CITY OF HOUSTON

John Whitmire
Mayor

HOUSTON AIRPORT SYSTEM

Jim Szczesniak
Director of Aviation

George Bush Intercontinental ~ William P. Hobby ~ Ellington Airport

April 25, 2024

SUBJECT: **Addendum No. 1**

RE: Invitation to Bid (ITB) Solicitation No. H93-IAHLVR-2024-021, IAH South Lighting Vault Renovation at George Bush Intercontinental Airport (IAH); Project No. 952

To: All Prospective Bidders:

This Addendum is being issued for the following reasons:

I. Extend the deadline for submission of questions from April 23, 2024, **to April 29, 2024, by 10:00 A.M.**

II. Add the Geotechnical Report.

III. Revise Project Manual Div00, Document 00419B-9 – Bid Form Part B. The Cash Allowance Table includes allowance for Centerpoint Energy charges for electrical service shutdowns.

IV. Revise drawings for the Airfield Lighting Control & Monitoring System (ALCMS) for Airfield Service Center (ASC) Vault, North Vault, West Vault, and Air Traffic Control Tower (ACTC).

1. SV-G0.01 - Cover Page – Title block including Addendum 1.
2. SV-G0.02 – Codes, Guidelines and Drawing List – Edits to drawing list indicating drawings included with Addendum 1.
3. SV-E0.01 – Electrical Abbreviations, Symbols and Notes – Clarified references and typos.
4. SV-EP2.01 – Electrical Power Plan – Misc. Circuit # revisions, added Panel LVS Section 2, added one receptacle.
5. SV-EP2.02 – Electrical Wire Vault Power Plan – Misc. Circuit # revisions
6. SV-EP2.01 – Electrical Grounding Plan – Moved key note.
7. SV-EF3.01 – Fire Alarm Coordination Plan – Added General Note E.
8. SV-E4.01 – Electrical One-line Diagram – added Panel LVS Section 2. Revised generator fuel tank to UL2085.
9. SV-E6.01 – Electrical Schedules – Added lighting fixture note 5.
10. SV-E6.02 – Electrical Schedules - Misc. Circuit # revisions, added Panel LVS Section 2, updated loads summary.
11. ASC-EL7.01 ASC Vault Electrical Plan – Added ALCMS plan for ASC.
12. ATCT-EL7.01 ATCT Vault Electrical Plan – Added ALCMS plan for ATCT.
13. NV-EL7.01 North Vault Electrical Plan– Added ALCMS plan for North Vault.
14. NV-EL7.02 North Vault Electrical Plan – Added ALCMS plan for North Vault.
15. WV-EL7.01 West Vault Electrical Plan – Added ALCMS plan for West Vault.
16. WV-EL7.02 West Vault Electrical Plan – Added ALCMS plan for West Vault.

V. **Revise** Project Manual Div01, Specifications, Sections 260524, 263213, 263623.

1. Section 260526 – Grounding and Bonding for Electrical Systems - Clarified grounding requirements for equipotential grounding and building grounding.
2. Section 263213 – Standby Engine Generator System - Revised generator fuel tank to UL2085, clarified noise criteria to 75dBA.
3. Section 263623 – Automatic Transfer Switches – Clarified preferred source controls.

When issued, Addendum shall automatically become part of the solicitation documents and shall supersede any previous specification(s) and/or provision(s) in conflict with the Addendum. Addendum will be incorporated into the Agreement as applicable. It is the responsibility of the bidder(s) to ensure that it has obtained all such letter(s). By submitting a bid on this project, bidder(s) shall be deemed to have received all Addenda and to have incorporated them into their bid.

If further clarification is needed regarding this solicitation, please contact Senior Procurement Specialist, Amanda Joseph via email at amanda.joseph@houstontx.gov.

Sincerely,

DS

DocuSigned by:
Cathy Vander Plaats
02232028DE994I4...

Cathy Vander Plaats
Aviation Procurement Officer
Houston Airport System

cc: File, ITB Solicitation No. H93-IAHLVR-2024-021

GEOTECHNICAL INVESTIGATION
SOUTH VAULT REPAIR AND REHABILITATION
AT GEORGE BUSH INTERCONTINENTAL AIRPORT (IAH)
HOUSTON, TEXAS

SUBMITTED TO

JACOBS ENGINEERING GROUP, INC.

818 Town & Country Blvd.

Houston, Texas 77024

BY

HVJ ASSOCIATES, INC.

Houston, Texas

April 19, 2024

HVJ ASSOCIATES

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April 19, 2024

Mr. Art Otto, PE
Sr. Project Manager
Jacobs Engineering Group, Inc.
818 Town & Country Blvd.
Houston, Texas 77024

Re: Geotechnical Investigation
South Vault Repair and Rehabilitation at George Bush Intercontinental Airport (IAH)
Houston, Texas
Owner: Houston Airport Systems (HAS)
HVJ Report No.: HG2110011

Dear Mr. Otto:

Submitted herein is the final report of our geotechnical investigation for the above referenced project. The study was performed in accordance with proposal number HG2110011 dated February 3, 2021 and is subject to the limitations presented in this report. It has been a pleasure to work with you on this project and we appreciate the opportunity to be of service. Please notify us if there are questions or if we may be of further assistance.

Sincerely,

HVJ ASSOCIATES, INC.
Texas Firm Registration No. F-000646

K. Nitharsan

Nitharsan Kanapathippillai, PE
Senior Project Manager

STATE OF TEXAS
NITHARSAN KANAPATHIPPILLAI
132996
LICENSED PROFESSIONAL ENGINEER
4/19/2024

Navya Dinesh

Navya Dinesh
Staff Engineer

NK/ND

This document was released under the authority of Nitharsan Kanapathippillai, PE 132996 on April 19, 2024. Alteration of a sealed document without proper notification to the responsible engineer is an offense under the Texas Engineering Practice Act.

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APPENDICES

1 EXECUTIVE SUMMARY

HVJ Associates, Inc. was retained by Jacobs Engineering Group Inc. to provide geotechnical services for repair and rehabilitation of the existing South Vault facility at George Bush Intercontinental Airport (IAH) in Houston, Texas. The proposed improvements include installation of new generator, fuel tank and switch gear enclosed by concrete masonry unit wall. The proposed improvements also include installation of a duct bank using open cut technique. The purpose of this study was to perform a geotechnical investigation and provide design and construction recommendations for the proposed structures mentioned above.

Subsurface conditions at the site were investigated by drilling three soil borings to a depth of 15 and 30 feet below existing grade. Based on the subsurface conditions revealed by the soil borings, the findings and recommendations of this report are summarized below:

1. Medium dense cohesionless soils (SC and SM) were generally encountered below the existing grade to a depth of approximately 15 to 20 feet underlain by stiff to hard cohesive soils (CL, CH) to the termination depth of borings. Notably, Boring B-1 was terminated at 15 feet and a cohesive soil layer was observed between 6 and 10 feet in Boring B-1. Details of the subsurface stratigraphy encountered in the borings are shown on the boring logs presented in Appendix A.

2. Groundwater was observed in borings B-2 through B-3 at a depth between 18.9 and 20 feet below the existing grade during the drilling operations. It should be noted that groundwater levels determined during drilling may not accurately reflect the groundwater conditions during construction, and therefore should only be considered as approximate.

3. Based on the information provided by Jacobs, we understand that the project involves installation of new generator, fuel tank and switch gear supported on concrete pad. We also understand that the proposed 20-foot tall concrete masonry unit enclosure wall will be supported on the same generator pad. Low plasticity sandy subgrade soils were observed at the proposed equipment pad locations. The estimated PVR of the subgrade soils is expected to be about 0.36 inches for dry condition.

