Block Modules: Integral with connector bodies, including plugs and jacks where indicated.
 - 2. IDC Connecting Hardware: Consistent throughout Project.
- G. STP Cable Connecting Hardware: Comply with TIA/EIA-568-A for connectors, plugs, and jack assemblies.
- H. Cross-Connect Panel: Modular array of IDC terminal blocks arranged to terminate building cables and permit interconnection between cables.
 - 1. Number of Terminals per Field: One for each conductor in assigned cables.
 - 2. Mounting: Backboard or rack.
- I. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.
 - 1. Number of Jacks per Field: One for each four-pair UTP cable or two-pair STP cable indicated and one for each four-pair conductor group of indicated cables, plus spares and blank positions adequate to satisfy specified expansion criteria.
 - 2. Mounting: Backboard or rack.
- J. Jacks and Jack Assemblies for UTP Cable: Modular, color-coded, RJ-45 receptacle units with integral IDC-type terminals. Use keyed jacks for data service.
- K. UTP Patch Cords: Four-pair cables in 48-inch (1200-mm) lengths, terminated with RJ-45 plug at each end. Use keyed plugs for data service.

- L. STP Patch Cords: Two-pair cables in 48-inch (1200-mm) lengths, terminated with STP plug connectors at both ends. Match-plug connectors with patch-panel connectors.
- M. Workstation Outlets: Dual jack-connector assemblies mounted in single or multigang faceplate.
 - 1. Faceplate: High-impact plastic; color as selected by Architect.
 - 2. Mounting: Flush, unless otherwise indicated.
 - 3. Legend: Factory labeled, top jack "Voice" and bottom jack "Data," by silk-screening or engraving.

2.5 FIBER-OPTIC CABLES, CONNECTORS, AND TERMINAL EQUIPMENT

- A. Multimode Cables: Factory fabricated, jacketed, low loss, glass type, fiber optic, multimode, graded index, operating at 850 and 1300 nm. All dielectric shall meet IBM 3044 Channel Extender and FDDI optical specifications.
 - 1. Workstation, Strands per Cable: Two.
 - 2. Backbone, Strands per Cable: 12, unless otherwise indicated.
 - 3. Dimensions: 62.5-micrometer core diameter; 125-micrometer cladding diameter.
 - 4. Maximum Attenuation: 3.40 dB/km at 850 nm; 1.00 dB/km at 1300 nm.
 - 5. Minimum Modal Bandwidth: 200 MHz/km at 850 nm; 500 MHz/km at 1300 nm.
 - 6. Operating Temperature Range: Minus 20 to plus 70 deg C.
- B. Multimode Outer Jackets: Provide specified product or approved equivalent for the following:
 - 1. Non-riser and non-plenum cables: polyethylene jacket, Lucent Technologies No. 3DNX-012-HXM.
 - 2. National Electrical Code (NEC) type OFNR riser cable: polyvinylchloride jacket or equivalent insulation to meet the 2004 NEC (Lucent Technologies No. LGBC-012D-LRX).
 - 3. NEC type OFNP plenum cable: fluorocopolymer jacket or equivalent insulation to meet the 2004 NEC (Lucent Technologies No. LGBC-012D-LPX).
- C. Singlemode Cables: Factory fabricated, jacketed, low loss, glass type, fiber optic, singlemode, operating at 1310 and 1550 nm. Fiber must comply with TIA/EIA 455 and IEC 793 test methods for required attributes. All fibers shall be color coded to facilitate individual fiber identification. Fiber will have D-LUX[®] coating or approved equivalent to ensure color retention, minimize microbending losses, and improve handling. The coating shall be mechanically strippable. All dielectric shall meet IBM 3044 Channel Extender and FDDI optical specifications.
 - 1. Workstation, Strands per Cable: Two.
 - 2. Backbone, Strands per Cable: 12, unless otherwise indicated.
 - 3. Dimensions: 8.3-micrometer core diameter; 125-micrometer cladding diameter.
 - 4. Maximum Attenuation: 0.40 dB/km at 1310 nm; 0.30 dB/km at 1550 nm.
 - 5. Operating Temperature Range: Minus 20 to plus 70 deg C.

- D. Singlemode Outer Jackets: Provide specified product or approved equivalent for the following:
 - 1. Non-riser and non-plenum cables: high-density polyethylene (HDPE) jacket, Lucent Technologies No. 4DNX-012-BXC.
 - 2. National Electrical Code (NEC) type OFNR riser cable: polyvinylchloride jacket or equivalent insulation to meet the 2004 NEC (Lucent Technologies No. LGBC-012D-SRX).
 - 3. NEC type OFNP plenum cable: fluorocopolymer jacket or equivalent insulation to meet the 2004 NEC (Lucent Technologies No. LGBC-012D-SPX).
- E. Cable Connectors: High-performance, rugged, compact ST couplers with precision ceramic tips and alignment mechanisms.
- F. Patch Panel: Modular panels housing multiple-numbered, cable connectors.
 - 1. Permanent Connection: Permanently connect one end of each connector module to installed cable fiber.
 - 2. Number of Connectors per Field: One for each fiber of cable or cables assigned to field, plus spares and blank positions adequate to satisfy specified expansion criteria.
 - 3. Mounting: Backboard or rack.
- G. Patch Cords: fiber cables in 36-inch (900-mm) lengths.
 - 1. Terminations: ST connectors arranged to mate with patch-panel connectors, one at each end of each fiber in cord.
- H. Workstation Outlets: Flush dual fiber-optic connector assemblies mounted in two-gang faceplate with flush dual RJ-45 jack assembly.
 - 1. Faceplate: High-impact plastic; color as selected by Architect.
 - 2. Mounting: Flush, unless otherwise indicated.
 - 3. Legend: Factory labeled, fiber-optic connectors "Data" and RJ-45 jacks "Voice," by engraving.

2.6 IDENTIFICATION PRODUCTS

- A. Comply with the following:
 - 1. Cable Labels: Self-adhesive vinyl or vinyl-cloth wraparound tape markers, machine printed with alphanumeric cable designations.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine pathway elements intended for cables. Check raceways, cable trays, and other elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATION OF MEDIA

- A. Backbone Cable for Data Service: Use fiber-optic cable for runs between equipment rooms and wiring closets and for runs between wiring closets.
- B. Backbone Cable for Voice Service: Use UTP Category 5 cable for runs between equipment rooms and wiring closets and for runs between wiring closets.
- C. Horizontal Cable for Data Service: Use STP Category 5 or fiber-optic cable for runs between wiring closets and workstation outlets.
- D. Horizontal Cable for Voice Service: Use UTP Category 5 cable for runs between wiring closets and workstation outlets.

3.3 INSTALLATION

- A. Wiring Method: Install wiring and optical fiber in raceway and cable tray except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Use UL-listed plenum cable in environmental air spaces, including plenum ceilings. Conceal raceway and cables except in unfinished spaces.
- B. Install cables using techniques, practices, and methods that are consistent with Category 5 rating of components and that ensure Category 5 performance of completed and linked signal paths, end to end.
- C. Fiber optic cable runs shall be continuous from building LIU to building LIU without splices. Maximum 0.2dB loss per connection will be allowed; however, the total transmission losses including cable and connectors shall not exceed 25 percent of the capability of the transceivers.
- D. Install cables without damaging conductors, shield, or jacket.
- E. Leave a minimum of 100 feet slack in each cable properly coiled and labeled in manholes located adjacent to buildings (manhole prior to entering facility). Leave a minimum of 25 feet slack in each cable coiled and labeled in all other manholes/pullboxes along the cable route.
- F. Do not bend cables, in handling or in installing, to smaller radii than minimums recommended by manufacturer.
- G. Perform cable-pulling calculations based on the actual field routing of the cables prior to installation. Demonstrate through the calculations that the cable pulling tension and sidewall pressure loading are within Manufacturer's limitations. Submit calculations for approval. Upon approval, the following requirements shall apply:
 - 1. Pull cables simultaneously if more than one is being installed in same raceway.
 - 2. Use pulling compound or lubricant if necessary. Use compounds that will not damage conductor or insulation.
 - 3. Use pulling means, including fish tape, cable, rope, and basket-weave wire or cable grips, that will not damage media or raceway.

- H. Install exposed cables parallel and perpendicular to surfaces or exposed structural members and follow surface contours where possible.
- I. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
- J. Wiring within Wiring Closets and Enclosures: Provide conductors of adequate length. Train conductors to terminal points with no excess. Use lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
- K. Separation of Wires: Comply with TIA/EIA-569-A rules for separating unshielded copper voice and data communication cabling from potential EMI sources, including electrical power lines and equipment.
- L. Make splices, taps, and terminations only at indicated outlets, terminals, and cross-connect and patch panels.
- M. Use splice and tap connectors compatible with media types.
- N. Provide fiber optic terminations made with “ST” style connectors; install in accordance with manufacturer’s instructions. Provide epoxy and polish type fiber connectors. Crimp and cleave terminations will not be accepted. Terminate all unused fibers with a connector to the LIU; neatly train and lace fiber optic cables within junction boxes and patch panels.
- O. Fiber optic patch panel configurations are dependent on project needs. Part numbers will vary according to the required fiber count. The following is a representative sample:
 - 1. 12 Position wall mount patch panel (LIU), Lucent Technologies 100A3 LIU complete with 2 coupling panels (10A) and 12 couplings (C3000A-2), or approved equivalent. Dimensions are 7.5"W x 8.75" H x 3"D.
- P. Fiber optic jumper cables shall be provided as required to run from the LIU to the equipment enclosures.

3.4 GROUNDING

- A. Ground cable shields, drain conductors, and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.
- B. Bond shields and drain conductors to ground at only one point in each circuit.
- C. Signal Ground Terminal: Locate in each equipment room and wiring closet; isolate from power system and equipment grounding.
- D. Signal Ground Bus: Mount on wall of main equipment room with standoff insulators.

- E. Signal Ground Backbone Cable: Extend from signal ground bus to signal ground terminal in each equipment room and wiring closet.

3.5 INSTALLATION IN EQUIPMENT ROOMS AND WIRING CLOSETS

- A. Install plywood backboards on walls of equipment rooms and wiring closets from floor to ceiling.
- B. Mount patch panels, terminal strips, and other connecting hardware on backboards, unless otherwise indicated.
- C. Group connecting hardware for cables into separate logical fields.
- D. Use patch panels to terminate cables entering the space, unless otherwise indicated.

3.6 INSTALLATION STANDARDS

- A. Comply with requirements in TIA/EIA-568-A and TIA/EIA-569-A.

3.7 IDENTIFICATION

- A. In addition to requirements in this Article comply with applicable requirements in TIA/EIA-606.
- B. System: Use a unique, three-syllable, alphanumeric designation for each cable, and label cable and jacks, connectors, and terminals to which it connects with same designation. Use logical and systematic designations for facility's architectural arrangement.
 - 1. First syllable identifies and locates equipment room or wiring closet where cables originate.
 - 2. Second syllable identifies and locates cross-connect- or patch-panel field in which cables terminate.
 - 3. Third syllable designates type of media (copper or fiber) and position occupied by cable pairs or fibers in field.
- C. Workstation: Label cables within outlet boxes.
- D. Distribution Racks and Frames: Label each unit and field within that unit.
- E. Within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.
- F. Cables, General: Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.

- G. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet (4.5 m).
- H. Cable Schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project, in software and format selected by Owner.
- I. Cable Administration Drawings: Show building floor plans with cable administration point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of TIA/EIA-606. Furnish electronic record of all drawings, in software and format selected by Owner.

3.8 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Operational Test: After installation of cables and connectors, demonstrate product capability and compliance with requirements. Test each signal path for end-to-end performance from each end of all pairs installed. Remove temporary connections when tests have been satisfactorily completed.
 - 2. Copper Cable Procedures: Inspect for physical damage and test each conductor signal path for continuity and shorts. Use Class 2, bidirectional, Category 5 tester. Test for faulty connectors, splices, and terminations. Test according to TIA/EIA-TSB67, "Transmission Performance Specifications for Field Testing of Unshielded Twisted-Pair Cabling Systems." Link performance for UTP cables must meet minimum criteria of TIA/EIA-568-A.
 - 3. Fiber-Optic Cable Procedures: Perform each visual and mechanical inspection and electrical test, including optional procedures, stated in NETA ATS, Section 7.25. Certify compliance with test parameters and manufacturer's written recommendations. Test optical performance with optical power meter capable of generating light at all appropriate wavelengths.
- B. Remove malfunctioning units, replace with new units, and retest as specified above.

3.9 CABLE TESTING PROCEDURES

- A. Provide all labor, tools, and equipment necessary to perform the fiber optic cable tests. Provide 72 hours prior notice of testing to the Airfield Electrical Department through the Owner's Authorized Representative (OAR) for fiber optic cable. Conduct tests in the presence of the OAR and Airfield Electrical Department personnel, as appropriate. Provide written test results.

- B. Test fiber optic cables using an Optical Time Domain Reflectometer (OTDR). Coordinate with the OAR to test existing cables between the nearest termination point prior to cutting cable in order to document existing cable condition. Test single mode cables at both 1310 nm and 1550 nm by OTDR on the cable spools prior to installation at the job site, and test multi-mode cables at both 850 and 1300 nm. Reject and replace cables having attenuation at wavelength greater than factory specifications.

- C. Test fiber optic cables by OTDR after installation and termination. Reject and replace cables having attenuation at wavelength greater than maximum factory specifications or having a localized discontinuity in excess of 0.2dB.

- D. Fiber optic cable testing with an OTDR shall be performed as follows:
 - 1. The Contractor shall test all light guide cable prior to the installation of the cable. The Contractor shall assume all liability for the replacement of the cable should it be found defective at a later date.

 - 2. All fiber testing shall be performed on all fibers in the completed end to end system. Testing shall consist of a bidirectional end to end OTDR trace performed per TIA/EIA 455-61. The system loss measurements shall be provided at 1310 and 1550 nanometers for single mode fibers.

 - 3. Fiber links shall have a maximum loss of: $(\text{allowable cable loss per km})(\text{km of fiber in link}) + (.4\text{dB})(\text{number of connectors}) = \text{maximum allowable loss}$

 - 4. Loss numbers for the installed link shall be calculated by taking the sum of the bidirectional measurements and dividing that sum by two.

 - 5. Any link not meeting the requirements of the standard shall be brought into compliance by the Contractor, at no charge to the MSCAA.

3.10 DOCUMENTATION

Documentation shall be provided in both hard copy and CD-ROM to the OAR.

3.11 DEMONSTRATION

Train Owner's maintenance personnel in cable-plant management operations, including changing signal pathways for different workstations, rerouting signals in failed cables, and extending wiring to establish new workstation outlets. Refer to Section 16890, Article 3.5.

END OF SECTION 16740

SECTION 16890 - AIRFIELD LIGHTING CONTROL AND MONITORING SYSTEM

PART 1 – GENERAL

1.1 SUMMARY

- A. Design, develop, fabricate, and install all hardware, software, and equipment to provide control and monitoring of airfield lighting and signage and associated equipment to form a complete type L-890CB Airfield Lighting Control and Monitoring System (ALCMS). The L-890CB ALCMS shall be approved under the FAA Airport Lighting Equipment Certification Program described in FAA Advisory Circular (AC) 150/5345-53, Appendices 3 and 4 of the current Addendum.

1.2 SECTION INCLUDES

- A. Complete, functional, and integrated Airfield Lighting Control and Monitoring System.
- B. Computers, monitors, printers; associated hardware.
- C. Uninterruptible power supplies.
- D. Equipment and software.
- E. Operator training, warranty, maintenance, and spare parts.
- F. Testing.

1.3 RELATED SECTIONS

- A. Section 16740-VOICE AND DATA COMMUNICATION CABLING.

1.4 REFERENCES

- A. FAA Advisory Circular 150/5345-56B, Specification for L-890 Airport Lighting Control and Monitoring System (ALCMS).
- B. Electronics Industries Alliance (EIA) TIA-455-59-Measurement of Fiber Point Defects Using an OTDR.
- C. National Fire Protection Association (NFPA) NFPA 70-National Electrical Code.
- D. National Electrical Manufacturers Association (NEMA) Standard 250-Enclosures for Electrical Equipment (1000 Volts Maximum).
- E. National Electrical Manufacturers Association (NEMA) ICS 1-Industrial Control and Systems General Requirements.
- F. Underwriters Laboratories, Inc. (UL).

1.5 DEFINITIONS

- A. In addition to the definitions listed in Section 10 of the General Provisions, the following words and abbreviations have particular meaning and relevance to the work of this Section:

AC	Alternating Current
ALCMS	Airfield Lighting Control and Monitoring System
ATCT	Air Traffic Control Tower
Button	Graphical computer interface screen button
CCR	Constant Current Regulator
CRT	Cathode Ray Tube
FAA	Federal Aviation Administration
GB	Giga-byte
GUI	Graphic User Interface
HVAC	Heating, Ventilating, and Air Conditioning
IRMS	Insulation Resistance Monitoring System
LAHSO	Land and Hold Short Operations
LED	Light Emitting Diode
MB	Mega-byte
NEC	National Electrical Code
OEM	Original Equipment Manufacturer
OTDR	Optical Time Domain Reflectometer
Owner	City of San Antonio Aviation Department
Page	Graphical computer interface screen
PC	Personal Computer
PLC	Programmable Logic Controller
RMS	Root Mean Square
SAW	Surface Acoustic Wave

UL	Underwriters Laboratories, Inc.
UPS	Uninterruptible Power Supply
User	FAA ATCT operators
user	Owner (City) operators (Operation and Maintenance personnel)

1.6 SYSTEM DESCRIPTION

- A. Provide a complete, functional, and integrated L-890CB Airfield Lighting Control and Monitoring System that includes the equipment and software necessary to accomplish the objectives outlined in this Section.
- B. The ALCMS shall, at a minimum, consist of four (4) computers and associated hardware and software networked via dedicated fiber optic cables for primary and redundant communications. One computer each shall be located in the ATCT, East Vault, West Vault and Maintenance. One additional roaming wireless laptop computer for Maintenance shall also be provided. See Figure 1, ALCMS Communications Block Diagram provided at the end of this Section.
- C. Integral to the ALCMS shall be an Insulation Resistance Monitoring System (IRMS) which will allow Maintenance to automatically or manually monitor, record, and report the insulation resistance of each airfield lighting series circuit.
- D. All components of the delivered system shall be compatible with one another allowing transfer of data while providing ease of use and exchange of information among the various components.
- E. This Section describes the system requirements. The intention is to provide information and requirements concerning the types of equipment and software that must be included in any proposed configuration. Drawings, diagrams, tables, and figures included at the end of this Section are representative of the intent and do not necessarily reflect the final ALCMS configuration. Provide hardware and software that will maximize accuracy, quality, speed and flexibility. Include additional or alternative equipment to meet these objectives. Provide any additional features that will improve efficiency, reliability, and functionality of the system.

System Features:

1. Summary of Features:

- a. The ALCMS shall include, but shall not be limited to, the following features:
 - 1) Control and monitoring of both East and West airfield electrical vaults and their associated equipment and systems.
 - 2) Touch screen control for monitors located in the ATCT.
 - 3) Preset Page: Provide control and monitoring of the airfield lighting systems through utilizing a selected aircraft arrival/departure flow (direction) and a selected daytime and nighttime visibilities to configure the airfield lighting systems and intensity. Provide future button configuration for Land and Hold Short Operations

- (LAHSO) control and monitoring. Display the airfield pavement configuration, description, and lighting status. Display the system date and time. See Figure 2 at end of this Section.
- 4) Runway and Taxiway Lighting Pages: Provide individual control and monitoring of runway and taxiway lighting as defined in this Section. These pages shall enable the User to adjust the airfield lighting brightness levels independently of the predefined visibility criteria provided on the Preset Page. See Figures 3 and 4 at end of this Section.
 - 5) Utility Page, see Figure 5: Provide utilities for the local machine interface including Tutorial/Help pages as well as Maintenance access to all of the maintenance utilities including but not limited to the following pages:
 - a) Vault Pages for the East and West airfield electrical vaults that provide status and control for the associated systems and circuits in each vault including IRMS. See Figures 6 and 7 at the end of this Section.
 - b) Circuit Graphical Query that lists all circuits individually by vault to enable a graphical representation of the associated selected circuit lights on a localized Query Map page. See Figure 8 at the end of this Section.
 - c) History Page that includes event and command logging, report generation, display, and printing.
- b. Provide the ALCMS with expansion capabilities to facilitate the future items addressed in this Section and to provide the user with the ability to implement the future requirements as needed. Address in detail the alterability of the ALCMS beyond the future items, by the user or manufacturer, to accommodate changes in the airfield lighting systems, such as circuit and regulator additions, deletions, and/or reconfiguration, including all associated hardware and software requirements.
 - c. Provide the total system with intrinsic failsafe capabilities for both hardware and software. Ensure the proper operation of runway, taxiway, and other lighting systems in the event of a failure of the ALCMS, failure of any component, or removal of any component, such as a computer being temporarily removed from service for maintenance purposes. The primary operation of the failsafe system shall be to retain the current state of the lighting systems based on the last entered command for each system. It shall also be capable of activating pre-selected equipment to preset states of operation. The preset features shall be user definable and adjustable; it shall also be adjustable from the Maintenance computer.
2. Feature Details:
- a. The following are more detailed descriptions of the required system features listed above:
 - 1) Provide control, monitoring, and communications equipment at the East and West Vaults including hardware and software, uninterruptible power supply systems, IRMS, and fiber optic cables installed between the ATCT and the East and West Vaults through

duct banks, and from Maintenance to the West Vault via aerial fiber optic cables. See figure 17.