   We recommend an allowable bearing capacity of 2,000 psf for the proposed concrete pads. This includes a factor of safety of 3. The design and construction recommendations for the concrete pad is provided in Section 6 of the report.

4. As requested by Jacobs, we have provided strip footings and straight sided shafts foundation recommendations as alternative foundation systems for the proposed enclosure wall. Based on our assessment of the on-site soils, foundation design and construction recommendations for the enclosure wall foundations are provided in Section 7 of this report.

5. The project involves installation of a duct bank by open cut technique. The exact invert depth of the duct bank is not available at the time of writing this report. We assumed that the invert depth of the proposed duct bank may vary between 5 and 10 feet below the existing grade. Recommendations for the installation of utility duct bank using the open cut technique are discussed in Section 8 of this report.

Please note that this executive summary does not fully relate our findings and opinions. Those findings and opinions are only presented through our full report.

2 INTRODUCTION

2.1 Project Description

HVJ Associates, Inc. was retained by Jacobs Engineering Group Inc. to provide geotechnical services for repair and rehabilitation of the existing South Vault facility at George Bush Intercontinental Airport (IAH) in Houston, Texas. The proposed improvements include installation of new generator, fuel tank and switch gear enclosed by concrete masonry unit wall. The proposed improvements also include installation of a duct bank using open cut technique. The purpose of this study was to perform a geotechnical investigation and provide design and construction recommendations for the proposed structures mentioned above. A site vicinity map is presented on Plate 1.

2.2 Geotechnical Investigation Program

The objectives of this study were to gather information on subsurface conditions at the proposed project location and to provide geotechnical recommendations for the proposed structures. The objectives were accomplished by:

- Drilling three soil borings to a depth of 15 and 30 feet below existing grade to determine soil stratigraphy and to obtain samples for laboratory testing;
- Performing laboratory tests to determine physical and engineering characteristics of the soils; and
- Performing engineering analyses to develop design guidelines and recommendations for the proposed structures.

Subsequent sections of this report contain descriptions of the field exploration, laboratory testing program, general subsurface conditions, design recommendations, and construction considerations.

3 FIELD INVESTIGATION

3.1 Geotechnical Borings

The field exploration program undertaken at the project site was performed between March 6th and March 12th, 2024. The boring details are presented in Table 3-1. The soil borings were drilled using truck-mounted drilling equipment using dry and wet rotary techniques. The boring on the pavement was backfilled with non-shrink grout by the tremie method and the borings away from the pavement was borehole was backfilled soil cuttings and bentonite chips after completion. The approximate boring location is presented on the Plan of Borings, Plate 2 of the report.

3.2 Survey Data

Survey data of boring locations provided by Jacobs Engineering Group Inc. is presented in the Table 3-1 below and on the boring logs in Appendix A.

Table 3-1 – Boring Details

Structure	Boring No.	Depth, Feet	Northing, Feet	Easting, Feet	Approximate Elevation, feet
Duct Bank	B-1	15	13,923,519.00	3,130,722.84	88.29
Generator, Fuel Tank and Switch Gear Pad	B-2	30	13,923,471.33	3,130,742.53	88.29
	B-3	30	13,923,443.35	3,130,715.76	88.01

Coordinates shown are referenced to Texas State Plane Coordinate System, South Central Zone, North American Datum 83. Elevations are referenced to North American Vertical Datum 1988.

3.3 Sampling Methods

Soil samples were obtained continuously to a depth of 20 feet and then at 5-foot intervals thereafter to the termination depth of the borings. The samples were obtained continuously to the termination depths for the borings less than 20 feet deep. Cohesive soil samples were obtained with a three-inch thin-walled (Shelby) tube sampler in general accordance with ASTM D1587 standard. Cohesionless soil samples were sampled with the split spoon sampler in accordance with the ASTM D 1586 standard. Each sample was removed from the sampler in the field, carefully examined, and then classified. The shear strength of the cohesive soils was estimated by a hand penetrometer in the field. Suitable portions of each sample were sealed and packaged for transportation to our laboratory. Detailed descriptions of the soils encountered in the borings are given on the boring logs presented in Appendix A, which also includes a Key to Terms and Symbols for the soil classifications used on the boring logs.

3.4 Water Level Measurements

Groundwater observations were made during drilling operations. Groundwater measurements are presented in Section 5.4.

4 LABORATORY TESTING

Selected soil samples were tested in the laboratory to determine applicable physical and engineering properties. All tests were performed according to the relevant ASTM Standards. These tests consisted of moisture content measurement, pocket penetrometer, percent passing No. 200 sieve, Atterberg limits, Unconfined Compression (UC) and Unconsolidated Undrained Triaxial (UU) tests.

The Atterberg Limits and percent passing number 200 sieve tests were utilized to verify field classification by the Modified Unified Soils Classification System, and the compression tests (UU and UC) were performed to obtain the undrained shear strength of the soil. The type and number of tests performed for this investigation are summarized below:

Table 4-1 – Laboratory Test Summary

Type of Test	Number of Tests
Moisture Content (ASTM D2216)	21
Atterberg Limits (ASTM D4318)	14
Percent Passing No. 200 Sieve (ASTM D1140)	14
Unconfined Compression (ASTM D2166)	2
Unconsolidated Undrained Triaxial (ASTM D2850)	2

The laboratory test results are presented on the boring logs in Appendix A. The conversion between pocket penetrometer readings obtained in the field to the shear strength parameters presented on the boring log were obtained using a conversion factor of 1/3. A summary of laboratory test results, is presented in Appendix B.

5 SITE CHARACTERIZATION

5.1 General Geology

There are two major surface geological formations that exist in the Houston area: the Beaumont formation and the Lissie formation. The Beaumont formation is a relatively younger formation generally found to the southeast of the Lissie formation. The Beaumont formation dips southeastward and extends beneath beach sand and waters of the Gulf of Mexico as far as the continental shelf. The project site is located in an area where the Lissie formation is typically encountered.

The upper Lissie formation is sometimes denoted as the Montgomery formation. The upper Lissie formation is heterogeneous, containing interbedded layers of clay, sand and silt. It was deposited in mid-Pleistocene times in shallow coastal river channels and flood plains. The clay present in the formation has been preconsolidated by a process of desiccation. Numerous wetting and drying cycles have produced a network of randomly oriented and closely spaced joints, which are sometimes slickensided, that is, have a shiny appearance when exposed. The joint pattern strongly influences the engineering behavior of the soil.

The sand layers vary in compactness from loose to very dense, and in thickness from a fraction of an inch to many feet due to an irregular depositional environment. Sands are generally subrounded to subangular and vary from coarse to very fine, are poorly graded, and often contain significant amounts of silt-sized particles in the sand matrix.

5.2 Geologic Faulting

The tectonic history of the Texas Gulf Coast includes a relatively stable depositional cycle since the Cretaceous Period (about 65 million years). During this period the area has been subjected to deposition of clays, silts, and sands resulting in over 30 thousand feet of sedimentary rocks. Underlying this clastic sequence are salt formations, which have migrated upwards to produce the typical salt dome features associated with the Texas Gulf Coast. In conjunction with salt movement, dewatering and compaction of some of the deeper sediments in the basin have resulted in the development of growth faults.

A literature review was conducted to identify the documented faults in the project area (Campbell, et al., 2018). The primary objective of this review was to evaluate available information from published and open file reports. Based on the review, the project site is situated at about 0.5 mile southwest of Jetero fault. Faulting is not anticipated to impact the project site; however, unmapped faults may exist near the site. A detailed fault study is not within the scope of this study. A fault map is presented on Plate 4 of this report.