- 2) Provide the ALCMS graphics, text, command sequences, monitoring and alarm functions associated with the Vaults.
- 3) The East Vault is planned for the following equipment:

Description	Existing Quantity	Future Est. Additions	Proposed Additions	Total Est. Quantity
L-828 Constant Current Regulators	10	8	0	18
L-828 CCR (Spare)	0	2	0	2
L-847 Circuit Selector Switch	0	0	0	0
Airfield Lighting Circuits	10	8	0	18
Sources of Commercial Power (480V, 3 Phase)	1	0	0	1
300KW, 480 Volt Standby Generator	1	0	0	1
480V Automatic Transfer Switch (ATS)	1	0	0	1
Insulation Resistance Monitoring System	0	0	1	1

Table 1: East Vault Existing and Future Equipment

- 4) The West Vault is planned for the following equipment:

Description	Existing Quantity	Future Est. Additions	Proposed Additions	Total Est. Quantity
L-828 Constant Current Regulators	20	5	0	25
L-828 CCR (Spare)	0	1	0	1
L-847 Circuit Selector Switch	0	0	0	0
L-884 Land and Hold Short Operation	0	1	0	1
Airport Rotating Beacon	1	0	0	1
Airfield Lighting Circuits	18	6	0	24
Sources of Commercial Power (480V, 3 Phase)	1	0	0	1
250KW, 480 Volt Standby Generator	1	0	0	1
480V Automatic Transfer Switch (ATS)	1	0	0	1
Insulation Resistance Monitoring System	0	0	1	1

Table 2: West Vault Existing and Future Equipment

- 5) Provide ALCMS equipment enclosures for the East and West Vaults that will accommodate the total estimated expansion of the lighting systems shown in Tables 1 and 2 above. Size uninterruptible power supplies to accommodate this expansion.
- 6) The East and West Vaults both have unfiltered ventilation systems consisting of screened louvers and exhaust fans set to operate above approximately 80 degrees Fahrenheit. The vault ALCMS computer/monitor enclosures shall be air conditioned and filtered to prolong the life of the enclosed electronics. The remaining ALCMS equipment shall be designed with adequate ventilation/filtration to correctly operate within the existing vault environment.
 - b. Provide touch-screen control for monitors located in the ATCT. Utilize surface acoustic wave (SAW) technology, or approved equivalent, to provide x and y grid coordinates of the monitor screen. All lighting

system command sequences shall require a minimum of two button commands to prevent an unintentional touch of the screen from executing a lighting command. Utilize color graphics and text to identify and guide command sequence selection and to depict current commanded states.

- c. The Preset control page shall consist of the button arrangements as shown in Figure 2 at the end of this Section. The following is a brief description of the button groups starting at the top left corner of the page and proceeding across and down the page:
 - 1) Across the top of the page shall be a row of buttons used to navigate to other available pages within the ALCMS and to control and monitor the beacon, East and West Vault emergency standby generators, and a button for future LAHSO control and monitoring. In addition, a Help/Tutorial Button shall be provided on the far right of the page. Not all of these buttons shall be visible at each node. See Table 8, for Node Control Default Restrictions at end of this Section for additional information.
 - 2) The next five buttons grouped together under the heading “Runway Selection,” shall be used to select an aircraft arrival/departure flow (direction). Selecting a particular runway end designation shall configure the airfield lighting to a predetermined state regarding which lighting circuits are turned on and which ones are turned off. Selecting one of these five buttons shall initiate a command sequence that must be followed by a Day/Night selection, a visibility selection, and then the “Confirm” button to execute the command. See Table 9 at end of this Section for individual button detail.
 - 3) The next group of five buttons under the heading “Visibility Setting” shall be used to select a default visibility that will configure the airfield lighting system intensities to predetermined values for the visibility selected. The visibility selection must be preceded by selection of the Day or Night button and followed by the “Confirm” button to execute the command. See Tables 10 and 11 at end of this Section for individual button detail.
 - 4) The next two buttons (“Confirm” and “Reject”) shall be used to either confirm (execute) command sequences or reject (cancel) command sequences.
 - 5) Located below the five “Runway Selection” buttons are the “Day/Night Setting” buttons that are used to select day or night operations following the “Runway Selection” and prior to selecting the “Visibility Setting” of the command sequence.
 - 6) Located on the right, adjacent the Runway 30L threshold, is a “30L DEP” (30L Departure) button that is used to activate the LAHSO light on Runway 4 at the holding position for Runway 30L. This button also activates circuit G-CL-3 centerline lights that illuminate Taxiway G centerline from Taxiway N and lead onto Runway 4 to the LAHSO light bar holding position. This button energizes the lighting described above to delineate the taxi path and holding position for aircraft departing Runway 30L (full length).

- 7) The remaining two buttons at the bottom of the Page are used to display alarm indications and silence the Alarm. These buttons shall not be visible unless a hard alarm condition exists. Upon receiving a hard alarm condition, the “Alarm Display” button and “Alarm Silence” button shall appear (flashing in red color) on all node preset pages and an audible alert shall be heard in the tower cab. ATCT personnel must select the “Display Alarm” button to view the alarm status and/or select the “Silence Alarm” button to silence and acknowledge the alarm condition. Upon acknowledging a hard alarm condition, the associated alarm button shall stop flashing and remain displayed in red until the condition is resolved.
- d. The ALCMS Preset Page shall graphically depict the airfield pavement and lighting system status as shown in Figures 9 through 14 at the end of this Section. The page shall have a black background with pavement configurations displayed in a light gray color. Runway end designations, taxiway designations, terminal area, and the location of the ATCT shall be identified with white text. Airfield lighting systems, when turned on, shall be depicted with their respective symbols and colors. If a hard alarm condition exists, the associated color graphic symbol shall flash until the alarm condition is resolved.
 - e. The Runway Lighting Page shall consist of the button arrangements shown on Figure 3 at the end of this Section. This page shall enable control of the specified lighting systems independent of the predefined runway flow and visibility command sequences of the Preset control page. Upon changing any lighting level from a predefined runway flow and visibility, the last commanded flow and visibility button shall change color or character in a manner to indicate that the default lighting levels have been adjusted from the last commanded predefined state. The following briefly describes the function of each button group starting at the top left corner of the page just below the first row of buttons previously described.
 - 1) The first group of eight buttons under the heading “Runways” shall be divided into rows by runway. These buttons shall enable runway lighting levels to be controlled individually by runway lighting system (edge, centerline, touchdown zone). Individual runway lighting system brightness levels shall be displayed on the lower half of each associated button. See Table 12 at end of this Section for individual button detail.
 - 2) Below the group of Runway buttons is a row of six buttons used to select the lighting brightness level (off through step 5) for the runway(s) selected.
 - 3) To the right of the group of Runway buttons are the “Confirm” and “Reject” buttons previously described.
 - 4) Below the row of six lighting level brightness buttons are two buttons under the heading “Runway Master”. These buttons each have an arrow, one pointing up and the other pointing down used to step all runway lighting systems up or down from the current brightness levels, respectively. Upon changing any lighting level from a predefined flow and visibility based on the Preset Page, the last

- commanded flow and visibility button shall change color or character in a manner to indicate that the default lighting levels have been adjusted from the last commanded predefined state.
- 5) The remaining two buttons at the bottom of the Page are used to display alarm indications and silence the Alarm as previously described.
- f. The Taxiway Lighting Page shall consist of the button arrangements shown on Figure 4 at the end of this Section. This page shall enable control of the specified taxiway lighting systems independent of the predefined taxiway lighting levels associated with the runway flow and visibility command sequences of the Preset control page. See Table 13 at the end of this section for button detail. Similar to the Runway lighting Page, the Taxiway Lighting Page consists of a group of individual taxiway lighting systems under the heading "Taxiways", followed by a row of lighting brightness level buttons, with the "Taxiway Master" brightness control buttons and the "Confirm" and "Reject" buttons as described before.
- g. The Utility Page consists of the button arrangements as shown in Figure 5 at the end of this Section. The following is a brief description of the button groups starting at the top left corner of the page and proceeding across and down the page:
- 1) Across the top of the page shall be a row of buttons used to navigate to other available pages within the ALCMS and a button to exist to the main menu.
 - 2) The next group of eight buttons under the heading "Utilities" is specific to the local machine and GUI. These buttons are generally self-explanatory with addition detail provided under Advisory Circular 150/5345-56B shown in the references of this section.
 - 3) The next group of five buttons under the heading "Maintenance" is only visible on the Vault, Maintenance, and Roaming Laptop computers. These buttons are additional navigation buttons to go to the associated maintenance utilities as described in the following sections.
- h. The Vault pages shall graphically depict constant current regulators (CCR's) as box/rectangle icons arranged on the screen in a manner that represents the actual CCR layout in each vault. See Figures 6 and 7 at the end of this Section for the East and West Vault pages, respectively. Each CCR icon shall include the CCR number, name (existing or future expansion), and shall depict via text and color graphics the last commanded brightness level, powered or unpowered status, local/remote status, lockout status, and alarm status. The Vault Page shall also include the current date, time, total CCR load for the vault based on energized CCR's and their measured loads and total Vault load based on current transformer (CT) and power transformer (PT) readings from the load side of the transfer switch.
- 1) Selecting a particular CCR from the associated vault page shall execute a "CCR Detail" pop-up window (see Figures 6 and 7 at end of this Section) that provides the following detail information on each CCR selected:

- a) Number/Name;
 - b) Size (KW);
 - c) Available (Max) brightness steps;
 - d) Commanded brightness level (Step);
 - e) Output voltage, current, and volt-amperes;
 - f) Last megger reading;
 - g) Calibration voltage setting
 - h) Status via color/graphics/and text for the various CCR conditions (powered/unpowered, local/remote, lockout and alarm status).
 - i) Provide a separate status window/page to depict the status of all remaining system variables not presently depicted on other screens including, but not limited to, the following:
 - ATS Load phase voltages (A-B, B-C, and C-A);
 - ATS Load phase currents (A-B, B-C, and C-A);
 - Transfer switch position (commercial or emergency).
- 2) Selecting the IRMS button on the vault page will open the insulation resistance monitoring system which shall include the following minimum requirements:
- a) Fully integrated with the ALCMS to allow manual testing and last megohm reading from a CCR detail window in addition to all features available from the IRMS page.
 - b) Automatically and manually monitor, record, and report the insulation resistance of each airfield lighting series circuit.
 - c) Testing of airfield lighting circuits that are energized or de-energized.
 - d) Provide a database for recording and displaying data both numerically and graphically to depict trends for preventative maintenance scheduling.
 - e) Provide Maintenance warning and alarm conditions that are user definable IRMS values to assist maintenance with preventative maintenance scheduling.
 - f) The IRMS shall include self-diagnostics and calibrations to assure proper readings are taken.
- i. The Circuit Query Page shall provide Maintenance with a means to graphically visualize individual airfield lighting circuits selected from the Circuit Query page. The Circuit Query page shall contain all of the airfield lighting circuits arranged by vault. The Circuit Query page shall enable Maintenance to query circuits and determine visually which operational surfaces are impacted when circuit maintenance or troubleshooting must be performed on a individual or group of circuits selected. The function of these pages shall not affect the control or monitoring of the ALCMS, and the display shall be localized. See Figure 8 at the end of this Section.
- j. The Alarm page shall consist of a row of buttons across the top of the page and a tabular listing of alarms down the page. The buttons shall enable a variety of sorting and acknowledgment functions to be performed on the alarm list. An alarm shall remain displayed on the Alarm page until it has been acknowledged from the Alarm page and the alarm condition has been resolved. Alarms shall be logged by date and

time with a brief description of the alarm, the node at which the alarm occurred, the type of alarm (Hard or Soft), and the alarm tag identification number. Hard alarms shall also include the date and time that corresponds to when a Hard alarm was acknowledged by the ATCT. The alarm text list shall be color and font enhanced to help the user quickly identify the difference between Hard and Soft alarms and between acknowledged and unacknowledged alarms. Reference FAA Advisory Circular 150/5345-56B for additional requirements.

- k. The ALCMS graphical touchscreen and mouse-driven interface shall include a tutorial/help section that can be accessed from any of the display screens. Provide a command-sequencing tutorial with a table of contents enabling direct access to a particular section. Provide the capability to either (1) page up or down through the entire tutorial/help section or (2) escape at any point to return to the tutorial/help index where another escape will return to the graphics page from which the tutorial/help section was entered. Selecting the Help button from a particular page shall directly access help that is related to the page from which the Help button was selected.
 - 1) The tutorial/help section shall be well organized to first address the common command sequences and then to provide more detailed information.
 - l. The History button shall provide Maintenance with the capability to access and print any event or group of events in the history log file via a “filtering process.” The total system shall have powerful and flexible database management, analysis, and report generating capabilities that allow integration of data from all sources. The current status of all lighting systems shall also be displayed from a predefined report. The status display shall show the current status of all runway and taxiway lighting systems control or monitored by the ALCMS and other related systems. Include detailed information of status displays, database management, analysis, and report generation.
3. Alarms
- a. All ALCMS alarms (faults) shall be divided into two categories: hard and soft. A hard alarm is more severe than a soft alarm and shall be reported to all ALCMS nodes. Hard alarms shall also trigger an audible alert in the ATCT until the alarm condition has been acknowledged. A soft alarm shall be displayed only on the alarm page of the Maintenance and Vault nodes. CCR alarms shall be prioritized to prevent listing of down stream alarms. An example would be a CCR unpowered alarm, which would be first on the priority list because it would generate all of the down stream CCR alarms (current soft, current hard, and voltage).
 - b. Provide the following alarm functions:
 - 1) CCR Current Alarms
 - a) Table 1 of AC 150/5345-10F, Output Current (Amperes RMS), provides the allowable range of current for constant current regulators (CCR’s) at various steps. From this data the percentage of current above and below the nominal current can be determined as shown below:

CCR Step	Nominal Current	Allowable Range		Percent	
		Below	Above	Below	Above
6.6A, 3 Step CCR					
1	4.8	4.66	4.94	3.0	3.0
2	5.5	5.33	5.67	3.0	3.0
3	6.6	6.40	6.70	3.0	1.5
6.6A, 5 Step CCR					
1	2.8	2.72	2.88	3.0	3.0
2	3.4	3.30	3.50	3.0	3.0
3	4.1	3.98	4.22	3.0	3.0
4	5.2	5.04	5.36	3.0	3.0
5	6.6	6.40	6.70	3.0	1.5
20A, 5 Step CCR					
1	8.5	8.25	8.76	3.0	3.0
2	10.3	9.99	10.61	3.0	3.0
3	12.4	12.03	12.77	3.0	3.0
4	15.8	15.33	16.27	3.0	3.0
5	20.0	19.40	20.30	3.0	1.5

Table 3: CCR Allowable Current Ranges at Each Step Intensity

b) With this information the hard and soft CCR output current alarms can be defined either as a percentage of the nominal current for each step or as a specific value. In either event, the user shall be able to dynamically adjust the soft and hard alarm threshold values from the Maintenance Computer. Initially, the CCR current alarm thresholds shall be set to the following values to avoid nuisance alarms during testing:

CCR Step	Nominal Current	Soft Alarm		Soft Alarm		Hard Alarm		Hard Alarm	
		Low Value	Threshold %	High Value	Threshold %	Low Value	Threshold %	High Value	Threshold %
1	4.8	4.66	3.00%	4.94	3.00%	4.32	10.00%	5.28	10.00%
2	5.5	5.34	3.00%	5.67	3.00%	4.95	10.00%	6.05	10.00%
3	6.6	6.40	3.00%	6.70	1.50%	5.94	10.00%	6.80	3.00%

Table 4: Hard and Soft Current Alarm Thresholds for Three Step, 6.6A CCR's

CCR Step	Nominal Current	Soft Alarm		Soft Alarm		Hard Alarm		Hard Alarm	
		Low Value	Threshold %	High Value	Threshold %	Low Value	Threshold %	High Value	Threshold %
1	2.8	2.72	3.00%	2.88	3.00%	2.52	10.00%	3.08	10.00%
2	3.4	3.30	3.00%	3.50	3.00%	3.06	10.00%	3.74	10.00%
3	4.1	3.98	3.00%	4.22	3.00%	3.69	10.00%	4.51	10.00%
4	5.2	5.04	3.00%	5.36	3.00%	4.68	10.00%	5.72	10.00%
5	6.6	6.40	3.00%	6.70	1.50%	5.94	10.00%	6.80	3.00%

Table 5: Hard and Soft Current Alarm Thresholds for Five Step, 6.6A CCR's

CCR Step	Nominal Current	Soft Alarm		Soft Alarm		Hard Alarm		Hard Alarm	
		Low Value	Threshold %	High Value	Threshold %	Low Value	Threshold %	High Value	Threshold %
1	8.50	8.24	3.00%	8.76	3.00%	7.65	10.00%	9.35	10.00%
2	10.30	9.99	3.00%	10.61	3.00%	9.27	10.00%	11.33	10.00%
3	12.40	12.03	3.00%	12.77	3.00%	11.16	10.00%	13.64	10.00%
4	15.80	15.33	3.00%	16.27	3.00%	14.22	10.00%	17.38	10.00%
5	20.00	19.40	3.00%	20.30	1.50%	18.00	10.00%	20.60	3.00%

Table 6: Hard and Soft Current Alarm Thresholds for Five Step, 20A CCR's

- c) Note that the high current threshold at the 100% setting on each CCR requires a smaller tolerance to avoid exceeding the maximum rated current that could trigger the CCR's internal overcurrent protection, thus shutting down the CCR.
 - d) A soft current alarm shall be generated for a particular circuit configuration if the associated CCR output current migrates above or below the high and low soft current alarm threshold values or percentages, respectively, as defined above. Similarly, a hard current alarm shall be generated for a particular circuit configuration if the associated CCR output current migrates above or below the high and low hard current alarm threshold values or percentages, respectively, as defined above.
 - e) To avoid nuisance current alarms, the ALCMS shall wait a specified amount of time (user definable) before testing for a CCR output current alarm condition. This shall allow the CCR and associated airfield circuit(s) to stabilize and avoid the generation of nuisance alarms that can be associated with CCR stabilization. Once a CCR output current alarm condition exists, it shall not be cleared until the current remains within the normal operating range for at least 1 minute (user definable). Delaying the clearing of a CCR output current alarm condition will reduce the amount of alarm events logged to the system which can greatly task the system if a value is right on the alarm threshold value and thus oscillates rapidly in and out of alarm.
 - f) Calibrate the output current for each brightness step of each constant current regulator to facilitate the reduction of nuisance alarms.
- 2) CCR Voltage Alarms
- a) CCR output voltage varies as required to maintain a nominal output current. As environmental conditions change, the circuit load can vary due to current leakage and the conductivity of conductors, etc. If the voltage changes by a large percentage, it is likely that some damage has occurred or several lamp outages have occurred provided load has not been physically added or removed from the circuit.
 - b) Circuit voltage alarms are defined as soft alarms.
 - c) A soft alarm shall be generated if the voltage of a given circuit and step deviates by a global user-definable percentage as shown below:

Description	user input
Circuit Voltage Variation Threshold Set point	± 30.0%

Table 7: Voltage Soft Alarm Threshold for All CCR’s

- d) Similar to CCR output current alarm, circuit voltage alarms shall have two user-definable delay time variables. One shall allow CCR stabilization prior to testing for a circuit voltage alarm condition. Another shall prevent clearing a circuit voltage alarm condition until it remains out of the alarm condition for a defined amount of time.
 - e) On a circuit by circuit basis, the user shall be able to execute a command (see Figures 6 and 7 at the end of this Section) which shall set (calibrate) the nominal voltage of a particular circuit and brightness step to correspond to the voltage present at the time of execution.
 - f) The ALCMS shall compare the present CCR voltage to the last set nominal voltage based on the circuit configuration and step intensity of each CCR. Nominal voltage values shall be stored for each possible circuit configuration on each CCR at each step intensity. To avoid generating a voltage alarm during the initial circuit energizing/stabilization period, the ALCMS shall only compare voltage values in 15 minute increments (user-definable variable) beginning after the first incremental period from CCR activation.
 - g) When adding or removing components intentionally changes a circuit load, the nominal voltage values for each step intensity will require updating (calibrating) as described previously. Provide the capability to update the nominal voltage values over a period of time to compensate for circuit degradation prior to scheduled maintenance activities.
 - h) It is noted that voltage or volt-ampere variations cannot reliably predict a percentage of lamps out when circuits contain loads that vary from 45W to 1000W or greater. Periodic visual inspections are still required to operate under certain visibility minimums.
- 3) Constant Current Regulator (CCR) Alarm
- a) All CCR’s shall be monitored for primary power status (powered or unpowered). Turning off primary power to a CCR shall not generate an alarm if the CCR is in an “off” state (no brightness level commanded). A hard alarm shall be generated if a circuit(s) associated with an unpowered CCR is issued a command other than “off.” A hard alarm shall also be generated if primary power is removed from a CCR while the CCR is operating at any brightness level other than “off” (0).
 - b) All CCR’s shall be monitored for local/remote status. A soft alarm shall be generated if a regulator is set to a local step. The local/remote status shall be displayed on the Vault pages for each CCR.