5.3 Soil Stratigraphy

HVJ's interpretation of soil and groundwater conditions at the project site is based on information obtained at the boring locations only. This information has been used as the basis for our conclusions and recommendations. Significant variations at areas not explored by the project borings may require re-evaluation of our findings and conclusions.

Medium dense cohesionless soils (SC and SM) were generally encountered below the existing grade to a depth of approximately 15 to 20 feet underlain by stiff to hard cohesive soils (CL, CH) to the termination depth of borings. Notably, Boring B-1 was terminated at 15 feet and a cohesive soil layer was observed between 6 and 10 feet in Boring B-1.

5.4 Groundwater Conditions

Groundwater was encountered in borings B-2 and B-3 during drilling operations. Table 5-3 shows a record of the groundwater readings taken during drilling operations.

Table 5-3 – Groundwater Readings

Structure	Boring No.	Groundwater Depth below Existing Grade During Drilling, Feet
Duct Bank	B-1	Not Observed
Generator, Fuel Tank and Switch Gear Pad	B-2	20.0
	B-3	18.9

It should be noted that groundwater levels determined during drilling may not accurately reflect the groundwater conditions during construction, and therefore should only be considered as approximate. Groundwater levels will fluctuate seasonally and in response to rainfall. Other factors that might impact groundwater levels include leakage from existing utility lines.

6 CONCRETE PAD FOUNDATION DESIGN AND CONSTRUCTION RECOMMENDATIONS

6.1 General

Based on the information provided by Jacobs, we understand that the project involves installation of new generator, fuel tank and switch gear supported on 4 feet thick concrete pad. We also understand that the proposed 20-foot tall concrete masonry unit enclosure wall will be supported on the same generator pad . The proposed generator and fuel tank will be installed in one pad. Borings B-2 and B-3 were performed in the vicinity of the proposed generator, fuel tank and switch gear location. The preliminary loads and the pad sizes provided by Jacobs are summarized in the table below.

Table 6-1 – Equipment Pad Details

Equipment	Load, lbs	Concrete Pad Size, Feet
Generator and Fuel Tank	75,000	65x20
Switch Gear	20,000	30x30

6.2 Expansive Soil

One of the major design factors for lightly loaded structures in the general project area is the shrinking and swelling potential of fine-grained soils. The shrink/swell movements can be estimated with the Plasticity Index (PI). Generally, the higher the PI of a material, the greater the potential for soil movements during moisture changes. Based on the soil conditions encountered in the boring drilled in this study, the soils at this site seem to have low to medium expansion potential. Potential Vertical Rise (PVR) values were estimated by the TEX 124-E method for the upper 7 feet of soils at the site. The PVR represents the potential ability of a soil material at a specific density, moisture and loading condition to swell. It indicates the potential movement of the soils that may be realized if the soils become wet from a relatively dry condition. The PVR value is provided to demonstrate the relative severity of the swell potential of the clayey soils at the site. However, this value is not intended to be used directly as a design parameter. The actual amount of swell the slab may experience depends on many variables, such as the time of year the slab is poured, which are not known at the time of this study. Low plasticity sandy subgrade soils were generally encountered near the proposed structure to a depth of 18 to 20 feet below the existing grade. The estimated PVR of the subgrade soils is expected to be about 0.36 inches for dry condition.

6.3 Allowable Bearing Capacity

Based on the subsurface soils encountered at this location, we recommend an allowable bearing capacity of 2,000 psf for the proposed concrete pads. This includes a factor of safety of 3. This bearing capacity recommendation assumes that the subgrade is relatively dry and undisturbed and prepared as discussed in Section 6.5. The subgrade reaction modulus (k) may be required for the concrete pad. A reaction modulus value of 150 pounds per cubic inch can be used.

6.4 Settlement

Based on the loads and pad sizes provided to us by Jacobs, we estimate that the settlement will be less than 1-inch.

6.5 Resistance to Lateral Loads

Concrete pad resist imposed lateral loads through friction acting on the base of the foundation and by some passive resistance of the soil adjacent to the foundation. We recommend using coefficient of friction value of 0.34 at the base of concrete pad for the lateral resistance calculations. Using a factor of safety of 3, an allowable passive pressure of 50 pounds per cubic foot can be used for the natural soils. We recommend ignoring the passive resistance offered by the top 2 feet of soil. The foundation depth can be increased beyond 2 feet to develop the passive resistance.

6.6 Resistance to Uplift Loads

The lateral loads imposed on the enclosure wall may cause uplift of the concrete pad in addition to buoyant uplift pressures acting on the base of the unit located below the water table. The Buoyant uplift pressure is a function of the depth to groundwater. The largest buoyant uplift pressure will occur when groundwater is at the ground surface. The ultimate uplift capacity of concrete pad is the

weight of the pad and enclosure wall plus any additional dead load of the equipment. We recommend using an effective unit 90 pcf for reinforced concrete and total unit weight 150 pcf for concrete. We recommend a factor of safety of 1.5 be applied to compute the allowable buoyant uplift resistance.

6.7 Site Preparation and Select Fill

The structure area should be stripped of all vegetation any other deleterious materials or gravels. Stripped areas should be appropriately graded and shaped to prevent ponding of water. Pumping may occur if the site becomes wet. Following site stripping, the exposed subgrade should be proof-rolled with heavy construction equipment to identify any weak areas. Weak areas, if encountered, should be excavated to firm subgrade and be replaced with select fill. The exposed subgrade should be compacted to at least 95 percent of the materials maximum dry density determined according to ASTM D698 at a moisture content equal to (± 3) percentage points of the optimum value. Select fill required to raise the grade or backfill grub holes should consist of lean clay or sandy lean clay with a Liquid Limit less than 40 and a Plasticity Index between 8 and 20. Fill material that is used should be placed in loose lifts not exceeding eight inches and should be compacted to 95 percent of the maximum dry density at a moisture content between optimum and 2% wet of optimum as determined by ASTM D 698-12.

Drainage around the concrete pad location is an important consideration in its performance. If an area of poor drainage is allowed to exist around this location, the subgrade soils in that area should have greater access to water. This may cause the soils in that area to exhibit higher shrink-swell movements compared to soils away from the area of poor drainage. We recommend that 1-2% grade sloping away from the structure be provided so as to discourage water logging in the foundation areas.

7 ENCLOSURE WALL FOUNDATION DESIGN AND CONSTRUCTION RECOMMENDATIONS

7.1 General

As requested by Jacobs, we have provided strip footings and straight sided shafts foundation recommendations as alternative foundation systems for the proposed enclosure wall . The following sections present our assessment of the on-site soils and provide foundation design and construction recommendations for the enclosure wall foundations.

7.2 Strip Footings

Allowable Net Bearing Capacity: Strip footing is a rectangular footing monolithically constructed a few feet below the grade. We recommend that strip footing be placed at a depth of at least 2 feet below the existing grade. Strip footing should be designed such that its applied bearing pressure does not exceed the allowable net bearing pressure of the underlying soils. An allowable bearing capacity of 2,000 psf can be used for the design of the strip footing founded at a depth of 2 feet below grade. This includes a factor of safety of 3.

The choice of safety factor is dependent on the duration of loading, confidence in soil parameters, design life of the structure, the expected quality of construction control, and the consequences of failure. The soil conditions encountered during construction should be of similar consistency and strength as the soil conditions reported on the boring logs.

The allowable bearing capacity for strip footing is based on the field and laboratory test data obtained at the boring locations. The contractor should verify the soil stratum at the time of construction. The excavations should be cut neat and clean with any soft or loose soils removed. Water should not be allowed to accumulate within the excavations. Should water accumulate, then any wet or softened soils should be removed or reworked if appropriate, and subsequently re-compacted.

Resistance to Uplift Loads: The ultimate uplift capacity of strip footings is the weight of the foundation plus the weight of any soil directly above the foundation. We recommend using an effective unit weight of 60 pcf for soil and 90 pcf for reinforced concrete and total unit weights of 120 pcf for soil and 150 pcf for concrete. We recommend a factor of safety of 1.5 be applied to compute the allowable uplift resistance.

Resistance to Lateral Loads: Strip footings will resist imposed lateral loads through frictional acting on the base of the foundation and by some passive resistance of the soil adjacent to the foundation. Using a factor of safety of 3, an allowable passive pressure of 50 pounds per cubic foot can be used for the natural soils. Using a factor of safety of 1.5, an allowable sliding resistance of 65 pounds per square foot can be used at the interface of bottom of base slab and soil. We recommend ignoring the passive resistance offered by the top 2 feet of soil. The foundation depth can be increased beyond 2 feet to develop the passive resistance. Alternatively, a shear key can be constructed at the bottom of the footing.

Resistance to Overturning Moment The design of strip footings subjected to overturning moments should consider a trapezoidal distribution of contact pressure between the base of the foundation and the foundation soil such that full soil contact is maintained under the foundation. We recommend the resultant be in the middle third of the foundation, and the maximum contact pressure should not exceed the allowable net bearing pressure for the foundation.

7.3 Straight Sided Shafts

Drilled straight-sided shafts can be used as an alternative foundation for the CMU wall. The ultimate compressive capacity, Q_{ult}, for a given embedded length is taken as the skin friction along the shaft wall, Q_s, and the end bearing at the tip, Q_p. Skin friction contributed at the top 5 feet from ground surface should be ignored to account for construction disturbances, and loss of adhesion between shaft wall and soil due to moisture fluctuation.

$$Q_{ult} = Q_s + Q_p = fA_{sa} + qA_E$$

Where:

A_{sa} = Embedded surface area
f = Unit skin friction
q = Unit end bearing
A_E = Cross-sectional end area

Allowable compressive capacity and uplift capacity curves were developed for 12, 18, 24, 30 and 36-inch diameter drilled shafts using the SHAFT 6.0 program by Ensoft. The capacity curves for allowable axial capacity under compression and allowable axial capacity under tension are presented in Appendix C. These curves were generated based on generalized profile of borings B-2 and B-3. For smaller diameter shafts (less than 24 inches), since it is difficult to verify if the bottom of the shaft is reasonably clean, capacity from end bearing is ignored in developing the allowable axial capacity curves. We recommend utilizing the skin friction curves presented in Plate C-1C for the allowable axial capacity under compression for shaft diameters less than 24 inches.

In order to determine the design allowable compressive capacity, a factor of safety of 2 was used to ultimate skin friction and the ultimate tip resistance. In order to determine the design allowable tensile capacity, a factor of safety of 3 was used to the ultimate skin friction capacity. The choice of safety factor is dependent on duration of loading, confidence in soil parameters, design life of structure, the expected quality of construction control, and the consequences of failure.

Lateral Capacity: Foundation elements often have to withstand significant lateral loads in addition to axial loads. Wind forces on structures are forms of lateral loading. Lateral loads or movements on a vertical shaft will be countered by the mobilization of resistance in the surrounding soils as the shaft deflects. The lateral load capacity of the shaft, therefore, will depend on the relative stiffness of the shaft and the strength of the surrounding soils. A rational analysis of a problem involving lateral loading on a shaft must consider the interaction of the soil and the structure. Equilibrium of forces and compatibility of displacements throughout the total system are the two fundamental conditions, which are to be satisfied in the analysis.

Lateral load analysis was beyond the scope of this study and should be performed using computer programs such as LPILE, etc. The input parameters for lateral load analysis are presented in Appendix D.

Group Effects: According to AASTHO LRFD Bridge Design Specifications (2020) Section 10.8.3.6, groups of shafts should have a center-to-center spacing of at least 3D, where D is the diameter of the shaft. For greater spacing, the total axial capacity will be equal to the sum of the capacities of the individual shafts in the group. The group capacity may be less than the sum of individual capacities at closer spacing. If smaller spacing is planned, HVJ should be contacted to assess group capacity.

For laterally loaded shafts groups, lateral load capacity primarily is developed by the outer row of shafts on the side opposite the direction of lateral load, which we refer to as the "front" row. The lateral load contribution of shafts behind the front row provides substantially less resistance. In order to determine a conservative capacity of a shaft group, determine the lateral capacity of the front row shafts using a program such as LPILE or another appropriate method. For shafts spaced at least 5 diameters apart the groups lateral load capacity is equal to the sum of the lateral capacity of the front row shafts. For spacing less than 5 diameters, p-multipliers should be applied to the shaft resistance. P-multipliers should be taken from Table 10.7.2.4-1 from AASHTO LRFD Bridge Design Specifications 9th Edition, 2020. A comprehensive analysis of group lateral load capacity that includes the contribution of shafts behind the front row was not in our scope.

Drilled Shaft Construction Recommendations: Shaft construction and installation should follow ACI 336.3R-14. Presented below are a few specific recommendations.

1. Excavations made for drilled shaft installation may experience sloughing due to the presence of water bearing sands. The slurry displacement method or casing will be required to prevent the cave-in of surrounding material.

2. Drilled shaft excavations should be inspected for verticality and side sloughing. Verticality is specified at one inch in ten feet of the shaft length, and should be checked to the full depth of drilled shaft.

3. Before placing concrete, the shaft bottom should be cleaned out with a drilling bucket in order to remove any sediments that may not be displaced by the concrete. The shaft bottoms should be cleaned with a "clean-out" bucket until rotation on the bottom without crowd (i.e. penetration under force) produces little spoil. Probing after clean-out is essential to verify the condition of the base of the shaft.

4. A computation of the final concrete volume for each shaft should be made. Shafts taking an unreasonably high or low volume of concrete should be cored to check their integrity.

5. Concrete should conform to the requirements Section 3.5.

6. The casing should always remain at least five feet below the level of the concrete during placement. Our analyses assume no casing will be left in place. We should be informed if casing will be left in place so revised shaft capacity calculations may be provided.

7. Shaft excavations should not be made within two shaft diameters (edge to edge) of shafts that have been concreted within the last 24 hours or from open shaft excavation.

8 DUCT BANK DESIGN CRITERIA AND RECOMMENDATIONS FOR OPEN CUT TECHNIQUES

8.1 General

The project involves installation of a new duct bank by open cut technique. The exact invert depth of the duct bank is not available at the time of writing this report. We assumed that the invert depth of the proposed duct bank may vary between 5 and 10 feet below the existing grade. Boring B-1 was performed at the proposed utility duct bank location. Recommendations for the installation of duct bank using the open cut technique are discussed in the following sections.

8.2 Geotechnical Parameters

Geotechnical design parameters for soils that may be encountered in the invert depth along the duct bank alignment are presented in Table 8-1. Design parameters given in the table are based on field and laboratory test data obtained at boring locations in the invert depth range. It must be noted that because of the nature of the soil stratigraphy at this site, parameters at locations away from the borings may vary substantially from values reported in the table.