- 4) Generator Alarm/Status
 - a) Both the East and West Vault emergency generators shall be monitored. Monitoring shall include phase-to-phase voltage monitoring (phases A-B, B-C, and C-A) for each generator. Generator running status shall be determined from the phase-to-phase voltage levels reaching a nominal value that is user definable per generator. A generator alarm shall be produced if after a preset (user definable) time the generator phase-to-phase voltages do not reach the nominal values following a command to start the generator from the transfer switch or from the ALCMS. A generator alarm shall also be produced if the generator phase-to-phase voltages drop below the nominal values for more than a specified (user definable) time.
 - b) To accomplish emergency power monitoring, power transformers (PT's) shall be added to the emergency generator feeds. The Contractor shall coordinate with Maintenance and the ALCMS manufacturer for optimum location and turns ratio required. A separate enclosure shall be provided. Contractor is responsible for all incidentals to achieve the required monitoring.
- 5) Automatic Transfer Switch (ATS) Status
 - a) Both the East and West Vault automatic transfer switches shall be monitored for position. The indicated value shall be either commercial power or emergency generator power depending on the transfer switch position. Contractor shall coordinate with ATS manufacturer. Dry contacts or additional hardware may have to be added to establish monitoring points. Contractor is responsible for all incidentals to achieve the required monitoring.
 - b) Additionally, the ATS RMS phase current monitoring (phases A, B, and C) shall be monitored by adding current transformers (CT's) to the load side of the switch. The Contractor shall coordinate with Maintenance and the ALCMS manufacturer for optimum location. A separate enclosure shall be provided. Contractor is responsible for all necessary incidentals to achieve the required monitoring.
 - c) The ALCMS shall utilize the ATS position status, emergency and commercial PT values, and the ATS load side CT values to provide the total vault load data described for the vault pages.
4. Event Logging (History)
 - a. All changes in state and user input commands shall be recorded and logged in the order of occurrence by date and time.
5. Node Control Restrictions
 - a. Provide all nodes of the ALCMS, via user-definable passwords, with full access and control of all ALCMS features. The following table depicts the default configurations of each node:

ALCMS Pages	ATCT	MAINTENANCE	VAULTS
Preset	1	2	2
Runway Lighting	1	2	2
Taxiway Lighting	1	2	2
Utility	3	1	1
West Vault	4	1	1
East Vault	4	1	1
Circuit Query	4	1	1
Alarms	4	1	1
History	4	1	1
Circuit Megging	4	1	1
1 = Unrestricted 2 = Restricted, Accessible, Control Authorization Required 3 = Partial Accessibility (Maintenance buttons hidden) 4 = Restricted, Not Accessible			

Table 8: Node Control Default Restrictions

- b. The “Control Auth” button on the Utility page shall cue a password pop-up window. The password window shall prompt for a password and, upon entering the correct password, the window shall prompt to ENABLE or DISABLE full functionality of that node, or CHANGE PASSWORD. Disabling shall return the node to the originally designed functionality. Passwords shall be specific to computer nodes. Maintenance shall have capability to require a master password to allow unlimited remote access for software updates and modifications.

1.7 SUBMITTALS

- A. Submit under provisions of Section 8 of the Special Conditions, shop drawings, product data, and samples providing 10 copies of each submittal package.
- B. Schedules: Submit and update monthly to reflect progress and weekly activities accomplished and proposed. Include in the schedules preliminary hardware and software designs along with equipment submittals, shop drawings, and computer screen configurations.
- C. Submit the preliminary hardware and software designs for formal review 35, 65, and 95 percent completion and reflect the timing of the review submittals on the monthly schedule.
- D. Final hardware and software design shall include all product data, shop drawings, wiring diagrams, training manuals, system documentation, and as-built information.
- E. Documentation: Provide two full sets of documentation of the ALCMS including operation and maintenance manuals, software documentation and user manuals, and system and procedure manuals. Include illustrations as applicable and block diagrams of all component subsystems and of the overall system. The final version of all software programs shall be provided on CD-ROM disks; provide a backup copy on the Maintenance computer’s hard drive.

- F. **Manufacturers' Data:** Submit two bound sets of manufacturers' data for all components of the ALCMS. Indicate which vendors within the San Antonio area support components and which components are factory supported only. Furnish names and telephone numbers for sales and service support.
- G. **RF Site Survey:** Submit ALCMS manufacturer's requirements for the RF Site Survey and support documentation for training and qualifications of the RF specialist to perform the survey described in Article 3.1.
- H. **Shop Drawings:** Indicate electrical characteristics and connection requirements, including layout of completed assemblies, interconnecting cabling, dimensions, and external power requirements.
- I. **Product Data:** Show electrical characteristics and connection requirements for each component.
- J. **Operation Data:** Include bound copies of operating instructions.
- K. **Test Reports:** Indicate satisfactory completion of each test.
- L. **Submit for approval, prior to start of training, a complete plan for Owner Personnel Training** described in Article 3.5.
- M. **Manufacturer's Installation Instructions:** Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.
- N. **Manufacturers' Certificates:** Certify that products meet or exceed specified requirements and are proper for intended use in every respect.
- O. **Manufacturer's Field Reports:** Submit under provisions of Section 8 of the Special Conditions. Indicate that installation is complete and system performs according to specified requirements.
- P. **Affidavit:** Submit written affidavit that all ALCMS material complies with FAA Buy America provisions, that the ALCMS Work complies with FAA Advisory Circular 150/5345-56B, Specification for L-890 Airport Lighting Control and Monitoring System (ALCMS), and that the ALCMS is approved under the FAA Airport Lighting Equipment Certification Program described in FAA Advisory Circular (AC) 150/5345-53, Appendices 3 and 4 of the current Addendum.

1.8 PROJECT RECORD DOCUMENTS

- A. **Submit under provisions of Section 28 of the Special Conditions.**
- B. **Record actual locations of each item of equipment and show interconnecting wiring.**
- C. **Record documents shall be certified "as-built" and shall depict all changes made during construction.**

1.9 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Section 8 of the Special Conditions.
- B. Operation Data: Include bound copies of operating instructions.
- C. Maintenance Data: Include routine troubleshooting procedures, manufacturer's operation and maintenance manual for each item of equipment and accessory, and routine cleaning methods and materials.

1.10 QUALIFICATIONS

- A. The manufacturer, supplier, and installer of products specified in this Section shall be identified and selected through the process outlined in Section 16916.

1.11 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and indicated.
- C. All Work to be performed in association with the ALCMS shall be in conformance with FAA Advisory Circular 150/5345-56B, Specification for L-890 Airport Lighting Control and Monitoring System (ALCMS). Additionally, the ALCMS shall be approved under the FAA Airport Lighting Equipment Certification Program described in FAA Advisory Circular (AC) 150/5345-53, Appendices 3 and 4 of the current Addendum.
- D. All material shall comply with FAA Buy America provisions.

1.12 DELIVERY, STORAGE, AND HANDLING

- A. Deliver to, and store, protect, and handle products, at site in compliance with all local, state and federal laws.
- B. Accept products on site in factory containers. Inspect for damage.
- C. Store products in clean, dry area; maintain temperature to NEMA ICS 1.

1.13 EXISTING CONDITIONS

- A. An ALCS currently exists at San Antonio International Airport that provides control and monitoring of two airfield electrical vaults, three runways, and associated taxiways from the existing control tower.
- B. The existing ALCMS is based on copper landlines, a pre-L-890 touchscreen control panel in the ATCT is utilized for control and monitoring the airfield lighting and associated components.

- C. The existing ALCS must and shall remain fully operational until final acceptance and commission of the new ALCMS.

1.14 SEQUENCING AND SCHEDULING

- A. The proposed ALCMS shall be fully operational within 120 calendar days from ALCMS Notice to Proceed. Install the proposed ALCMS on or before the beginning of day 104 in such a manner as to provide control and monitoring of the East and West Vault from a remote site (possibly Maintenance). This configuration shall enable testing of control and monitoring functions of the system while not interfering with the existing ALCMS or the existing ATCT operations. Perform a demonstration of the complete system from Maintenance or one of the Vaults on or before day 110.
- B. Coordinate delivery and installation of equipment in the ATCT 72 hours in advance with the FAA through the Aviation Department in accordance with FAA regulations. Night and/or weekend work may be required.
- C. Submit a description of the method of system integration including whether the proposed system will run parallel to the existing system; what measures will be taken to assure the proposed system will function properly during and after integration; and what alternate means of control will be provided in the event the system does not function properly.

1.15 WARRANTY

- A. Provide, prior to final acceptance, a 15-month performance warranty including all equipment, materials, installation, software, and labor effective beginning at the time of final written acceptance by the Aviation Department.
- B. Prior to the warranty period, all system performance, including equipment, materials, installations, software, and labor, shall be a part of the initial contracted cost regardless of time frame.
- C. Within the initial 90 days of the warranty period complete as-built documentation and the Maintenance training.
- D. All original equipment manufacturer (OEM) warranties that extend beyond the warranty period designated above shall continue to benefit the Owner throughout the OEM warranty period.

1.16 MAINTENANCE SERVICE

- A. Provide support during and after the Warranty period.
- B. Support during the Warranty period:
 - 1. Support during the 15-month warranty period shall consist of both critical response and non-critical response. In both cases, make technical service personnel available to Owner. Technical service personnel shall be capable of making software changes and of troubleshooting signals between, and operation of, the components of the ALCMS. Critical response shall result

- from a single telephone call with technical service personnel arriving on-site within eight (12) hours of the call from the Owner's representative.
2. Non-critical response shall result from a single telephone call with technical service personnel response to solve the problem within 24 hours of the call from the Owner's representative.
 3. In every case, Owner's representative will designate during the telephone call whether the required response is critical or non-critical.
- C. Support after the Warranty period:
1. Include both "system down" service and a required annual maintenance program.
 2. Offer terms and conditions for furnishing parts and providing continued testing and servicing, including replacement of materials and equipment.
 3. Provide remote troubleshooting from the manufacturer's service center and diagnostic capability via modem or broadband Ethernet connection.
 4. The support agreement shall include a maximum guaranteed response time of not more than 24 hours after notification to have a qualified technician on site to correct software or hardware problems.

1.17 SPARE PARTS

- A. Identify and define critical components and provide a list and quantity of spare parts included with submittal.
- B. Provide 10 percent spares, or a minimum of one, whichever is greater, for all critical components, through the board level of the ALCMS, which can be removed and installed on site. One spare ATCT cab level monitor shall be provided.
- C. Provide a full quantity of spare parts when the ALCMS is accepted and placed into service. These parts may be used during the Warranty period. Replenish expended items and furnish a full stock of spare parts at the end of the Warranty period.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Provide, to the maximum extent possible, standard and readily available products, components, and equipment of manufacturers and suppliers regularly engaged in producing and supplying the items specified in this Section. All ALCMS material shall comply with FAA Buy America provisions.

2.2 EQUIPMENT

A. Computers

1. All PC Computers with exception of the Maintenance desktop and roaming laptop PC shall be industrial grade, 19" rack mounted with integrated keyboard drawer for keyboard and mouse device.
2. Industrial computers shall be capable of internal diagnostics that include monitoring the temperature and supply power of the unit.
3. Provide at a minimum an Intel Core i5 or dual microprocessor for each machine with a clock speed of 2.4 GHz.
4. As a minimum, the computers shall contain the following:
 - a. Automatic power-on self test of system components;
 - b. 4 GB of random access memory expandable to 16GB;
 - c. 80 Gigabyte (GB) hard drive;
 - d. 48x CD ROM drive;
 - e. Keyboard;
 - f. SVGA or DVI graphics card to support 1024 x 768 pixel resolution;
 - g. 1 spare serial port;
 - h. 1 spare USB port;
 - i. Parallel printer port;
 - j. Mouse port;
 - k. Real time clock with battery backup;
5. The Maintenance PC shall be a desktop version of the other system PC's with a minimum 160GB Hard Drive, 56k baud modem.
6. The Maintenance Roaming laptop PC shall be separate from the Maintenance desktop PC and shall have the following minimum requirements:
 - a. 15-inch viewable screen;
 - b. Wireless LAN connection;
 - c. 4-hour battery life
7. Install all computers with all the hardware cards required for rapid software execution, keyboard operation, graphics support, touchscreen support, and network support as required.
8. Test and "burn in" all components prior to delivery.

B. Monitors

1. All monitors, except for the ATCT cab level monitor, shall comply with the following:
 - a. Provide 1024 x 768 minimum resolution high contrast color flat panel monitors, with a minimum 17" diagonal viewable screen size.
 - b. Monitors shall be easily viewable under daytime or nighttime operation conditions.
 - c. Equip monitors with front access controls for brightness, contrast, and horizontal and vertical adjustment.
 - d. Provide Maintenance desktop monitor with an optional swivel base for desktop mounting.
 - e. Provide each monitor with a front facing power indicator light to indicate that the monitor is on.
 - f. Monitors shall be capable of 256 distinct colors.

- a. Evaporator drain shall discharge outside of the vault and shall be coordinated with Maintenance.
3. Provide enclosures with additional space for future expansion as described in this Section.
4. Provide housekeeping pads for ALCMS computer enclosures in both vaults.

G. Uninterruptible Power Supplies.

1. Size uninterruptible power supplies (UPS) so that only half the rated capacity is used when the computer and associated peripherals are connected.
2. Provide batteries for a minimum of 15 minutes at full rated capacity of the UPS. Provide sealed type batteries that do not require venting.
3. Provide alarm status for AC input failure and UPS fault.
4. Connect the ALCMS uninterruptible power supplies located in the ATCT and Vaults to the emergency power bus.

2.3 ACCESSORIES

A. Fiber Optic Cables:

1. Install new fiber optic cables (primary and redundant) in existing duct (part pre-existing and part constructed under the Prime Contract from the ATCT to the East and West Vaults. Utilize existing telephone poles to establish new overhead fiber optic cables (primary and redundant) between the West Vault and Maintenance. See Figure 17 at end of this Section showing the location and routing of these duct banks and overhead cables. Figure 1 “ALCMS Communications Block Diagram” drawing depicts the proposed fiber optic communications links.
2. Provide manufacturer’s certificates of compliance, which state that the materials meet or exceed the requirements of this Section and Section 16740-VOICE AND DATA COMMUNICATION CABLING.

PART 3 – EXECUTION

3.1 WIRELESS COMMUNICATION INTERFERENCE TEST

A. Wireless Network

1. The method of wireless communication chosen shall be suitable for use in the existing airport environment. Contractor shall coordinate the requirements of a proper RF site survey with the ALCMS manufacturer as required for the specific system implementation. The basic rules of a radio frequency site survey shall be observed (See paragraph 3.1.B below.)
2. The wireless network shall be license-free.
3. Contractor shall verify wireless communication system has direct line-of-sight between subsystems. No obstructions including trees, buildings, towers, etc. can exist between locations of antennas.
4. The wireless system shall combine antenna diversity and digital signal processing to assure secure, reliable wireless communication.

B. RF Site Inspection and Survey

1. The RF site inspection and survey must be performed by a trained and qualified RF specialist to determine wireless communication equipment requirements and verify open frequencies that can be used for wireless communication.
2. RF specialist shall use the previously determined antenna installation locations and mast sizes indicated on the Contract Documents. Inspection shall include all locations which will require wireless communication, antenna installation locations and verification of line-of-sight from each installation location.
3. RF specialist shall complete an interference test that includes a frequency sweep (using a spectrum analyzer) run over a 24-hour period. The resulting usable frequency report must be included as part of the design.

3.2 FIBER OPTIC CABLE

- A. Refer to Section 16740-VOICE AND DATA COMMUNICATION CABLING for fiber optic cable requirements.
- B. Provide manufacturer's certificates of compliance which state that the installation meets or exceeds the requirements of this Section and Section 16740-VOICE AND DATA COMMUNICATION CABLING, Article 3.3, Installation.

3.3 FIELD QUALITY CONTROL

- A. Field inspection and testing shall be performed under provisions of Section 100 of the General Provisions.
- B. Perform operational testing on systems to verify proper operation and field wiring connections.

3.4 TESTS

- A. The ALCMS manufacturer must perform a Factory Acceptance Test (FAT) at the manufacturer's facility to demonstrate operation of the ALCMS in accordance with the hardware and software design per the specifications. The manufacturer shall provide a 30 day advance notice of the FAT to the owner to allow for owner representative(s) to attend and observe the FAT. A report of the FAT must be provided to the airport.
- B. Upon completing installation of the ALCMS, perform a System Acceptance Test (SAT) and furnish written certification of results. Required tests shall include the following:
 1. Operation of all features of the software;
 2. Monitoring capabilities;
 3. Communications links;
 4. All system mechanical, electrical, and electronic features;
 5. Alarm response through the creation of artificial fault conditions.
- C. Complete and document tests prior to system demonstration and training.

- D. Perform tests requiring the activation or deactivation of lighting systems or related equipment at a time prearranged with Airport Maintenance Department.
- E. Fiber Optic Cable Testing Procedures
 1. Provide all labor, tools, and equipment necessary to perform the fiber optic cable tests. Provide 48 hours prior notice of testing to the Airport Maintenance Representative. Conduct tests in the presence of the Airport Maintenance Representative. Provide written test results.
 2. Test fiber optic cables using an Optical Time Domain Reflectometer (OTDR), in accordance with Section 16740, Articles 3.8 and 3.9. Reject and replace cables having attenuation at wavelength greater than factory specifications.
 3. Test fiber optic cables by OTDR after installation and termination. Reject and replace cables having attenuation at wavelength greater than maximum factory specifications or having a localized discontinuity in excess of 0.2dB.

3.5 OWNER PERSONNEL TRAINING

- A. Provide complete User and Maintenance training for the entire system.
- B. Conduct User training at the installation site prior to final acceptance.
- C. Perform Maintenance training after final acceptance.
- D. Provide training of sufficient duration and quality to prepare User (ATCT) employees to operate and Airport Maintenance employees to operate, maintain, and modify the complete system after the relevant training has occurred.
- E. The process equipment supplier, if applicable, shall conduct process equipment factory training for Maintenance.
- F. Minimum training requirements shall include all operational and maintenance aspects of the system and hands-on operation. Training shall consist of two separate categories (User and Maintenance) as described below:
 1. Provide User training consisting of operating the ALCMS from the touchscreen graphical interface. This training is the minimum required for FAA ATCT personnel. Train ATCT operators to perform all command control sequences; address alarm conditions; and operate the airfield lighting systems to the extent intended. Include a general system overview.
 2. Provide Maintenance training including complete maintenance of the overall system design, operation, troubleshooting, and repair procedures. This includes operating all software programs, implementing airfield lighting changes, generation of reports, backup/restore procedures, and day-to-day system operations.
- G. Training time frames and number of personnel to be trained per category are as follows:

User Training	10 personnel	2 day of training
Maintenance Training	10 personnel	5 days of training

- H. Provide all trainees with all necessary training documentation bound in three-ring binders.
- I. Videotape both training sessions in color with audio on standard VHS videotapes or DVD. Submit one complete set of VHS videotapes or DVD's at the end of the training sessions.