Table 8-1 – Geotechnical Parameters for Duct Bank Design

Structure	Boring	Approx. Invert Depth, Feet	Soil Description	Total Unit Weight, pcf	Undrained Shear Strength (psf)	Friction angle (deg)	Allowable Bearing Capacity, psf
Utility Duct Bank	B-1	5-6	Clayey Sand (SC)	120	-	31	1,900
		6-10	Sandy Lean Clay (CL)	135	2,340	-	4,000

The values shown in the above table represent our interpretation of the soil properties based on the available laboratory and field test data. Use of the soil properties shown above may or may not be appropriate for a particular analysis, since choice of design parameters often depends on whether total or effective stress analysis is used, rate of loading, duration of loading, geometry of loaded area, and other factors. The total unit weight values shown above represent our interpretation of soil unit

weight at natural moisture content. The undrained shear strength and allowable bearing capacity values for cohesive soils were estimated based on the results of unconsolidated undrained triaxial tests and hand penetrometer tests. The friction angle and allowable bearing capacity values of sand are based on standard penetration test results. The allowable bearing pressures include a factor of safety of three. These values are based on the soil data obtained at the boring locations only and may be used for the noted invert depth zone.

8.3 Pipe Design

The loads imposed on underground utilities depend principally upon the method of installation, the weight of overburden soils, roadway traffic load, and loads due to existing surface structures.

For design of rigid pipe loads installed using the open-cut method, loads due to overburden and traffic can be determined from Plate 6. We recommend using the groundwater level at the bottom of the pipe for calculations associated with Plate 3. The traffic load is generally based on AASHTO HS-20 truckloads as indicated in Table 5.1 of the American Water Works Association Manual M11 (2017).

8.4 Open Cut Bedding and Backfill

Bedding: Duct bank embedment (bedding, haunching, and initial backfill) material for utilities should be in accordance with City of Houston Standard Specifications Sections 02317 and 02320. If water bearing sands are encountered during excavation, we recommend groundwater control in accordance with Section 01578 of City of Houston Standard Specification to achieve stable trench conditions.

Trench Backfill: Trench backfill (initial backfill to the pavement base or subgrade) should be in accordance with Section 02317, Excavation and Backfill for Utilities, of the latest City of Houston Standard Specifications. Fill material should be placed in loose lifts not exceeding eight inches, and should be compacted to 95 percent of the standard Proctor maximum dry density as determined by ASTM D 698 as specified in City of Houston Standard Specifications, Section 02317. The backfill up to 12 inches above the top of the pipe should be compacted carefully so as to prevent structural damage to the pipe.

8.5 Open Cut Excavation Considerations

Excavations should satisfy two requirements. First, the soils above final grade must be removed without disturbing the soil below, which will support constructed facilities. Second, the sides of the excavation must be stable to prevent damage to adjacent streets and facilities as a result of either vertical or lateral movements of the soil. In addition, a satisfactory excavation procedure must include an adequate construction dewatering system to lower and maintain the water level, if encountered, at least a few feet below the lowest excavation grade.

Excavation Stability: Excavations shall be shored, laid back to a stable slope or some other equivalent means may be used to provide safety for workers and adjacent structures. Earth pressures for braced excavations are presented on Plates 5A thru 5C. Assessment of the need for excavation sloping, use of trench boxes, or other measures required to provide a stable excavation, and the use of appropriate construction practices and/or equipment is the contractor's responsibility. The following comments are intended to represent common solutions to stability problems encountered in similar soil conditions in the Houston area and may not be construed as excavation system design recommendations. The excavation operations shall be performed in accordance with 29 CFR Part 1926 subpart P, as amended, including rules published in the Federal Register, Vol. 54, No. 209,

dated October 31, 1989, as a minimum. In addition, the provisions of legislation enacted by the Texas Legislature and City of Houston should be satisfied.

The OSHA soil classifications for the subsurface soils in boring B-1 are presented in Table 8-2. We recommend that a professional engineer should design temporary support for trenches deeper than 20 feet, and that the OSHA tables are not used below this depth. In general, it is our opinion that the pressure distribution (for braced walls) should be used for design of sheeting or trench boxes. To reduce the potential for ground movement adjacent to the top of the excavation, the bracing should be preloaded in stages as the excavation is deepened. The detailed earth pressure diagram is presented on Plates 5A thru 5C.

Table 8-2 – OSHA Soil Classification

Boring	OSHA Soil Type		
	Depth of Trench (feet)		
	0 – 5	5 – 10	10-15
B-1	C	C	C

The contractors should be aware of potential excavation stability problems while working in the vicinity of old trenches and the excavation system should be designed to accommodate this weak material (trench backfill). The vertical walls of excavations should be located at a safe distance from existing utilities in order to prevent movement in the soil mass behind the excavation that may adversely affect the utilities. We recommend that the horizontal distance of existing utilities should be greater than their vertical distance from the bottom of excavation.

8.6 Groundwater Control

Based on our field investigation, groundwater seepage may not be expected in excavations made for duct bank installation. Assessment of the need for groundwater control and installation of appropriate dewatering equipment is the contractor's responsibility. The following comments are intended to represent common solutions to groundwater control problems encountered in similar soil conditions in the Houston area, and may not be construed as dewatering system design recommendations.

A conventional pump and sump arrangement may be adequate if water bearing cohesive soils are encountered during trench excavations. Well points or eductors may be utilized to lower the groundwater level to at least three feet below the excavation level where water bearing cohesionless soils are encountered. These are generally not effective below about 15 feet beneath the top of the well point, and deeper dewatering requires deep wells with submersible pumps and eductors. Well points or eductors may be utilized if water bearing sand is encountered. In any case, the groundwater control system used must provide a relatively dry, stable base for construction.

Control of groundwater should be accomplished in a manner that will preserve the strength of the foundation soils; will not cause instability of the excavation; and will not result in damage to existing structures. Where necessary to this purpose, the water will be lowered at least 3 feet in advance of excavation by pump and sump arrangement, wells, well points, or similar methods. Open pumping should not be permitted if it results in boils, loss of fines, softening of the subgrade, or excavation instability. Discharge should be arranged to facilitate sampling by the owner's representative or engineer.

8.7 Select Fill and General Earthwork Recommendations

The select fill required to raise the grade should consist of lean clay/sandy lean clay with a liquid limit less than 40 and a plasticity index between 8 and 20. Fill material that is used should be placed in loose lifts not exceeding eight inches and should be compacted to 95 percent of standard Proctor maximum dry density as determined by ASTM D698.

8.8 Spoil Disposal

Spoil from construction will be generated from the excavations. Soils that will be excavated from this project area will consist primarily of low plasticity cohesive soils and cohesionless soils. However, the low plasticity cohesive soils (PI < 20) and any cohesionless soils may be suitable for use in engineered fill.

9 DESIGN REVIEW

HVJ should be retained to review the final design plans and specifications for this project. During the construction phase of this project, HVJ should provide the observation services so our geotechnical recommendations may be interpreted and implemented correctly.

10 LIMITATIONS

This investigation was performed for the exclusive use of Jacobs Engineering Group Inc. and Houston Airport Systems (HAS) to provide geotechnical services for South Vault Repair and Rehabilitation at IAH in Houston, Texas. HVJ has endeavored to comply with generally accepted geotechnical engineering practice common in the local area. HVJ makes no warranty, express or implied. The analyses and recommendations contained in this report are based on data obtained from subsurface exploration, laboratory testing, the project information provided to us and our experience with similar soils and area conditions. The methods used indicate subsurface conditions only at the specific locations where samples were obtained, only at the time they were obtained, and only to the depths penetrated. Samples cannot be relied on to accurately reflect the strata variations that usually exist between sampling locations. Should any subsurface conditions other than those described in our boring logs be encountered, HVJ should be immediately notified so that further investigation and supplemental recommendations can be provided.

PLATES

HVJ ASSOCIATES
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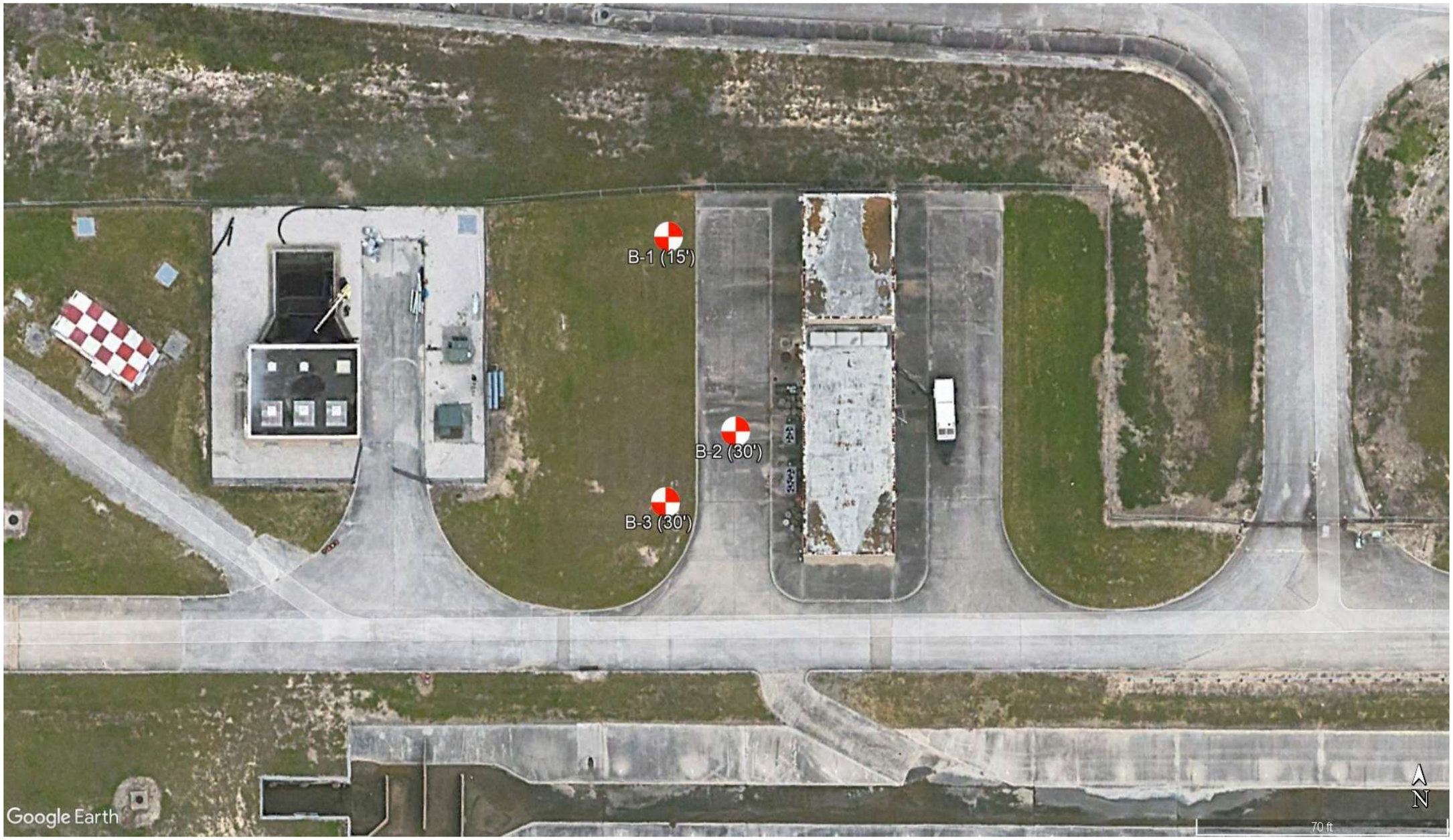
281.933.7293 Fax

DATE: 3/21/2024	APPROVED BY: NK	PREPARED BY: ND

SITE VICINITY MAP
SOUTH VAULT REPLACEMENT AT IAH

PROJECT NO.: HG2110011	DRAWING NO.: PLATE 1



LEGEND:

APPROXIMATE BORING LOCATIONS

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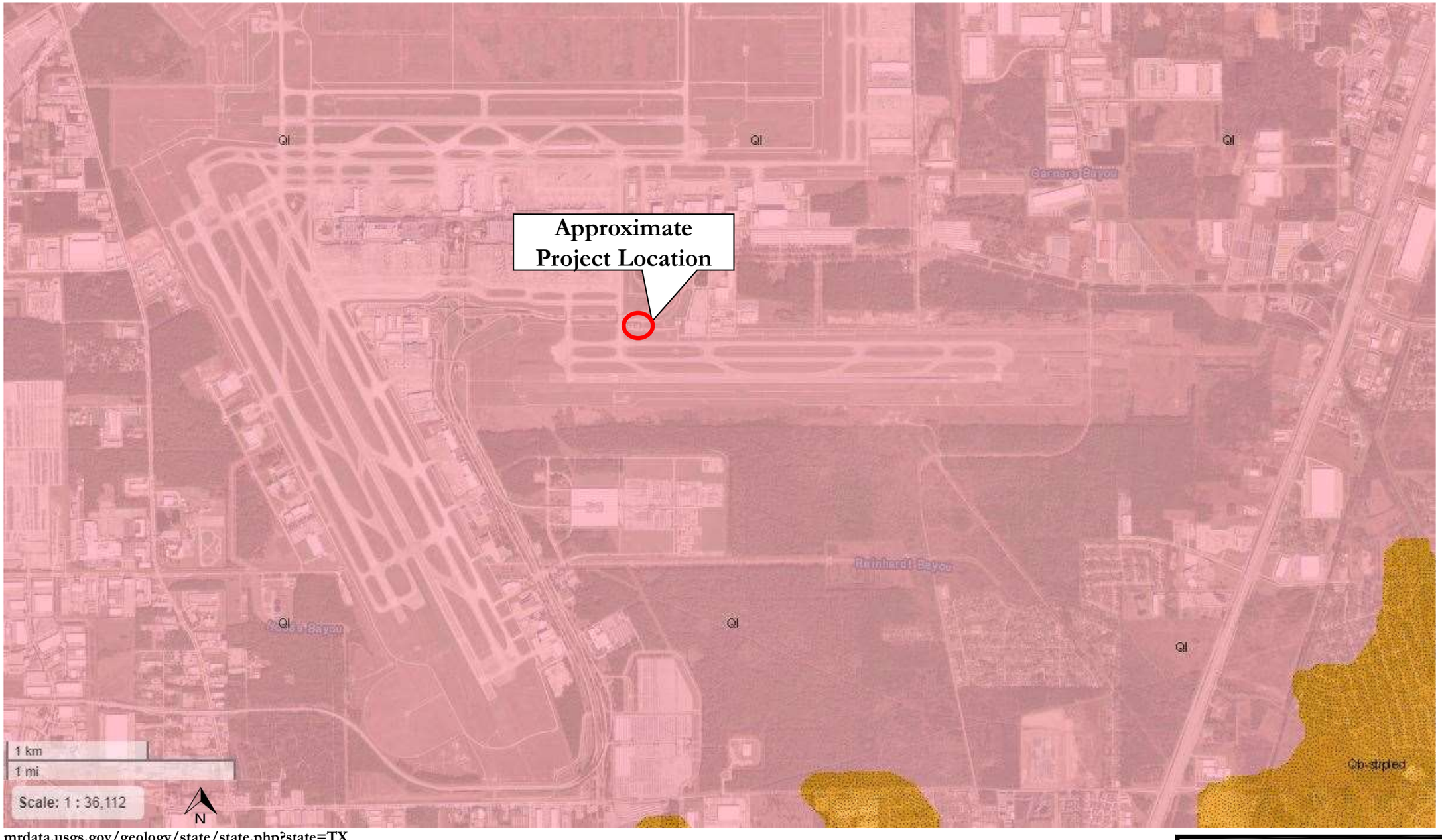
PLAN OF BORINGS
SOUTH VAULT REPLACEMENT AT IAH