3.6 ATTACHMENTS

The following drawings, diagrams, and tables included at the end of this Section are referenced throughout the specification:

FIGURE 1 - ALCMS Communications Block Diagram

FIGURE 2 – ALCMS Preset Page

FIGURE 3 – ALCMS Runway Page

FIGURE 4 – ALCMS Taxiway Page

FIGURE 5 – ALCMS Utility Page

FIGURE 6 – ALCMS East Vault Page

FIGURE 7 – ALCMS West Vault Page

FIGURE 8 – ALCMS Query Page

FIGURE 9 – ALCMS Graphic Map Lighting Configuration (Sheet 1 of 6)

FIGURE 10 – ALCMS Graphic Map Lighting Configuration (Sheet 2 of 6)

FIGURE 11 – ALCMS Graphic Map Lighting Configuration (Sheet 3 of 6)

FIGURE 12 – ALCMS Graphic Map Lighting Configuration (Sheet 4 of 6)

FIGURE 13 – ALCMS Graphic Map Lighting Configuration (Sheet 5 of 6)

FIGURE 14 – ALCMS Graphic Map Lighting Configuration (Sheet 6 of 6)

FIGURE 15 – East Vault Layout

FIGURE 16 – West Vault Layout

FIGURE 17 – ALCMS Fiber Optic Cable Duct Routing

FIGURE 18 – Air Traffic Control Tower Equipment Locations

TABLE 9 – Runway Button Relation To Circuit Control (Preset Page)

TABLE 10 – Circuit Brightness Levels At Selected Daytime Visibility

TABLE 11 – Circuit Brightness Levels At Selected Nighttime Visibility

TABLE 12 – Runway Button Relation To Circuit Control (Runway Lighting Page)

TABLE 13 – Taxiway Button Relation To Circuit Control (Taxiway Lighting Page)

TABLE 14 – East Vault CCR Data

TABLE 15 – West Vault CCR Data

TABLE 16 – East Vault Additional Equipment

TABLE 17 – West Vault Additional Equipment

PART 4 - MEASUREMENT AND PAYMENT

All items to be furnished and installed under this specification shall be measured and paid for by lump sum. Payment shall be full compensation for furnishing all materials and for all preparation, assembly, and installation of these materials, where applicable, and for all labor, equipment, tools, and incidentals necessary to complete this item. Monthly progress payments shall be contingent upon the Owner's assessment of the percentage of completed work based on the schedule of values submitted by the Contractor and as approved by the Owner.