PROJECT NO.: HG2110011	DRAWING NO.: PLATE 2



mrdata.usgs.gov/geology/state/state.php?state=TX

Ql

Lissie Formation (Ql): The upper part, clay, slit, sand, and very minor siliceous gravel of granule and small pebble size gravel more abundant northwestward, locally calcareous, concretions of calcium carbonate, iron oxide, and iron-manganese oxides common in zone of weathering; fluviatile; surface fairly flat and featureless except for numerous rounded shallow depressions and pimple mounds, bower part, clay, silt, sand, and minor amount of gravel; gravel slightly coarser than in upper part, noncalcareous, iron oxide concretions mare abundant than in upper part; fluviatile; very gently rolling; thickness ± 200 feet.

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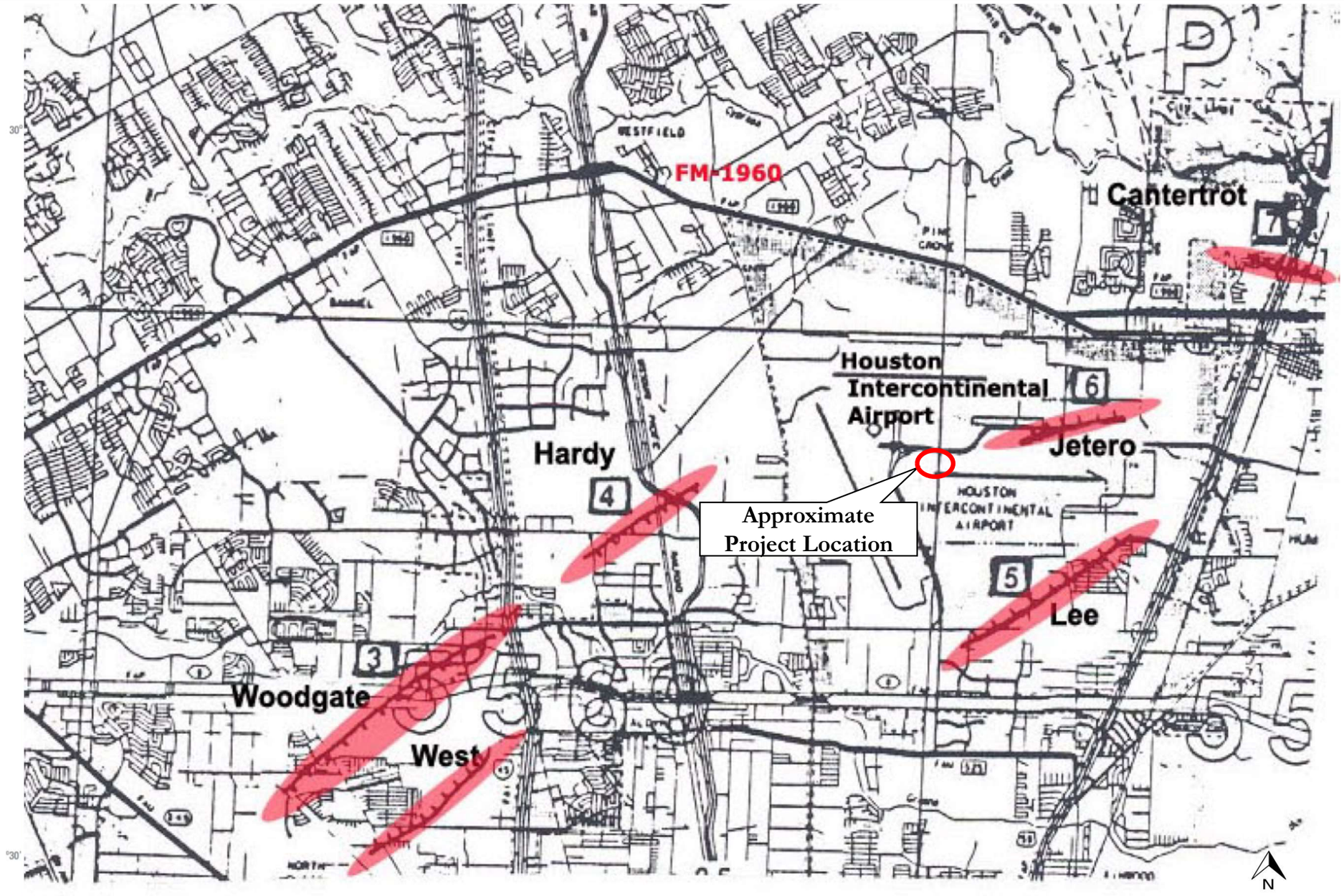
GEOLOGIC MAP
SOUTH VAULT REPLACEMENT AT IAH

PROJECT NO.: HG2110011	DRAWING NO.: PLATE 3



Source: Growth Faulting and Subsidence in the Houston, Texas Area: Guide to the Origins, Relationships, Hazards, Potential Impacts and Methods of Investigation: An Update, Journal of Geology and Geoscience, Campbell, et al., 2018.