END OF SECTION 16890

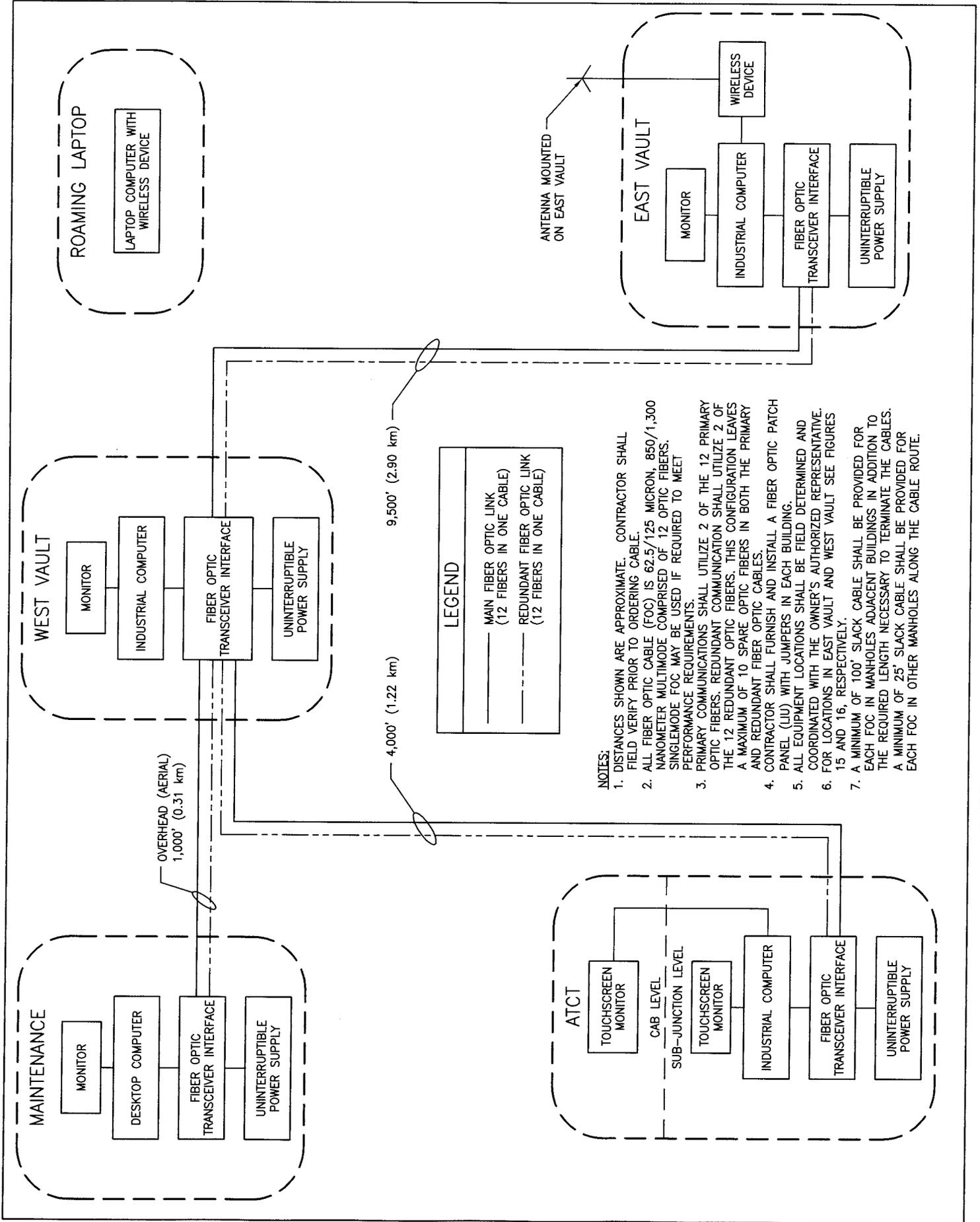


FIGURE 1: ALCMS COMMUNICATIONS BLOCK DIAGRAM

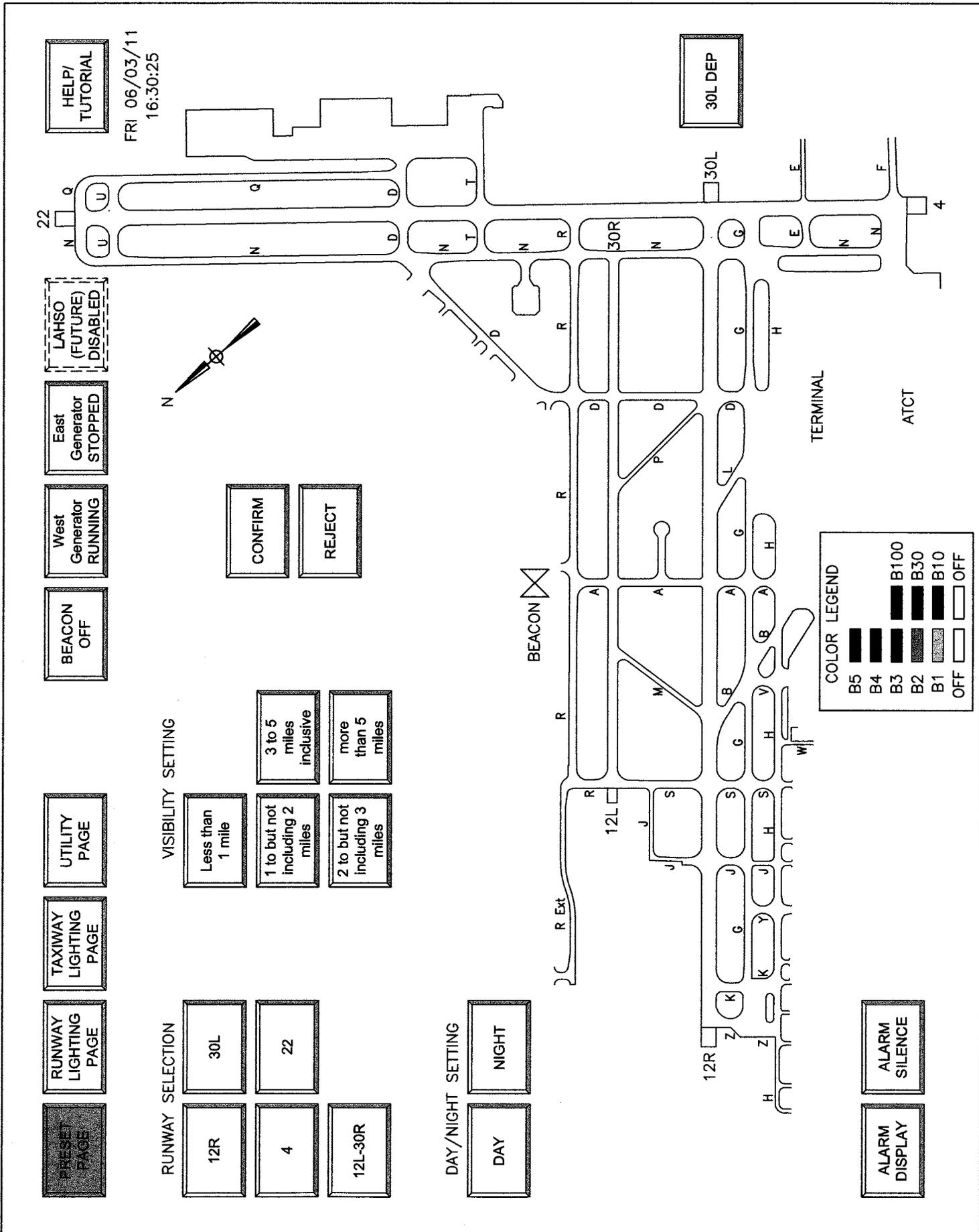


FIGURE 2: ALCMS PRESET PAGE

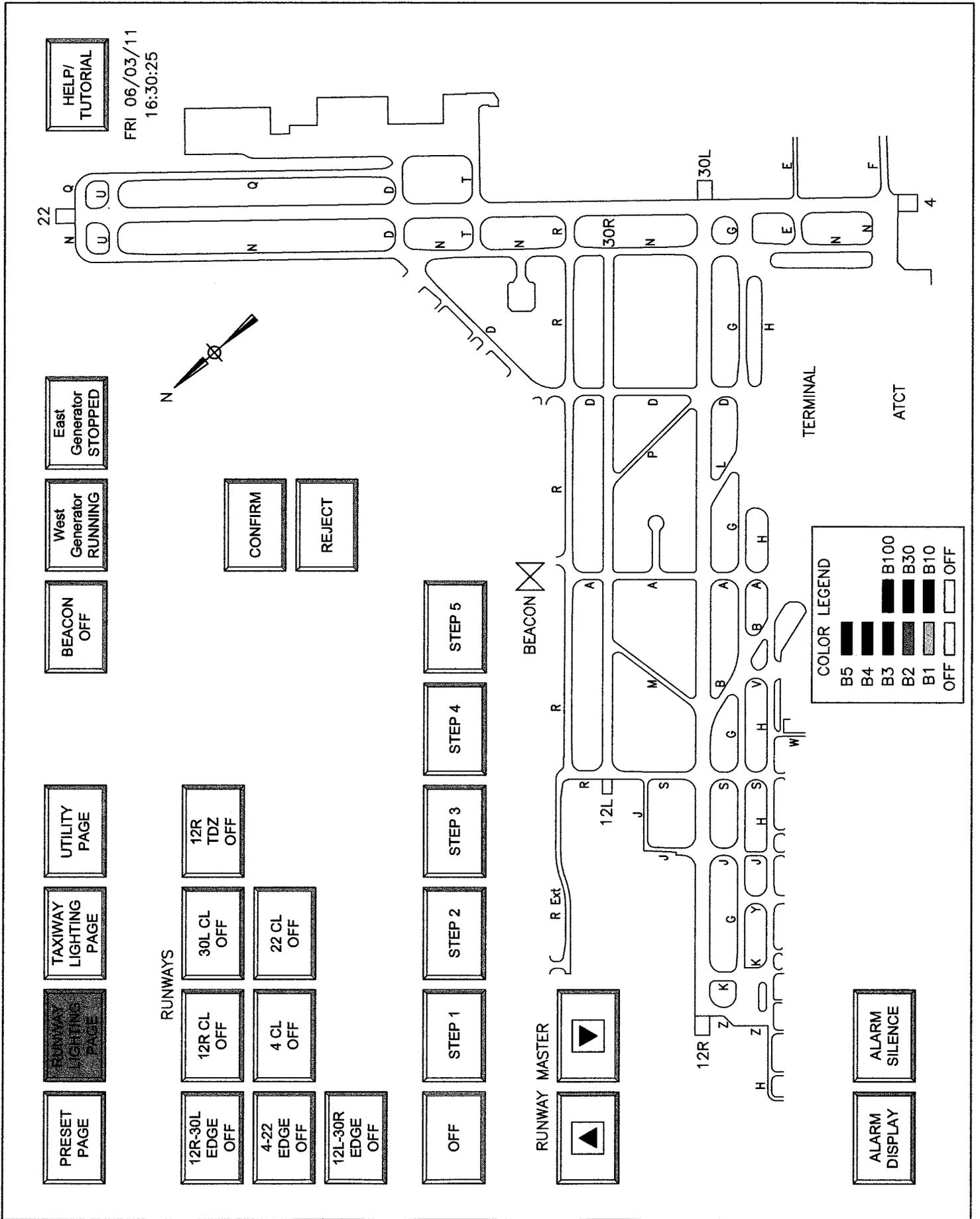


FIGURE 3: ALCMS RUNWAY PAGE

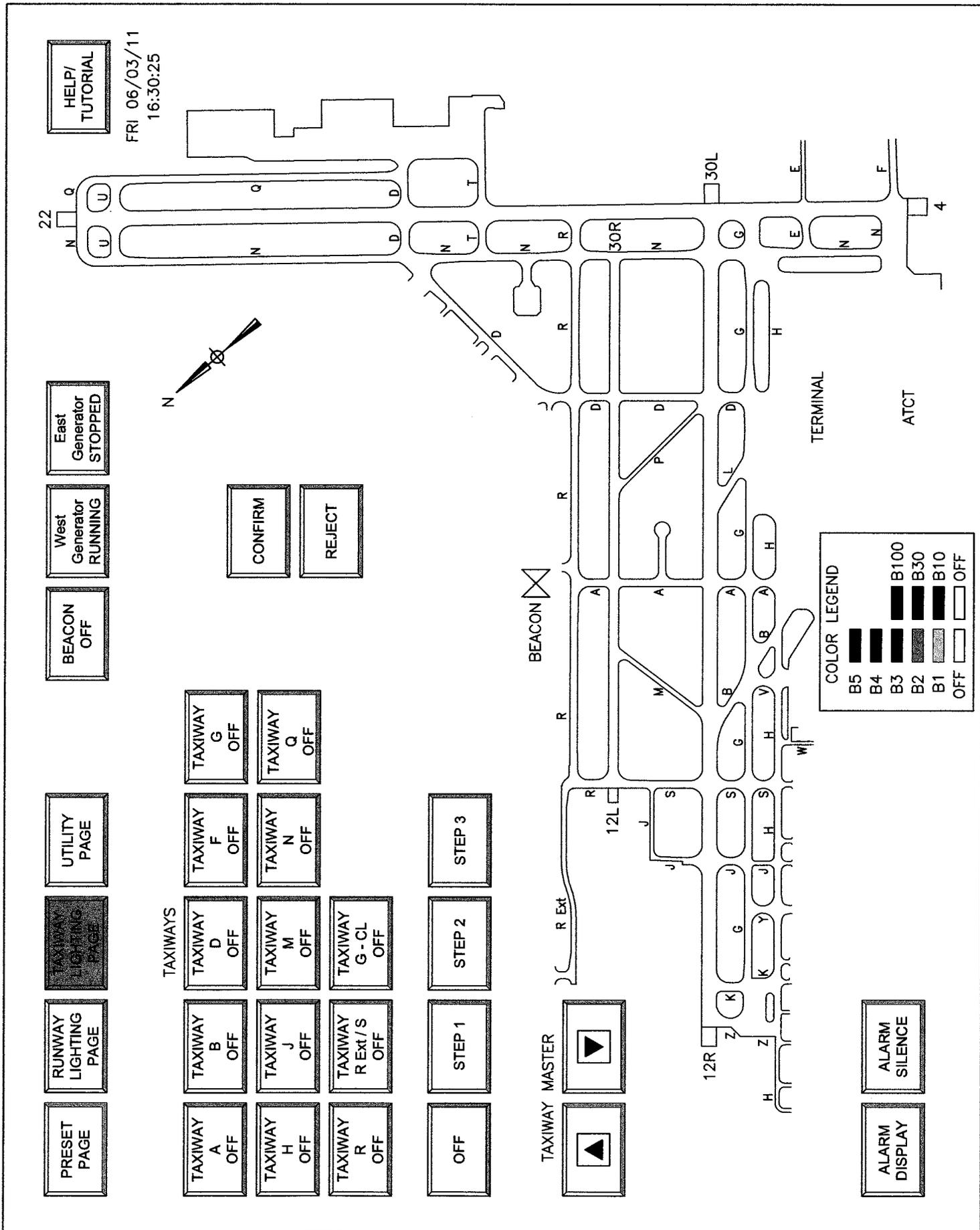


FIGURE 4: ALCMS TAXIWAY PAGE

PRESET PAGE

RUNWAY LIGHTING PAGE

TAXIWAY LIGHTING PAGE

UTILITY PAGE

UTILITIES

ABOUT

ALARM VOLUME

SET SYSTEM DATE/TIME

EXIT TO MAIN MENU

CLEAN SCREEN

CONTROL AUTH

CALIBRATE TOUCH SCREEN

SHUTDOWN STATION

MAINTENANCE

WEST VAULT

CIRCUIT QUERY

ALARMS

EAST VAULT

HISTORY

IRMS

CONFIRM

REJECT



FRI 06/03/11
16:30:25

HELP/
TUTORIAL

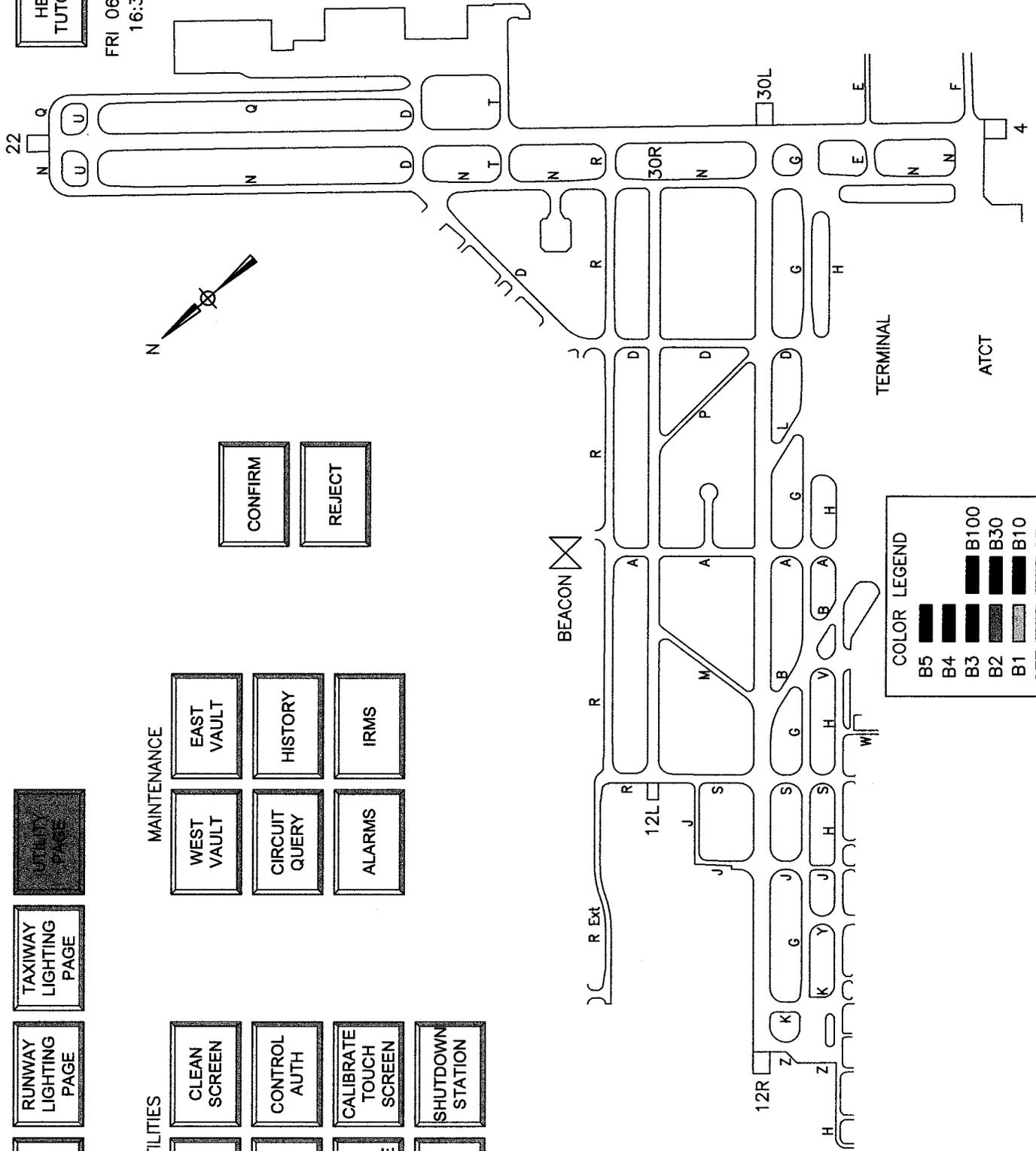


FIGURE 5: ALCMS UTILITY PAGE

EAST VAULT

PRESET PAGE

RUNWAY LIGHTING PAGE

TAXIWAY LIGHTING PAGE

UTILITY PAGE

EXIT TO MAIN MENU

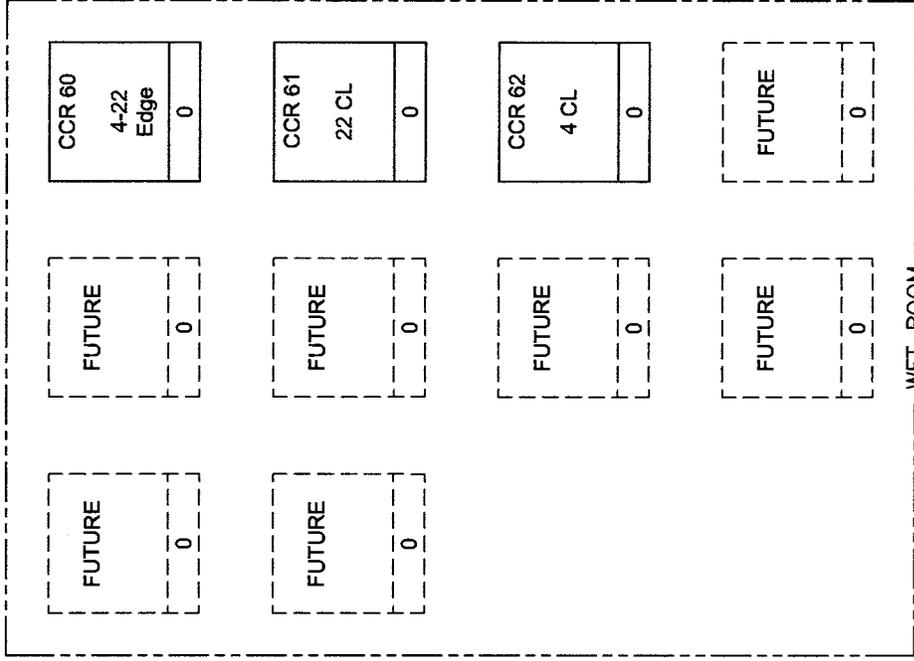
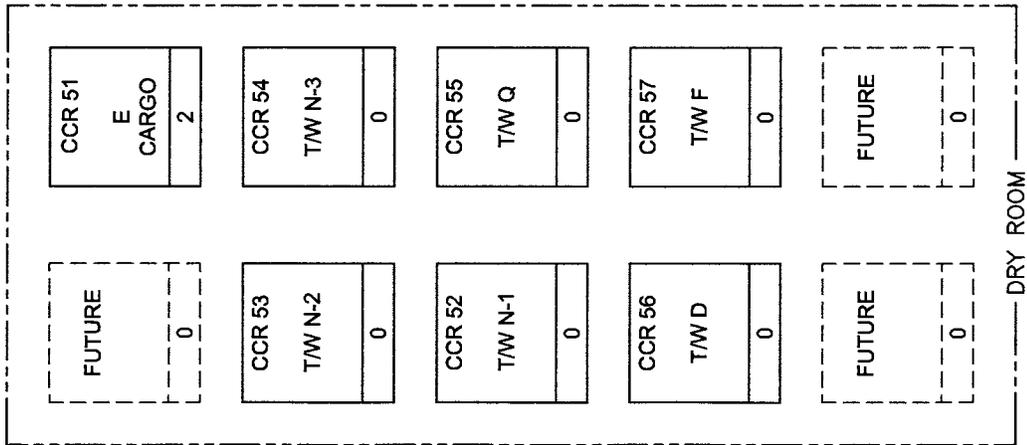
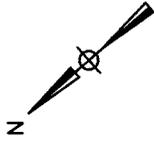
IRMS

FRI 06/03/11
16:30:25

HELP/TUTORIAL

CURRENT EAST VAULT CCR LOAD 10.56 KVA

CURRENT EAST VAULT LOAD 11.34 KVA



CCR DETAIL

CCR # : NAME 51 : East Cargo

SIZE 7.5 KW MAX STEPS 3

COMMANDED STEP 2

VOLTAGE (V) 1,342

CURRENT (A) 5.5

POWER (KVA) 7.38

LAST MEG (Mohm) 132.56

CALIBRATION (V) 1,358

STATUS OK

LOCKOUT CALIBRATE

RELEASE MEGGER

LEGEND

- 0 POWERED
- 0 UNPOWERED
- X IN ALARM
- LOCKED OUT

FIGURE 6: ALCMS EAST VAULT PAGE

WEST VAULT

PRESET PAGE

RUNWAY LIGHTING PAGE

TAXIWAY LIGHTING PAGE

UTILITY PAGE

EXIT TO MAIN MENU

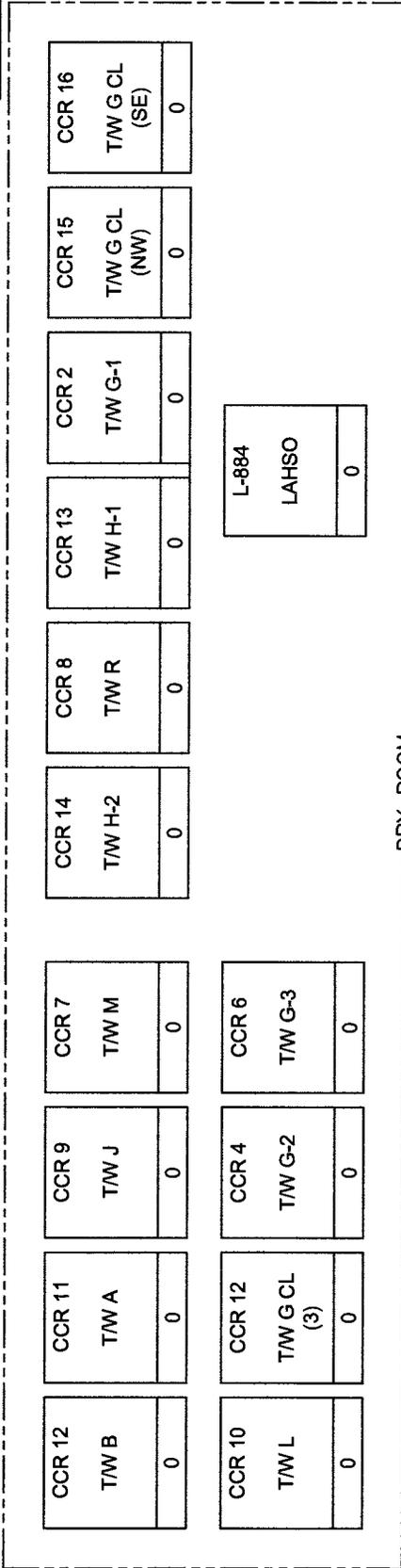
IRMS

FRI 06/03/11
16:30:25

HELP/TUTORIAL

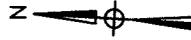
CURRENT WEST VAULT CCR LOAD 68.33 KVA

CURRENT WEST VAULT LOAD 70.24 KVA



DRY ROOM

WET ROOM



CCR DETAIL

CCR # : NAME 31 : 12R-30L Edge
 SIZE 30 KW MAX STEPS 5

COMMANDER STEP 5
 VOLTAGE (V) 1,243
 CURRENT (A) 20.0
 POWER (KVA) 24.87
 LAST MEG (Mohm) 56.23
 CALIBRATION (V) 1,250

STATUS OK

LOCKOUT CALIBRATE
 RELEASE MEGGER

LEGEND

0 POWERED
 0 UNPOWERED
 X IN ALARM
 ■ LOCKED OUT

FIGURE 7: ALCMS WEST VAULT PAGE

CIRCUIT QUERY

PRESET PAGE

RUNWAY LIGHTING PAGE

TAXIWAY LIGHTING PAGE

UTILITY PAGE

EXIT TO MAIN MENU

WEST VAULT

12R-30L	12R CL	12R TDZ
12L-30R	30L CL	A
B	G1	G2
G3	G CL (NW)	G CL (SE)
G CL (3)	H1	H2
J	LAHSO	M
R	R Ext / S	Future
Future	Future	Future

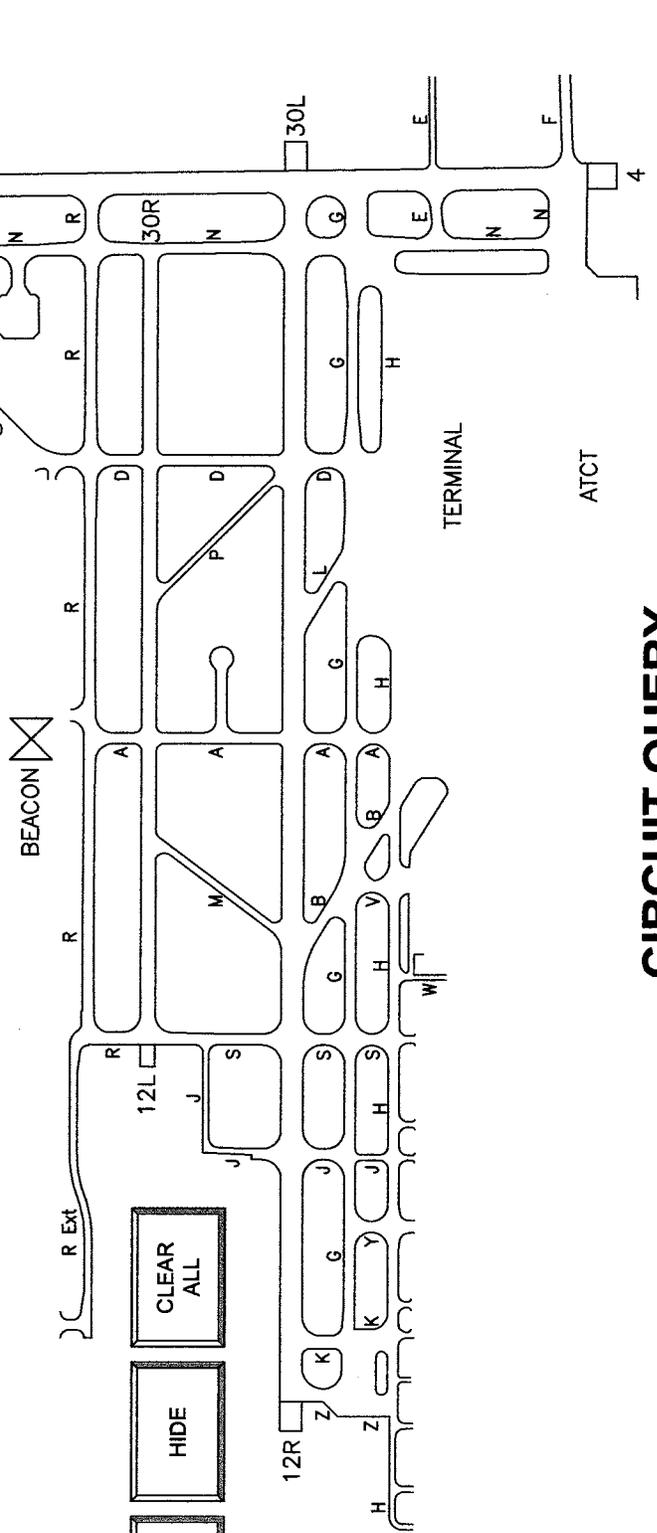
EAST VAULT

4 CL	22 CL	4-22
D	E Cargo	F
N-1	N-2	N-3
Q	Future	Future
Future	Future	Future



FRI 06/03/11
16:30:25

HELP/TUTORIAL



SHOW

HIDE

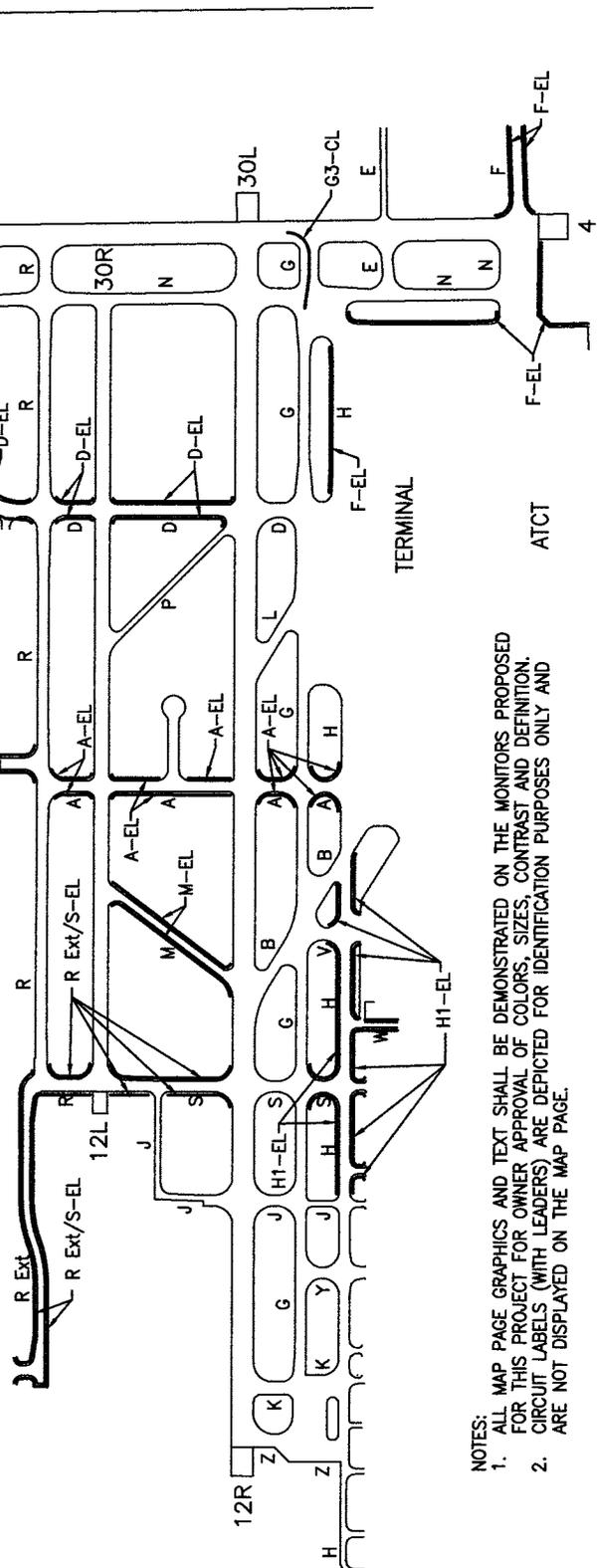
CLEAR ALL

CIRCUIT QUERY

FIGURE 8: ALCMS CIRCUIT QUERY PAGE

MAP PAGE COLORS	
BACKGROUND	BLACK
PAVEMENT	LIGHT GRAY
TEXT	WHITE

CIRCUIT LEGEND			
PROPOSED NAME	SHOWN	DESCRIPTION (CCR #)	PROPOSED COLOR
12R/30L-EL		R/W 12R-30L EDGE LIGHTS (CCR 31)	YELLOW
12R-CL		R/W 12R CENTERLINE LIGHTS (CCR 30)	DARK RED
12R-TDZ		R/W 12R TDZ LIGHTS (CCR 33)	DARK RED
30L-CL		R/W 30L CENTERLINE LIGHTS (CCR 32)	DARK RED
4/22-EL		R/W 4-22 EDGE LIGHTS (CCR 60)	YELLOW
4-CL		R/W 4 CENTERLINE LIGHTS (CCR 62)	DARK RED
22-CL	✓	R/W 22 CENTERLINE LIGHTS (CCR 61)	DARK RED
12L/30R-EL		R/W 12L-30R EDGE LIGHTS (CCR 34)	YELLOW
A-EL	✓	T/W EDGE LIGHTS (CCR 11)	LIGHT GREEN
B-EL		T/W EDGE LIGHTS (CCR 02)	LIGHT GREEN
D-EL	✓	T/W EDGE LIGHTS (CCR 56)	LIGHT GREEN
E-CARGO		T/W EDGE LIGHTS (CCR 51)	LIGHT GREEN
F-EL	✓	T/W EDGE LIGHTS (CCR 57)	LIGHT GREEN
G1-EL		T/W EDGE LIGHTS (CCR 02)	LIGHT GREEN
G2-EL		T/W EDGE LIGHTS (CCR 04)	LIGHT GREEN
G3-EL		T/W EDGE LIGHTS (CCR 06)	LIGHT GREEN
H1-EL	✓	T/W EDGE LIGHTS (CCR 13)	LIGHT GREEN
H2-EL		T/W EDGE LIGHTS (CCR 14)	LIGHT GREEN
J-EL	✓	T/W EDGE LIGHTS (CCR 09)	LIGHT GREEN
M-EL		T/W EDGE LIGHTS (CCR 07)	LIGHT GREEN
N1-EL		T/W EDGE LIGHTS (CCR 52)	LIGHT GREEN
N2-EL		T/W EDGE LIGHTS (CCR 53)	LIGHT GREEN
N3-EL		T/W EDGE LIGHTS (CCR 54)	LIGHT GREEN
Q-EL		T/W EDGE LIGHTS (CCR 55)	LIGHT GREEN
R-EL		T/W EDGE LIGHTS (CCR 08)	LIGHT GREEN
R Ext/S-EL	✓	T/W G CENTERLINE LIGHTS (NW) CCR 15	DARK GREEN
G-CL(NW)		T/W G CENTERLINE LIGHTS (SE) CCR 16	DARK GREEN
G-CL(SE)		T/W G CENTERLINE LIGHTS (3) CCR 12	DARK GREEN
G-CL (3)	✓	LAHSO LIGHTS ON R/W 4 (LAHSO L-884)	WHITE



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 2. CIRCUIT LABELS (WITH LEADERS) ARE DEPICTED FOR IDENTIFICATION PURPOSES ONLY AND ARE NOT DISPLAYED ON THE MAP PAGE.

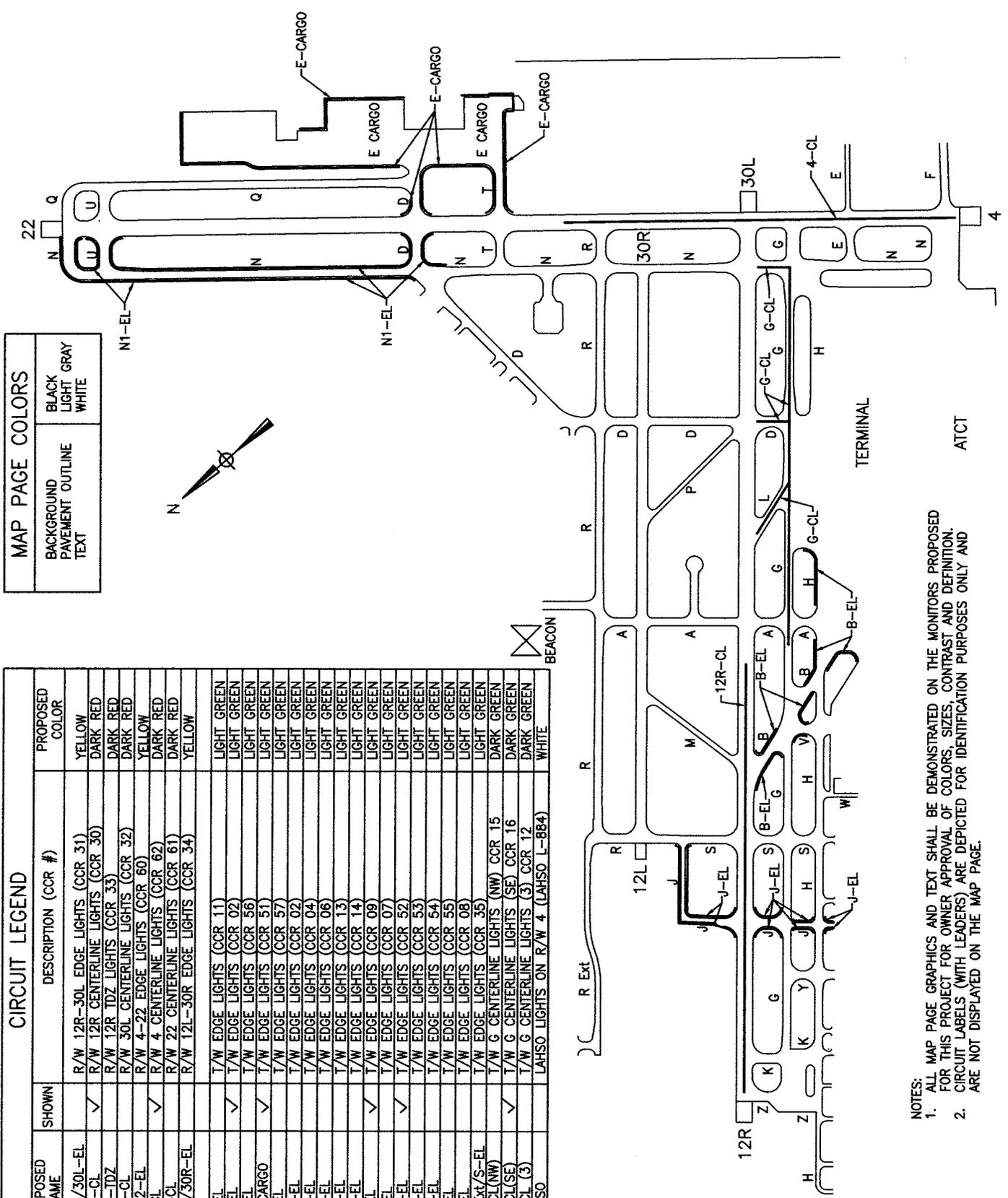
FIGURE 9: ALCMS GRAPHIC MAP LIGHTING CONFIGURATION (SHEET 1 OF 6)

CIRCUIT LEGEND

PROPOSED NAME	SHOWN	DESCRIPTION (CCR #)	PROPOSED COLOR
12R/30L-EL		R/W 12R-30L EDGE LIGHTS (CCR 31)	YELLOW
12R-CL	✓	R/W 12R CENTERLINE LIGHTS (CCR 30)	DARK RED
12R-TDZ		R/W 12R TDZ LIGHTS (CCR 33)	DARK RED
30L-CL		R/W 30L CENTERLINE LIGHTS (CCR 32)	DARK RED
4/22-EL	✓	R/W 4-22 EDGE LIGHTS (CCR 60)	YELLOW
4-CL		R/W 4 CENTERLINE LIGHTS (CCR 62)	DARK RED
22-CL		R/W 22 CENTERLINE LIGHTS (CCR 61)	DARK RED
12L/30R-EL		R/W 12L-30R EDGE LIGHTS (CCR 34)	YELLOW
A-EL		T/W EDGE LIGHTS (CCR 11)	LIGHT GREEN
B-EL	✓	T/W EDGE LIGHTS (CCR 02)	LIGHT GREEN
D-EL		T/W EDGE LIGHTS (CCR 56)	LIGHT GREEN
E-CARGO	✓	T/W EDGE LIGHTS (CCR 51)	LIGHT GREEN
F-EL		T/W EDGE LIGHTS (CCR 57)	LIGHT GREEN
G1-EL		T/W EDGE LIGHTS (CCR 02)	LIGHT GREEN
G2-EL		T/W EDGE LIGHTS (CCR 04)	LIGHT GREEN
G3-EL		T/W EDGE LIGHTS (CCR 06)	LIGHT GREEN
H1-EL		T/W EDGE LIGHTS (CCR 13)	LIGHT GREEN
H2-EL		T/W EDGE LIGHTS (CCR 14)	LIGHT GREEN
J-EL	✓	T/W EDGE LIGHTS (CCR 09)	LIGHT GREEN
M-EL		T/W EDGE LIGHTS (CCR 07)	LIGHT GREEN
N1-EL	✓	T/W EDGE LIGHTS (CCR 52)	LIGHT GREEN
N2-EL		T/W EDGE LIGHTS (CCR 53)	LIGHT GREEN
N3-EL		T/W EDGE LIGHTS (CCR 54)	LIGHT GREEN
Q-EL		T/W EDGE LIGHTS (CCR 55)	LIGHT GREEN
R-EL		T/W EDGE LIGHTS (CCR 08)	LIGHT GREEN
R EX/S-EL		T/W EDGE LIGHTS (CCR 35)	LIGHT GREEN
G-CL(NW)		T/W G CENTERLINE LIGHTS (NW) CCR 15	DARK GREEN
G-CL(SE)	✓	T/W G CENTERLINE LIGHTS (SE) CCR 16	DARK GREEN
G-CL (3)		T/W G CENTERLINE LIGHTS (3) CCR 12	DARK GREEN
LAHSO		LAHSO LIGHTS ON R/W 4 (LAHSO L-884)	WHITE

MAP PAGE COLORS

BACKGROUND	BLACK
PAVEMENT	LIGHT GRAY
OUTLINE	GRAY
TEXT	WHITE



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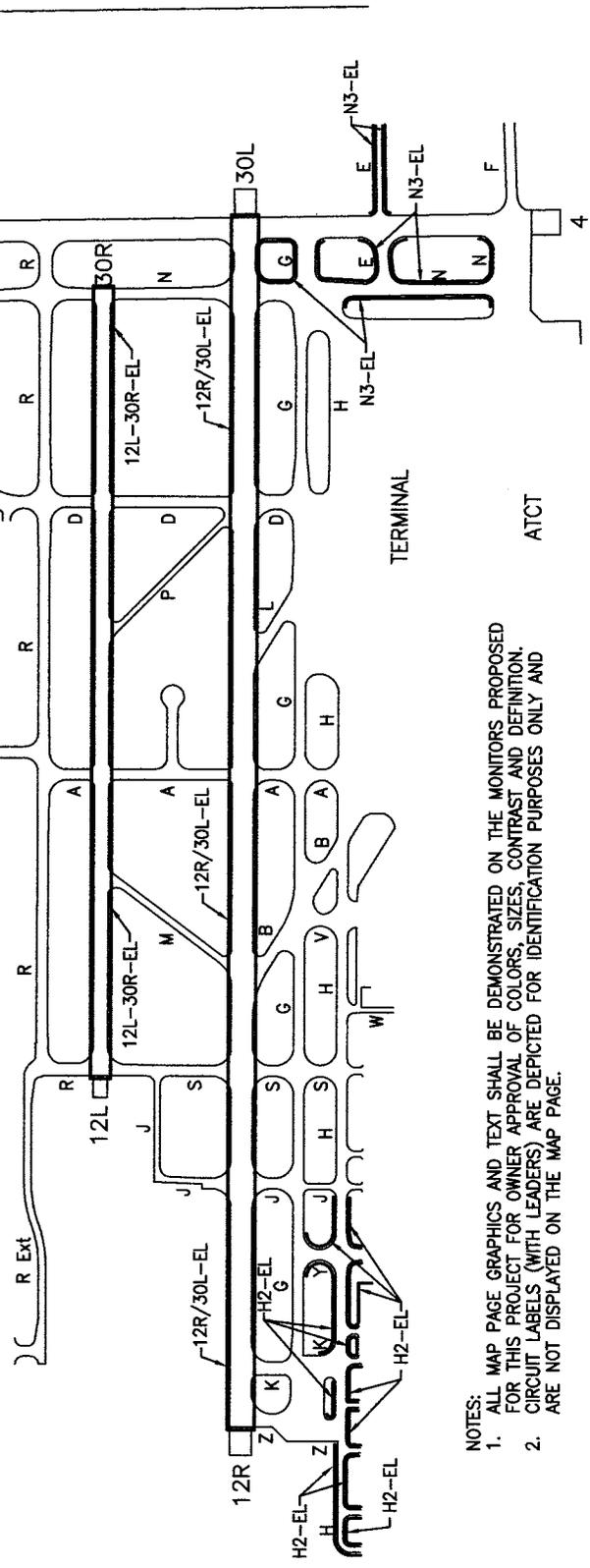
FIGURE 10: ALCMS GRAPHIC MAP LIGHTING CONFIGURATION
(SHEET 2 OF 6)

CIRCUIT LEGEND

PROPOSED NAME	SHOWN	DESCRIPTION (CCR #)	PROPOSED COLOR
12R/30L-EL	✓	R/W 12R-30L EDGE LIGHTS (CCR 31)	YELLOW
12R-CL		R/W 12R CENTERLINE LIGHTS (CCR 30)	DARK RED
12R-IDZ		R/W 12R IDZ LIGHTS (CCR 33)	DARK RED
30L-CL		R/W 30L CENTERLINE LIGHTS (CCR 32)	DARK RED
4/22-EL		R/W 4-22 EDGE LIGHTS (CCR 60)	YELLOW
4-CL		R/W 4 CENTERLINE LIGHTS (CCR 62)	DARK RED
22-CL		R/W 22 CENTERLINE LIGHTS (CCR 61)	DARK RED
12L/30R-EL	✓	R/W 12L-30R EDGE LIGHTS (CCR 34)	YELLOW
A-EL		T/W EDGE LIGHTS (CCR 11)	LIGHT GREEN
B-EL		T/W EDGE LIGHTS (CCR 02)	LIGHT GREEN
D-EL		T/W EDGE LIGHTS (CCR 56)	LIGHT GREEN
E-CARGO		T/W EDGE LIGHTS (CCR 51)	LIGHT GREEN
F-EL		T/W EDGE LIGHTS (CCR 57)	LIGHT GREEN
G1-EL		T/W EDGE LIGHTS (CCR 02)	LIGHT GREEN
G2-EL		T/W EDGE LIGHTS (CCR 04)	LIGHT GREEN
G3-EL		T/W EDGE LIGHTS (CCR 06)	LIGHT GREEN
H1-EL		T/W EDGE LIGHTS (CCR 13)	LIGHT GREEN
H2-EL	✓	T/W EDGE LIGHTS (CCR 14)	LIGHT GREEN
J-EL		T/W EDGE LIGHTS (CCR 09)	LIGHT GREEN
M-EL		T/W EDGE LIGHTS (CCR 07)	LIGHT GREEN
N1-EL		T/W EDGE LIGHTS (CCR 52)	LIGHT GREEN
N2-EL		T/W EDGE LIGHTS (CCR 53)	LIGHT GREEN
N3-EL	✓	T/W EDGE LIGHTS (CCR 54)	LIGHT GREEN
Q-EL		T/W EDGE LIGHTS (CCR 55)	LIGHT GREEN
R-EL		T/W EDGE LIGHTS (CCR 08)	LIGHT GREEN
R Ext/S-EL		T/W EDGE LIGHTS (CCR 35)	LIGHT GREEN
G-CL(NW)		T/W G CENTERLINE LIGHTS (NW) CCR 15	DARK GREEN
G-CL(SE)		T/W G CENTERLINE LIGHTS (SE) CCR 16	DARK GREEN
G-CL (3)		T/W G CENTERLINE LIGHTS (3) CCR 12	DARK GREEN
LAHSO		LAHSO LIGHTS ON R/W 4 (LAHSO L-884)	WHITE

MAP PAGE COLORS

BACKGROUND	BLACK
PAVEMENT	LIGHT GRAY
OUTLINE	GRAY
TEXT	WHITE

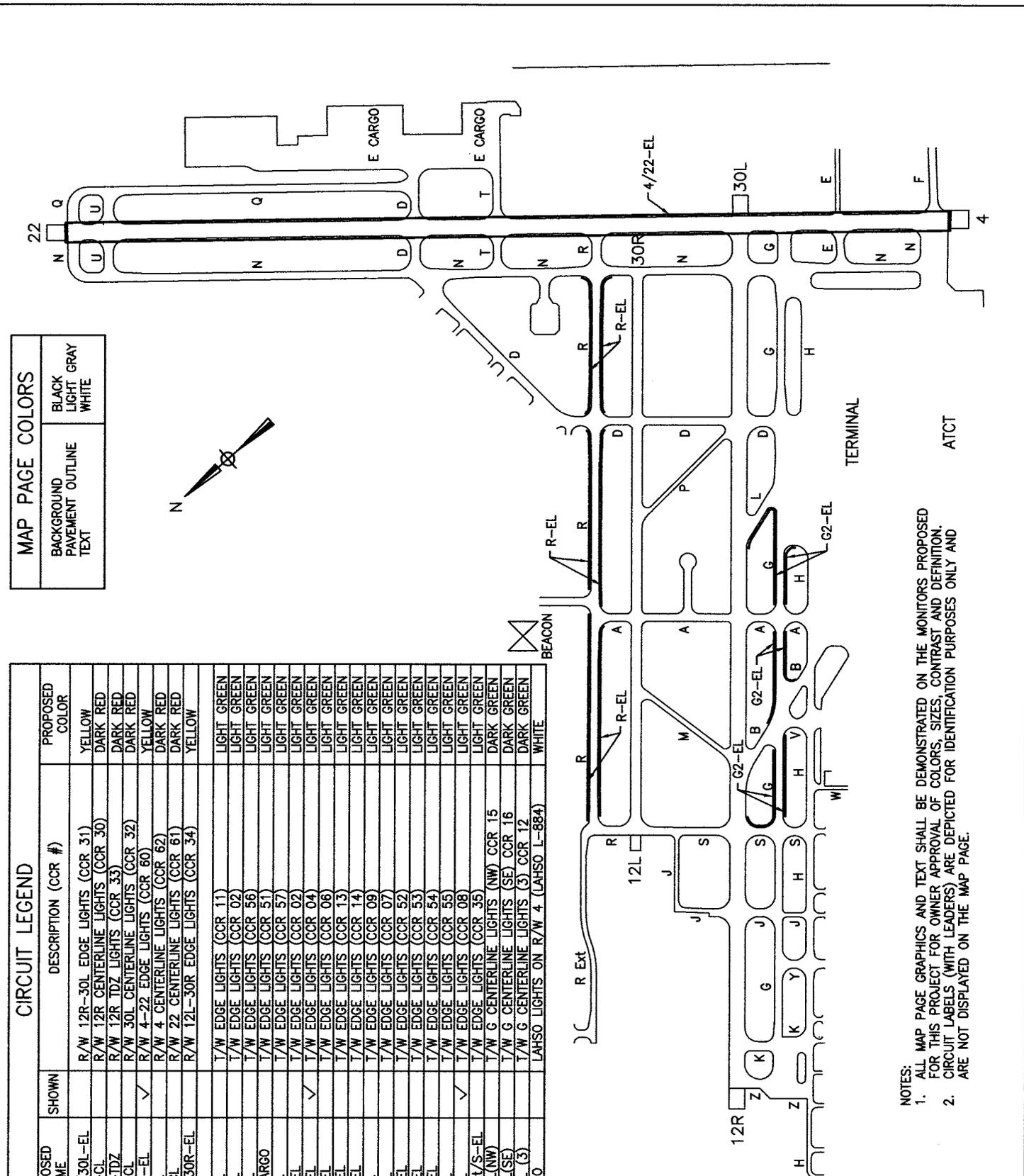


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FIGURE 11: ALCMS GRAPHIC MAP LIGHTING CONFIGURATION (SHEET 3 OF 6)

CIRCUIT LEGEND			
PROPOSED NAME	SHOWN	DESCRIPTION (CCR #)	PROPOSED COLOR
12R/30L-EL		R/W 12R-30L EDGE LIGHTS (CCR 31)	YELLOW
12R-CL		R/W 12R CENTERLINE LIGHTS (CCR 30)	DARK RED
12R-TDZ		R/W 12R TDZ LIGHTS (CCR 33)	DARK RED
30L-CL		R/W 30L CENTERLINE LIGHTS (CCR 32)	DARK RED
4/22-EL	✓	R/W 4-22 EDGE LIGHTS (CCR 60)	YELLOW
4-CL		R/W 4 CENTERLINE LIGHTS (CCR 62)	DARK RED
22-CL		R/W 22 CENTERLINE LIGHTS (CCR 61)	DARK RED
12L/30R-EL		R/W 12L-30R EDGE LIGHTS (CCR 34)	YELLOW
A-EL		T/W EDGE LIGHTS (CCR 11)	LIGHT GREEN
B-EL		T/W EDGE LIGHTS (CCR 02)	LIGHT GREEN
D-EL		T/W EDGE LIGHTS (CCR 56)	LIGHT GREEN
E-CARGO		T/W EDGE LIGHTS (CCR 51)	LIGHT GREEN
F-EL		T/W EDGE LIGHTS (CCR 57)	LIGHT GREEN
G1-EL		T/W EDGE LIGHTS (CCR 02)	LIGHT GREEN
G2-EL	✓	T/W EDGE LIGHTS (CCR 04)	LIGHT GREEN
G3-EL		T/W EDGE LIGHTS (CCR 06)	LIGHT GREEN
H1-EL		T/W EDGE LIGHTS (CCR 13)	LIGHT GREEN
H2-EL		T/W EDGE LIGHTS (CCR 14)	LIGHT GREEN
J-EL		T/W EDGE LIGHTS (CCR 09)	LIGHT GREEN
M-EL		T/W EDGE LIGHTS (CCR 07)	LIGHT GREEN
N1-EL		T/W EDGE LIGHTS (CCR 52)	LIGHT GREEN
N2-EL		T/W EDGE LIGHTS (CCR 53)	LIGHT GREEN
N3-EL		T/W EDGE LIGHTS (CCR 54)	LIGHT GREEN
Q-EL		T/W EDGE LIGHTS (CCR 55)	LIGHT GREEN
R-EL	✓	T/W EDGE LIGHTS (CCR 08)	LIGHT GREEN
R Ex/S-EL		T/W G CENTERLINE LIGHTS (CCR 35)	LIGHT GREEN
G-CL(NW)		T/W G CENTERLINE LIGHTS (NW) CCR 15	DARK GREEN
G-CL(SE)		T/W G CENTERLINE LIGHTS (SE) CCR 16	DARK GREEN
G-CL (3)		T/W G CENTERLINE LIGHTS (3) CCR 12	DARK GREEN
LAHSO		LAHSO LIGHTS ON R/W 4 (LAHSO L-884)	WHITE

MAP PAGE COLORS	
BACKGROUND	BLACK
PAVEMENT	LIGHT GRAY
OUTLINE	GRAY
TEXT	WHITE



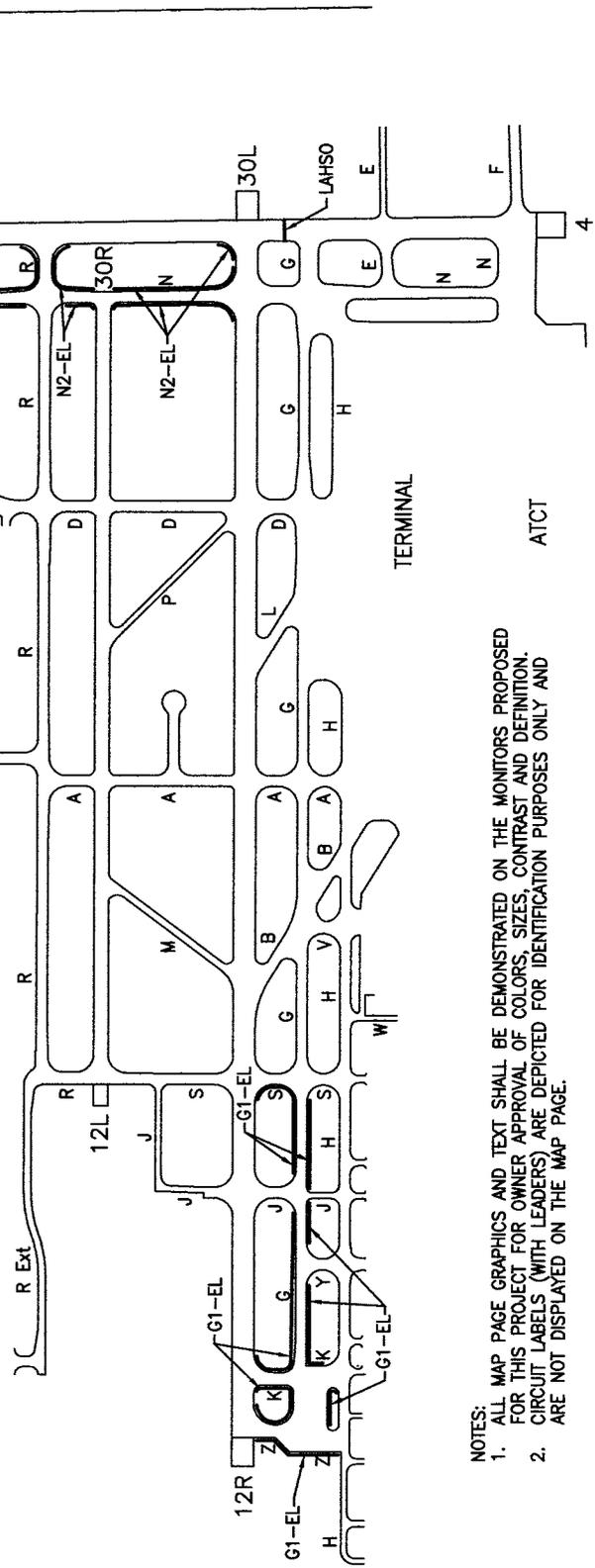
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 2. CIRCUIT LABELS (WITH LEADERS) ARE DEPICTED FOR IDENTIFICATION PURPOSES ONLY AND ARE NOT DISPLAYED ON THE MAP PAGE.

FIGURE 12: ALCMS GRAPHIC MAP LIGHTING CONFIGURATION (SHEET 4 OF 6)

MAP PAGE COLORS	
BACKGROUND	BLACK
PAVEMENT	LIGHT GRAY
OUTLINE	GRAY
TEXT	WHITE



CIRCUIT LEGEND			
PROPOSED NAME	SHOWN	DESCRIPTION (CCR #)	PROPOSED COLOR
12R/30L-EL		R/W 12R-30L EDGE LIGHTS (CCR 31)	YELLOW
12R-CL		R/W 12R CENTERLINE LIGHTS (CCR 30)	DARK RED
12R-TDZ		R/W 12R TDZ LIGHTS (CCR 33)	DARK RED
30L-CL		R/W 30L CENTERLINE LIGHTS (CCR 32)	DARK RED
4/22-EL		R/W 4-22 EDGE LIGHTS (CCR 60)	YELLOW
4-CL		R/W 4 CENTERLINE LIGHTS (CCR 62)	DARK RED
22-CL		R/W 22 CENTERLINE LIGHTS (CCR 61)	DARK RED
12L/30R-EL		R/W 12L-30R EDGE LIGHTS (CCR 34)	YELLOW
A-EL		T/W EDGE LIGHTS (CCR 11)	LIGHT GREEN
B-EL		T/W EDGE LIGHTS (CCR 02)	LIGHT GREEN
D-EL		T/W EDGE LIGHTS (CCR 56)	LIGHT GREEN
E-CARGO		T/W EDGE LIGHTS (CCR 51)	LIGHT GREEN
F-EL		T/W EDGE LIGHTS (CCR 57)	LIGHT GREEN
G1-EL	✓	T/W EDGE LIGHTS (CCR 02)	LIGHT GREEN
G2-EL		T/W EDGE LIGHTS (CCR 04)	LIGHT GREEN
G3-EL		T/W EDGE LIGHTS (CCR 06)	LIGHT GREEN
H1-EL		T/W EDGE LIGHTS (CCR 13)	LIGHT GREEN
H2-EL		T/W EDGE LIGHTS (CCR 14)	LIGHT GREEN
J-EL		T/W EDGE LIGHTS (CCR 09)	LIGHT GREEN
M-EL		T/W EDGE LIGHTS (CCR 07)	LIGHT GREEN
N1-EL		T/W EDGE LIGHTS (CCR 52)	LIGHT GREEN
N2-EL	✓	T/W EDGE LIGHTS (CCR 53)	LIGHT GREEN
N3-EL		T/W EDGE LIGHTS (CCR 54)	LIGHT GREEN
Q-EL		T/W EDGE LIGHTS (CCR 55)	LIGHT GREEN
R-EL		T/W EDGE LIGHTS (CCR 08)	LIGHT GREEN
R Ext/S-EL		T/W EDGE LIGHTS (CCR 35)	LIGHT GREEN
G-CL(NW)		T/W G CENTERLINE LIGHTS (NW) CCR 15	DARK GREEN
G-CL(SE)		T/W G CENTERLINE LIGHTS (SE) CCR 16	DARK GREEN
G-CL (3)		T/W G CENTERLINE LIGHTS (3) CCR 12	DARK GREEN
LAHSO	✓	LAHSO LIGHTS ON R/W 4 (LAHSO L-884)	WHITE

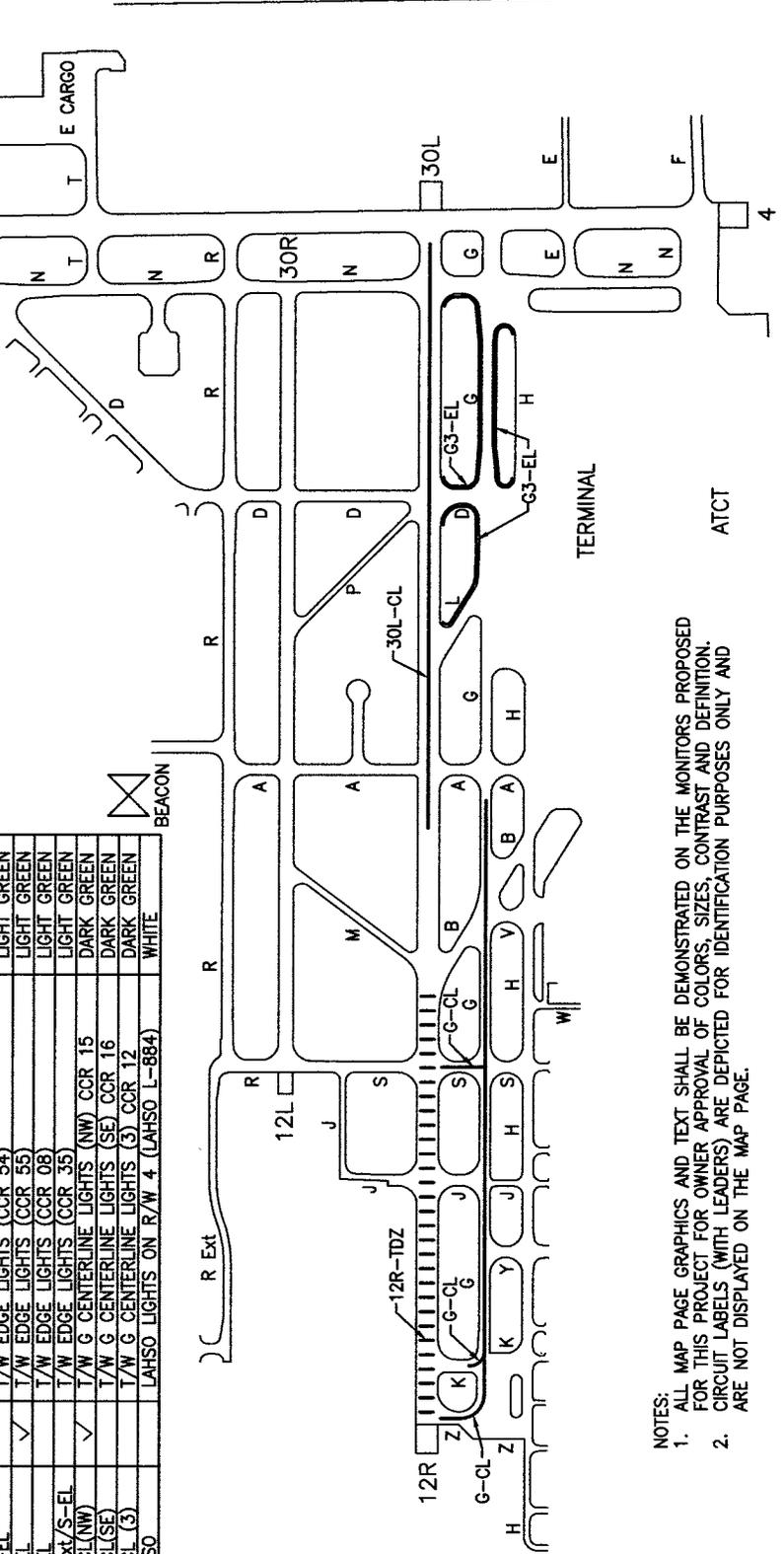


- NOTES:
1. ALL MAP PAGE GRAPHICS AND TEXT SHALL BE DEMONSTRATED ON THE MONITORS PROPOSED FOR THIS PROJECT FOR OWNER APPROVAL OF COLORS, SIZES, CONTRAST AND DEFINITION.
 2. CIRCUIT LABELS (WITH LEADERS) ARE DEPICTED FOR IDENTIFICATION PURPOSES ONLY AND ARE NOT DISPLAYED ON THE MAP PAGE.

FIGURE 13: ALCMS GRAPHIC MAP LIGHTING CONFIGURATION (SHEET 5 OF 6)

CIRCUIT LEGEND			
PROPOSED NAME	SHOWN	DESCRIPTION (CCR #)	PROPOSED COLOR
12R/30L-EL		R/W 12R-30L EDGE LIGHTS (CCR 31)	YELLOW
12R-CL		R/W 12R CENTERLINE LIGHTS (CCR 30)	DARK RED
12R-TDZ	✓	R/W 12R TDZ LIGHTS (CCR 33)	DARK RED
30L-CL	✓	R/W 30L CENTERLINE LIGHTS (CCR 32)	DARK RED
4/22-EL		R/W 4-22 EDGE LIGHTS (CCR 60)	YELLOW
4-CL		R/W 4 CENTERLINE LIGHTS (CCR 62)	DARK RED
22-CL		R/W 22 CENTERLINE LIGHTS (CCR 61)	DARK RED
12L/30R-EL		R/W 12L-30R EDGE LIGHTS (CCR 34)	YELLOW
A-EL		T/W EDGE LIGHTS (CCR 11)	LIGHT GREEN
B-EL		T/W EDGE LIGHTS (CCR 02)	LIGHT GREEN
D-EL		T/W EDGE LIGHTS (CCR 56)	LIGHT GREEN
E-CARGO		T/W EDGE LIGHTS (CCR 51)	LIGHT GREEN
F-EL		T/W EDGE LIGHTS (CCR 57)	LIGHT GREEN
G1-EL		T/W EDGE LIGHTS (CCR 02)	LIGHT GREEN
G2-EL		T/W EDGE LIGHTS (CCR 04)	LIGHT GREEN
G3-EL		T/W EDGE LIGHTS (CCR 06)	LIGHT GREEN
H1-EL		T/W EDGE LIGHTS (CCR 13)	LIGHT GREEN
H2-EL		T/W EDGE LIGHTS (CCR 14)	LIGHT GREEN
J-EL		T/W EDGE LIGHTS (CCR 09)	LIGHT GREEN
M-EL		T/W EDGE LIGHTS (CCR 07)	LIGHT GREEN
N1-EL		T/W EDGE LIGHTS (CCR 52)	LIGHT GREEN
N2-EL		T/W EDGE LIGHTS (CCR 53)	LIGHT GREEN
N3-EL		T/W EDGE LIGHTS (CCR 54)	LIGHT GREEN
R-EL	✓	T/W EDGE LIGHTS (CCR 55)	LIGHT GREEN
R-EL		T/W EDGE LIGHTS (CCR 08)	LIGHT GREEN
R-EL		T/W EDGE LIGHTS (CCR 35)	LIGHT GREEN
R-EL		T/W G CENTERLINE LIGHTS (NW) CCR 15	DARK GREEN
G-CL(NW)	✓	T/W G CENTERLINE LIGHTS (SE) CCR 16	DARK GREEN
G-CL(SE)		T/W G CENTERLINE LIGHTS (3) CCR 12	DARK GREEN
G-CL (3)		LAHSO LIGHTS ON R/W 4 (LAHSO L-884)	WHITE

MAP PAGE COLORS	
BACKGROUND	BLACK
PAVEMENT	LIGHT GRAY
OUTLINE	GRAY
TEXT	WHITE



- NOTES:
1. ALL MAP PAGE GRAPHICS AND TEXT SHALL BE DEMONSTRATED ON THE MONITORS PROPOSED FOR THIS PROJECT FOR OWNER APPROVAL OF COLORS, SIZES, CONTRAST AND DEFINITION.
 2. CIRCUIT LABELS (WITH LEADERS) ARE DEPICTED FOR IDENTIFICATION PURPOSES ONLY AND ARE NOT DISPLAYED ON THE MAP PAGE.

FIGURE 14: ALCMS GRAPHIC MAP LIGHTING CONFIGURATION (SHEET 6 OF 6)

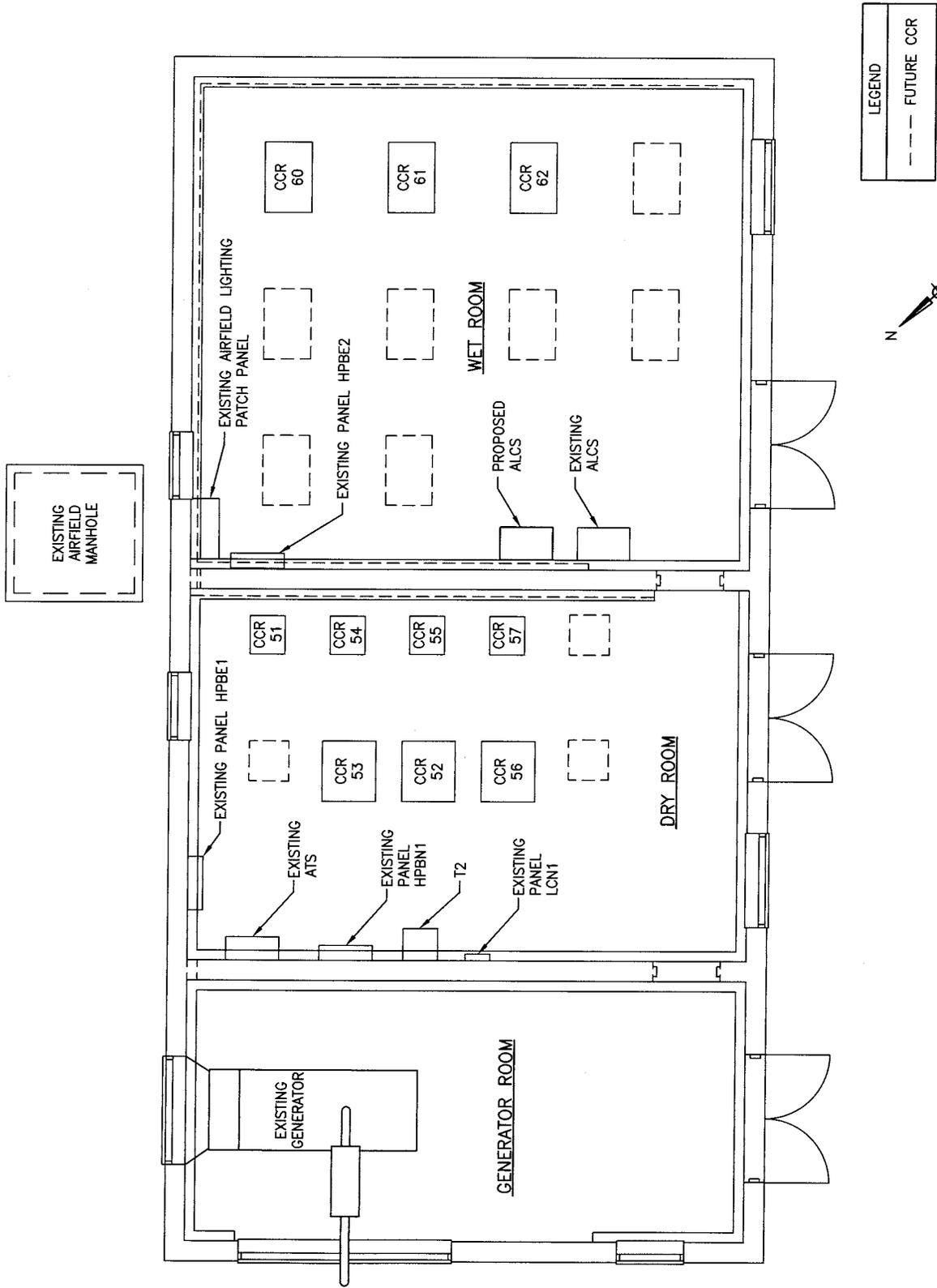


FIGURE 15: EAST VAULT LAYOUT

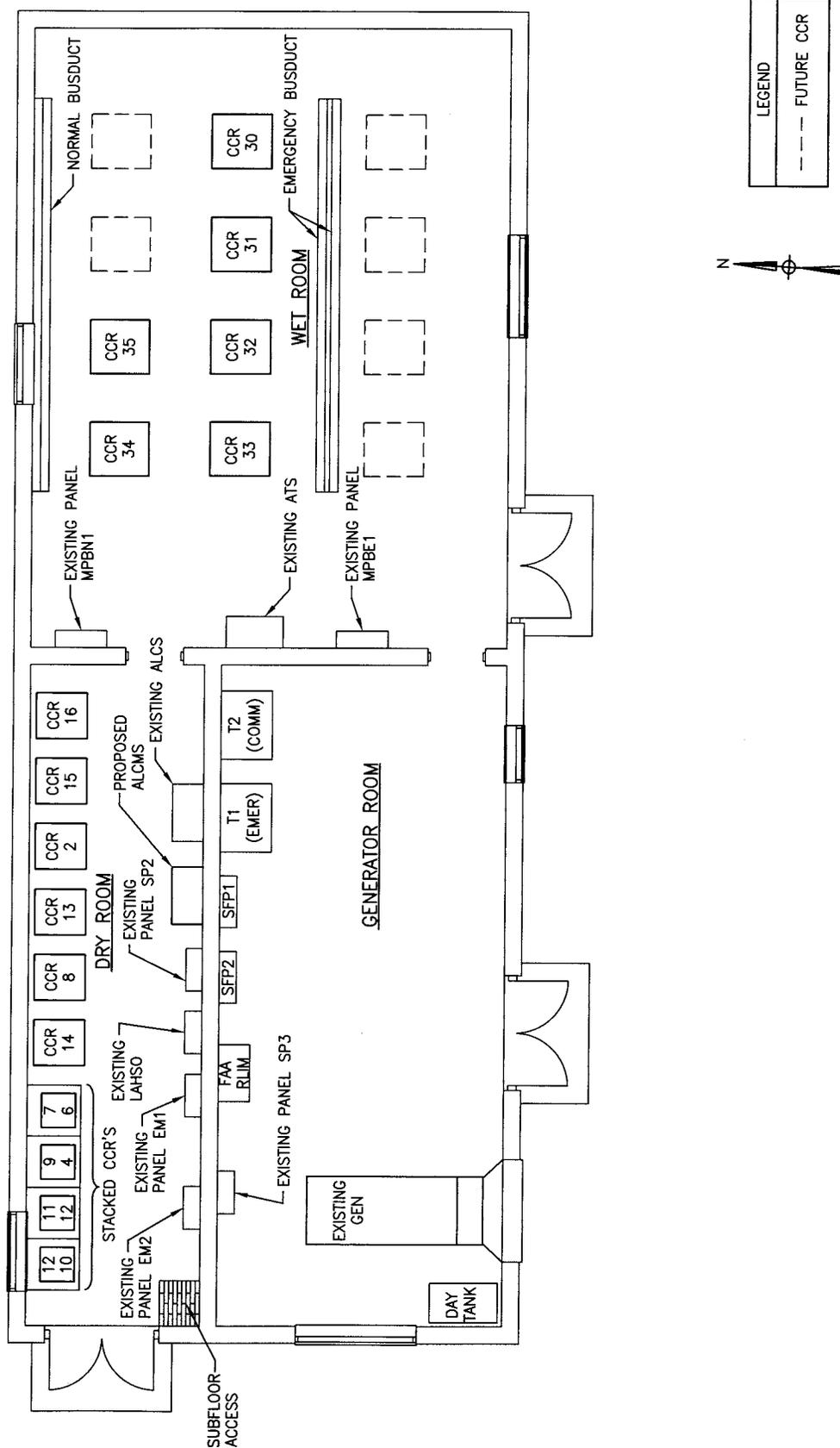


FIGURE 16: WEST VAULT LAYOUT

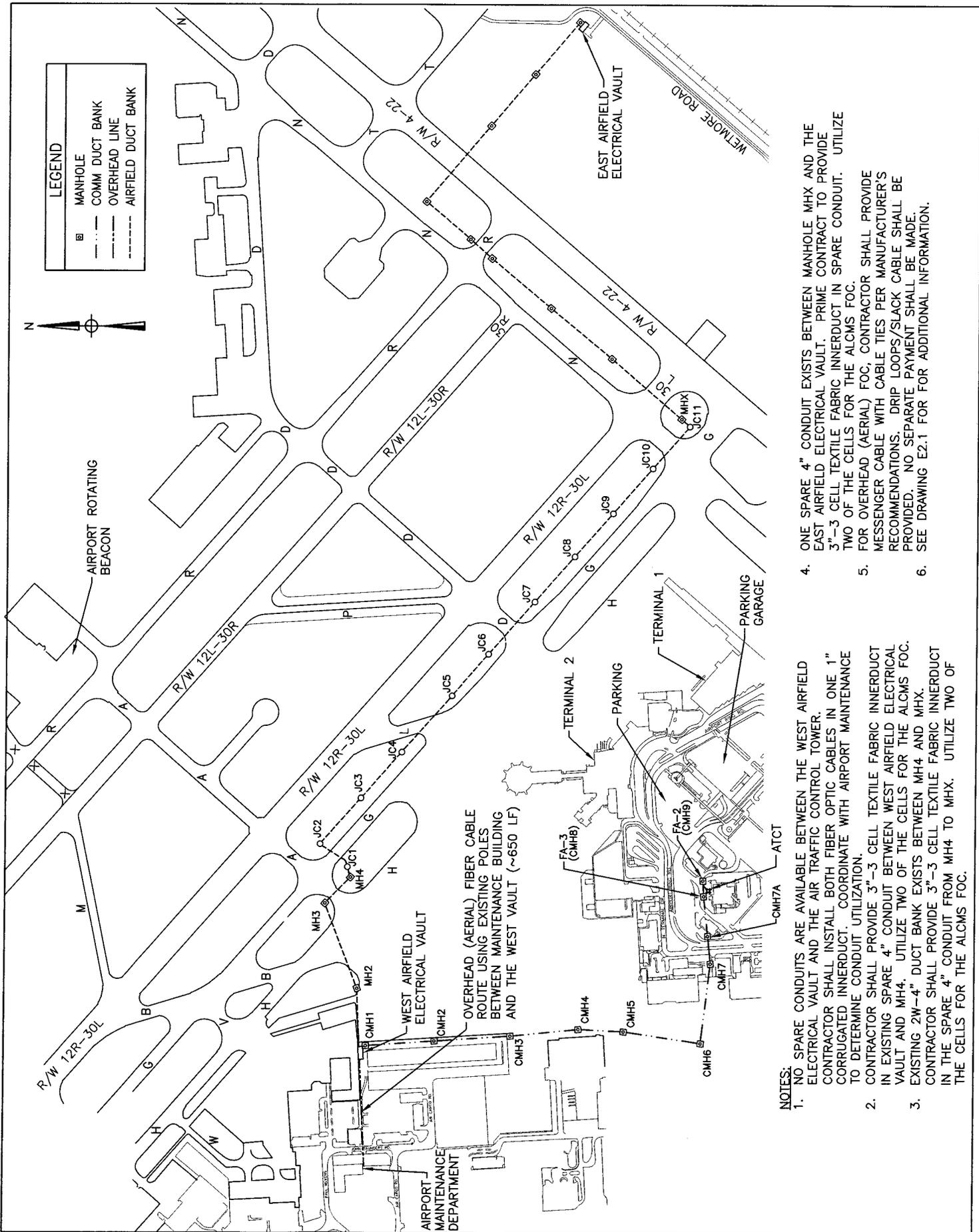
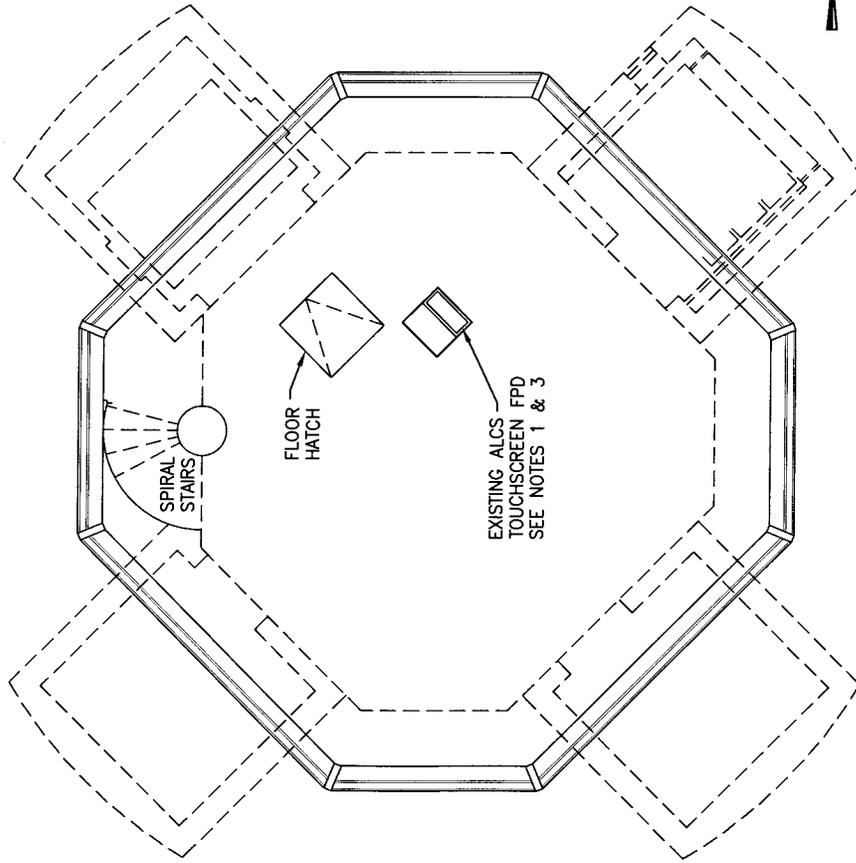
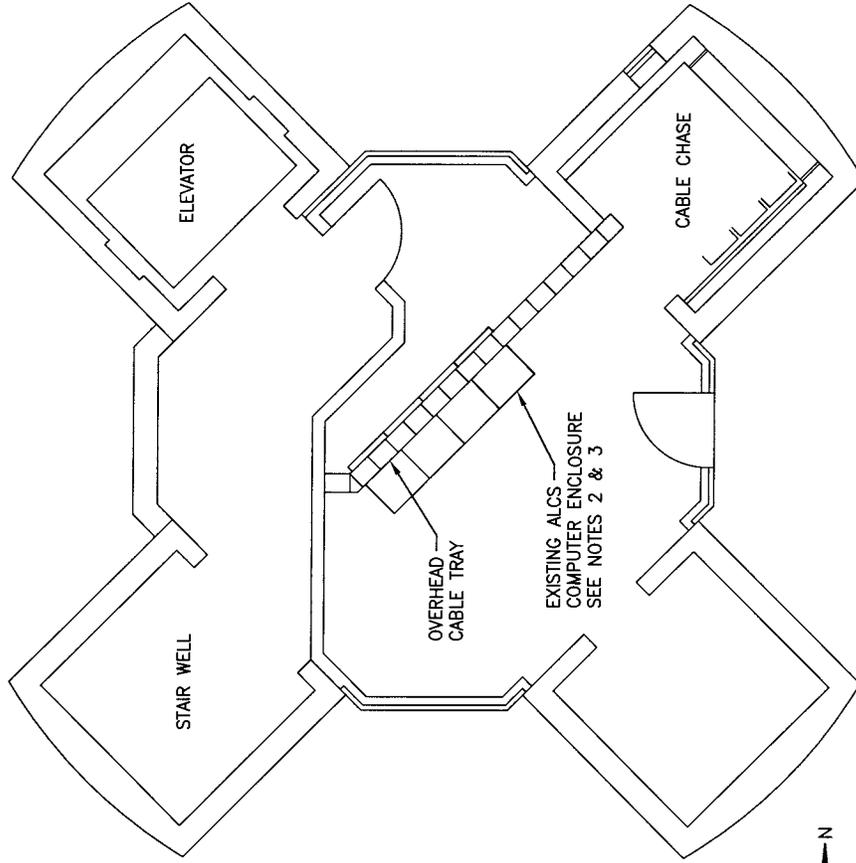


FIGURE 17: ALCMS FIBER OPTIC CABLE DUCT ROUTING



CAB FLOOR PLAN (AT CONSOLE LEVEL)



SUBJUNCTION LEVEL PLAN

NOTES:

1. EXISTING PODIUM CONTAINS AN ALCS COMPUTER, KEYBOARD, AND MOUSE LOCATED BELOW THE ALCS TOUCHSCREEN MONITOR.
2. CONTRACTOR SHALL COORDINATE WITH ATCT ELECTRONICS PERSONNEL TO INSTALL THE NEW ALCS ATCT INDUSTRIAL COMPUTER ENCLOSURE IN THE LOCATION OF THE EXISTING SYSTEM. THE EXISTING ENCLOSURE WILL HAVE TO BE TEMPORARILY MOVED WITHIN CABLE CONSTRAINTS TO A POSITION THAT DOES NOT INTERFERE WITH OPERATIONS.
3. UPON FINAL ACCEPTANCE THE EXISTING ALCS COMPUTER ENCLOSURE, CAB LEVEL COMPUTER, MONITOR, AND PERIPHERALS SHALL BE RETURNED TO THE OWNER AT THE DIRECTION OF MAINTENANCE.

FIGURE 18: AIR TRAFFIC CONTROL TOWER EQUIPMENT LOCATIONS

Button Designation	Lighting Circuits Controlled			
	Vault	CCR #	Description	Circuits
12R	W	31, 30, 33	Runway 12R-30L Edge Lights, 12R CL, 12R TDZ	12R-30L, 12R-CL, 12R-TDZ
30L	W	31, 32	Runway 12R-30L Edge Lights, 30L CL	12R-30L, 30L-CL
4	E	60, 62	Runway 4-22 Edge Lights, 4 CL	4-22, 4-CL
22	E	60, 61	Runway 4-22 Edge Lights, 22 CL	4-22, 22-CL
12L-30R	W	34	Runway 12L-30R Edge Lights	12L-30R
30L DEP	W	12, LAHSO	Taxiway G Centerline 3 Lights & LAHSO Lights	G-CL-3, LAHSO

Note: All Taxiways are invoked to their preset state for any runway configuration.

**TABLE 9 - RUNWAY BUTTON RELATION TO CIRCUIT CONTROL
(PRESET PAGE)**

Circuit	Vault	CCR	CCR Steps	Daytime Visibility (Runway Visual Range)				
				< 1M	1M < 2M	2M < 3M	3M to 5M	> 5M
12R-30L	W	31	5	5	4	3	0	0
12R-CL	W	30	5	5	4	3	0	0
30L-CL	W	32	5	5	4	3	0	0
12R-TDZ	W	33	5	5	4	3	0	0
4-22	E	60	5	5	4	3	0	0
4-CL	E	62	5	5	4	3	0	0
22-CL	E	61	5	5	4	3	0	0
12L-30R	W	34	*5	3	0	0	0	0
A	W	11	3	3	0	0	0	0
B	W	12	3	3	0	0	0	0
D	E	56	3	3	0	0	0	0
E-Cargo	E	51	3	3	0	0	0	0
F	E	57	3	3	0	0	0	0
G-1	W	02	3	3	0	0	0	0
G-2	W	04	3	3	0	0	0	0
G-3	W	06	3	3	0	0	0	0
H-1	W	13	3	3	0	0	0	0
H-2	W	14	3	3	0	0	0	0
J	W	09	3	3	0	0	0	0
L	W	10	3	3	3	3	3	3
M	W	07	3	3	0	0	0	0
N-1	E	52	3	3	0	0	0	0
N-2	E	53	3	3	0	0	0	0
N-3	E	54	3	3	0	0	0	0
Q	E	55	3	3	0	0	0	0
R	W	08	3	3	0	0	0	0
R Ext / S	W	35	3	3	0	0	0	0
G-CL (NW)	W	15	3	3	0	0	0	0
G-CL (SE)	W	16	3	3	0	0	0	0
G-CL (3)	W	12	3	3	0	0	0	0

* 5-Step CCR controlled as 3-step CCR

TABLE 10 - CIRCUIT BRIGHTNESS LEVELS AT SELECTED DAYTIME VISIBILITY

Circuit	Vault	CCR	CCR Steps	Nighttime Visibility (Runway Visual Range)				
				< 1M	1M < 2M	2M < 3M	3M to 5M	> 5M
12R-30L	W	31	5	4	3	3	2	1
12R-30L	W	31	5	4	3	3	2	1
12R-CL	W	30	5	4	3	3	2	1
30L-CL	W	32	5	4	3	3	2	1
12R-TDZ	W	33	5	4	3	3	2	1
4-22	E	60	5	4	3	3	2	1
4-CL	E	62	5	4	3	3	2	1
22-CL	E	61	5	4	3	3	2	1
12L-30R	W	34	*5	2	1	1	1	1
A	W	11	3	2	1	1	1	1
B	W	12	3	2	1	1	1	1
D	E	56	3	2	1	1	1	1
E-Cargo	E	51	3	2	1	1	1	1
F	E	57	3	2	1	1	1	1
G-1	W	02	3	2	1	1	1	1
G-2	W	04	3	2	1	1	1	1
G-3	W	06	3	2	1	1	1	1
H-1	W	13	3	2	1	1	1	1
H-2	W	14	3	2	1	1	1	1
J	W	09	3	2	1	1	1	1
L	W	10	3	3	2	2	2	2
M	W	07	3	2	1	1	1	1
N-1	E	52	3	2	1	1	1	1
N-2	E	53	3	2	1	1	1	1
N-3	E	54	3	2	1	1	1	1
Q	E	55	3	2	1	1	1	1
R	W	08	3	2	1	1	1	1
R Ext / S	W	35	3	2	1	1	1	1
G-CL (NW)	W	15	3	2	1	1	1	1
G-CL (SE)	W	16	3	2	1	1	1	1
G-CL (3)	W	12	3	2	1	1	1	1

* 5-Step CCR controlled as 3-step CCR

TABLE 11 - CIRCUIT BRIGHTNESS LEVELS AT SELECTED NIGHTTIME VISIBILITY

Button Designation	Lighting Circuits Controlled			
	Vault	CCR #	Description	Circuits
12R-30L	W	31	Runway 12R-30L Edge Lights	12R-30L
12R CL	W	30	Runway 12R Centerline Lights	12R-CL
30L CL	W	32	Runway 30L Centerline Lights	30L-CL
12R TDZ	W	33	Runway 12R Touchdown Zone Lights	12R-TDZ
4-22	E	60	Runway 4-22 Edge Lights	4-22
4 CL	E	62	Runway 4 Centerline Lights	4-CL
22 CL	E	61	Runway 22 Centerline Lights	22-CL
12L-30R	W	34	Runway 12L-30R Edge Lights	12L-30R

**TABLE 12 - RUNWAY BUTTON RELATION TO CIRCUIT CONTROL
(RUNWAY LIGHTING PAGE)**

Button Designation	Lighting Circuits Controlled			
	Vault	CCR #	Description	Circuits
A	W	11	Taxiway A Edge Lights	A
B	W	12	Taxiway B Edge Lights	B
D	E	56	Taxiway D Edge Lights	D
F	E	57	Taxiway F Edge Lights	F
G	W	02, 04, 06	Taxiway G Edge Lights	G-1, G-2, G-3
H	W	13,14	Taxiway H Edge Lights	H-1, H-2
J	W	09	Taxiway J Edge Lights	J
M	W	07	Taxiway M Edge Lights	M
N	E	52, 53, 54	Taxiway N Edge Lights	N-1, N-2, N-3
Q	E	55	Taxiway Q Edge Lights	Q
R	W	08	Taxiway R Edge Lights	R
R Ext / S	W	35	Taxiway R Extension / S Edge Lights	R Ext / S
G - CL	W	15, 16	Taxiway G Centerline Lights	G-CL-NW, G-CL-SE

**TABLE 13 - TAXIWAY BUTTON RELATION TO CIRCUIT CONTROL
(TAXIWAY LIGHTING PAGE)**

CCR #	Identification		Description	Vault Room	Mfg.	Model	Monitoring	Size kW	Steps	Primary Volts	Output Amps
	Existing	Proposed									
1	51		East Cargo Edge	Dry	CH	31360-076-3		7.5	3	480	6.6
2	54		TW N-3 Edge	Dry	CH	31360-106-3		10	3	480	6.6
3	55		TW Q Edge	Dry	CH	31360-106-3		10	3	480	6.6
4	57		TW F Edge	Dry	CH	31360-106-3		10	3	480	6.6
5	56		TW D Edge	Dry	CH	82860-D-15-8-66-03		15	3	480	6.6
6	52		TW N-1 Edge	Dry	CH	82860-D-15-8-66-03		15	3	480	6.6
7	53		TW N-2 Edge	Dry	CH	82860-D-15-8-66-03		15	3	480	6.6
8	60		RW 4-22 Edge	Wet	CH	31060-30-P-4		30	5	480	6.6
9	61		RW 22 Centerline	Wet	CH	31060-30-P-4		15	5	480	6.6
10	62		RW 4 Centerline	Wet	CH	31060-30-P-4		15	5	480	6.6

TABLE 14 - EAST VAULT CCR DATA

CCR #	Identification		Description	Vault Room	Mfg.	Model	Monitoring	Size kW	Steps	Primary Volts	Output Amps
	Existing	Proposed									
1	12		TW G CL (3)	Dry	TBD	TBD		7.5	3	208	6.6
2	11		TW A Edge	Dry	CH	31360-101-3		10	3	208	6.6
3	09		TW J Edge	Dry	CH	31360-071-3		7.5	3	208	6.6
4	07		TW M Edge	Dry	CH	31360-071-3		7.5	3	208	6.6
5	10		TW L 3-Light Bar	Dry	CH	31360-071-3		7.5	3	208	6.6
6	12		TW B Edge	Dry	CH	31360-071-3		7.5	3	208	6.6
7	04		TW G-2 Edge	Dry	CH	31360-101-3		10	3	208	6.6
8	06		TW G-3 Edge	Dry	CH	31360-101-3		10	3	208	6.6
9	14		TW H-2 Edge	Dry	CH	82860-D-15-1-66-03-23T	Computer Interface	15	3	208	6.6
10	08		TW R Edge	Dry	CH	82860-D-15-1-66-03		15	3	208	6.6
11	13		TW H-1 Edge	Dry	CH	82860-D-15-1-66-03		15	3	208	6.6
12	02		TW G-1 Edge	Dry	CH	82860-D-15-1-66-03		15	3	208	6.6
13	15		TW G CL (NW)	Dry	CH	82860-D-15-1-66-03		15	3	208	6.6
14	16		TW G CL (SE)	Dry	CH	82860-D-15-1-66-03		15	3	208	6.6
15	30		RW 12R CL	Wet	CH	31060-31-P-4		30	5	480	20
16	31		RW 12R-30L Edge	Wet	CH	31060-50-P-4		50	5	480	20
17	32		RW 30L CL	Wet	CH	31060-31-P-4		30	5	480	20
18	33		RW 12R TDZ	Wet	CH	31060-31-P-4		30	5	480	20
19	34		RW 12L-30R Edge	Wet	CH	31060-30-P-4		30	5	480	6.6
20	35		TW R Ext/S Edge	Dry	TBD	TBD		15	3	208	6.6

TBD = To Be Determined (new this project or ongoing project)

TABLE 15 - WEST VAULT CCR DATA

Item	Description	Vault Room	Mfg.	Model	Voltage Amps	Size kW	Control/Monitoring Requirements
1	Automatic Transfer Switch (ATS)	Dry	Catapillar	TCF3B6PXXXXXXX0	480 600		Detect and Monitor Switch Position, Add CT's to Load Side of Switch to Monitor Phase Currents (A, B, & C)
2	Emergency Standby Generator	Gen	Catapillar	3406 Set	480 451	300	Add Start/Stop Remote Control
3	Emergency Power	Dry			480		Add PT's to Monitor Phase Voltages (A-B, B-C, & C-A)
4	Commercial Power	Dry			480		Add PT's to Monitor Phase Voltages (A-B, B-C, & C-A)

Note: CT's and PT's shall not be located in ATS enclosure. Contractor shall provide a separate enclosure and coordinate location with Maintenance.

TABLE 16 - EAST VAULT ADDITIONAL EQUIPMENT

Item	Description	Vault Room	Mfg.	Model	Voltage Amps	Size kW	Control/Monitoring Requirements
1	Automatic Transfer Switch (ATS)	Wet	Catapillar	TCE2B6PXX2XXXXRXX0	480 400		Detect and Monitor Switch Position, Add CT's to Load Side of Switch to Monitor Phase Currents (A, B, & C)
2	Emergency Standby Generator	Gen	Cummins	500FDR7116JJW	480 376	250	Start/Stop Remote Control
3	Emergency Power	Wet			480		Add PT's to Monitor Phase Voltages (A-B, B-C, & C-A)
4	Commercial Power	Wet			480		Add PT's to Monitor Phase Voltages (A-B, B-C, & C-A)
5	Land & Hold Short Operation (LAHSO) TBD = To Be Determined (ongoing project)	Dry	CH	TBD	208	0.31	Control from 30L DEP Button

Note: CT's and PT's shall not be located in ATS enclosure. Contractor shall provide a separate enclosure and coordinate location with Maintenance.

TABLE 17 - WEST VAULT ADDITIONAL EQUIPMENT