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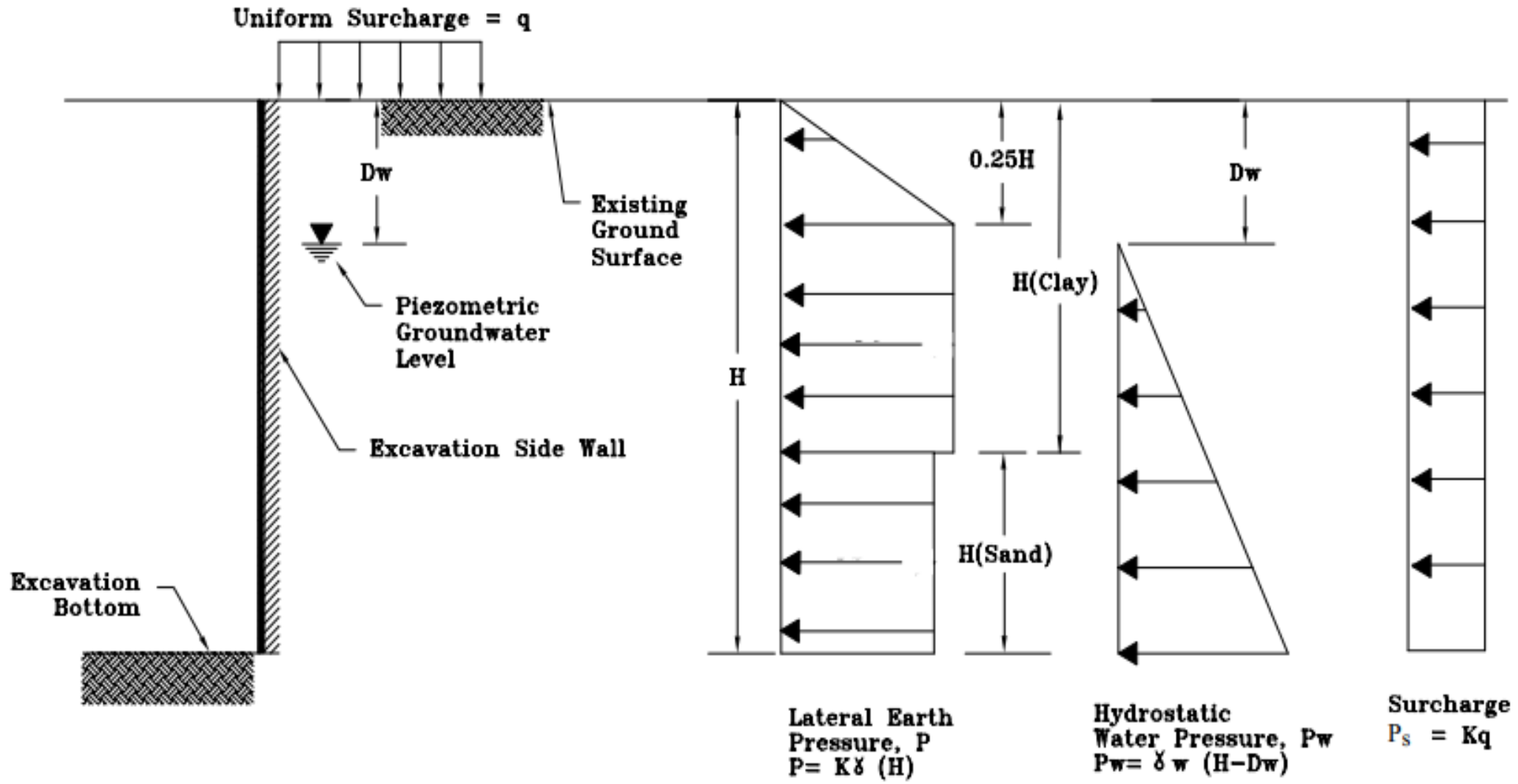
FAULT MAP
SOUTH VAULT REPLACEMENT AT IAH

PROJECT NO.: HG2110011	DRAWING NO.: PLATE 4



H, (ft) = Depth to Excavation Bottom

Ps, (psf) = Surcharge loading adjacent to Excavation wall

Dw, (ft) = Depth to groundwater below Existing grade

= Zero for temporary excavation

ɣ, (pcf) = Total unit weight above water table or submerged unit weight below groundwater level

ɣw, (pcf) = Unit weight of water = 62.4 pcf

Kc = Lateral Earth Pressure coefficient of clay

= Ka "active" for short-term conditions (use 0.50)

= Ko "at rest" for long-term conditions (use 1.0)

Ks = Lateral Earth Pressure coefficient of sand

= Ka "active" for short-term conditions (use 0.35)

= Ko "at rest" for long-term conditions (use 0.50)

Note: The pressure diagram shown is not appropriate for design of cantilever walls

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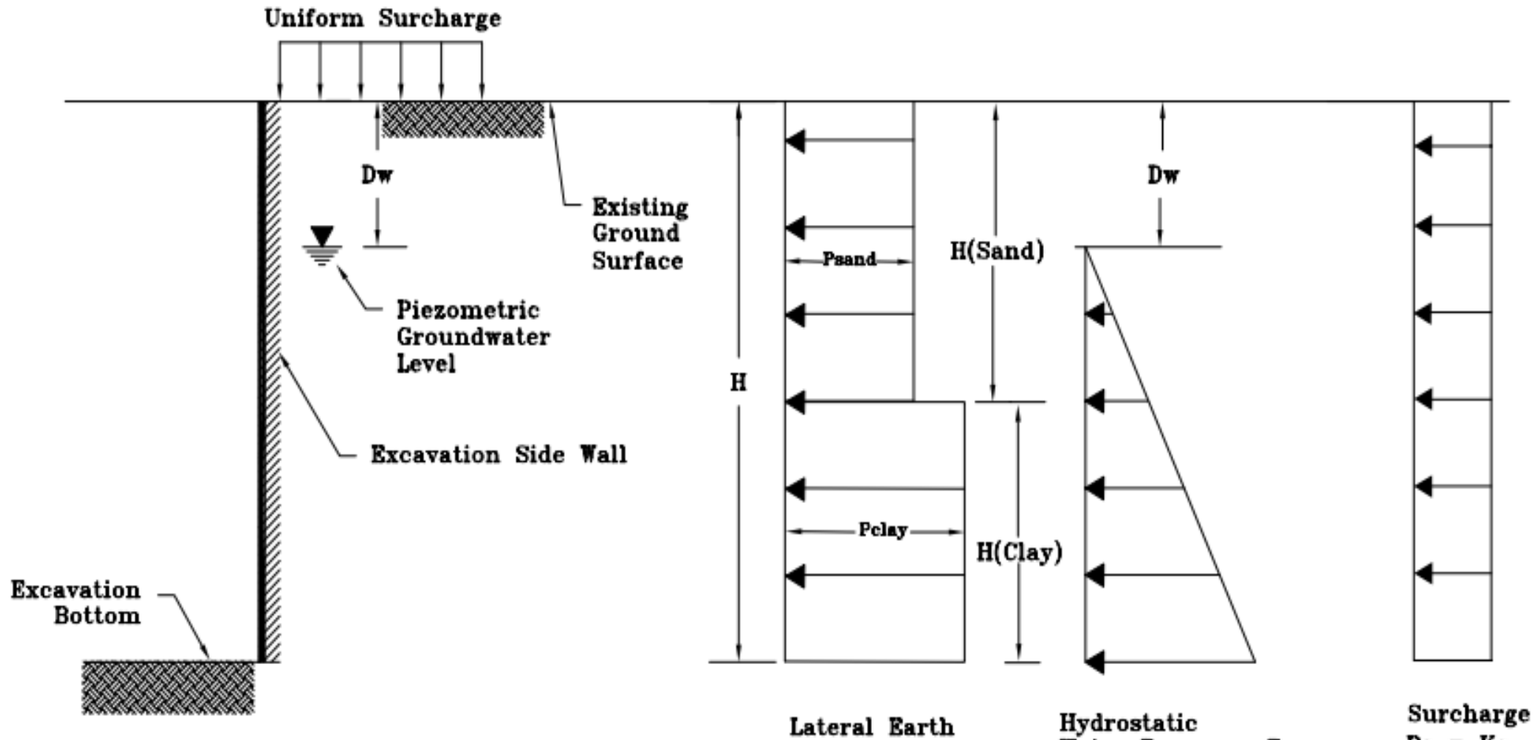
DATE: 3/25/2024	APPROVED BY: NK	PREPARED BY: ND

BRACED EXCAVATION
LATERAL EARTH PRESSURE DIAGRAM
(CLAY OVER SAND)

PROJECT NO.: HG2110011	DRAWING NO.: PLATE 5A



H, (ft) = Depth to Excavation Bottom

Ps, (psf) = Surcharge loading adjacent to Excavation wall

Dw, (ft) = Depth to groundwater below Existing grade

= Zero for temporary excavation

ɣ, (pcf) = Total unit weight above water table or submerged unit weight below groundwater level

ɣw, (pcf) = Unit weight of water = 62.4 pcf

Ks = Lateral Earth Pressure coefficient of sand

= Ka "active" for short-term conditions (use 0.35)

= Ko "at rest" for long-term conditions (use 0.50)

Kc = Lateral Earth Pressure coefficient of clay

= Ka "active" for short-term conditions (use 0.50)

= Ko "at rest" for long-term conditions (use 1.0)

Note: The pressure diagram shown is not appropriate for design of cantilever walls

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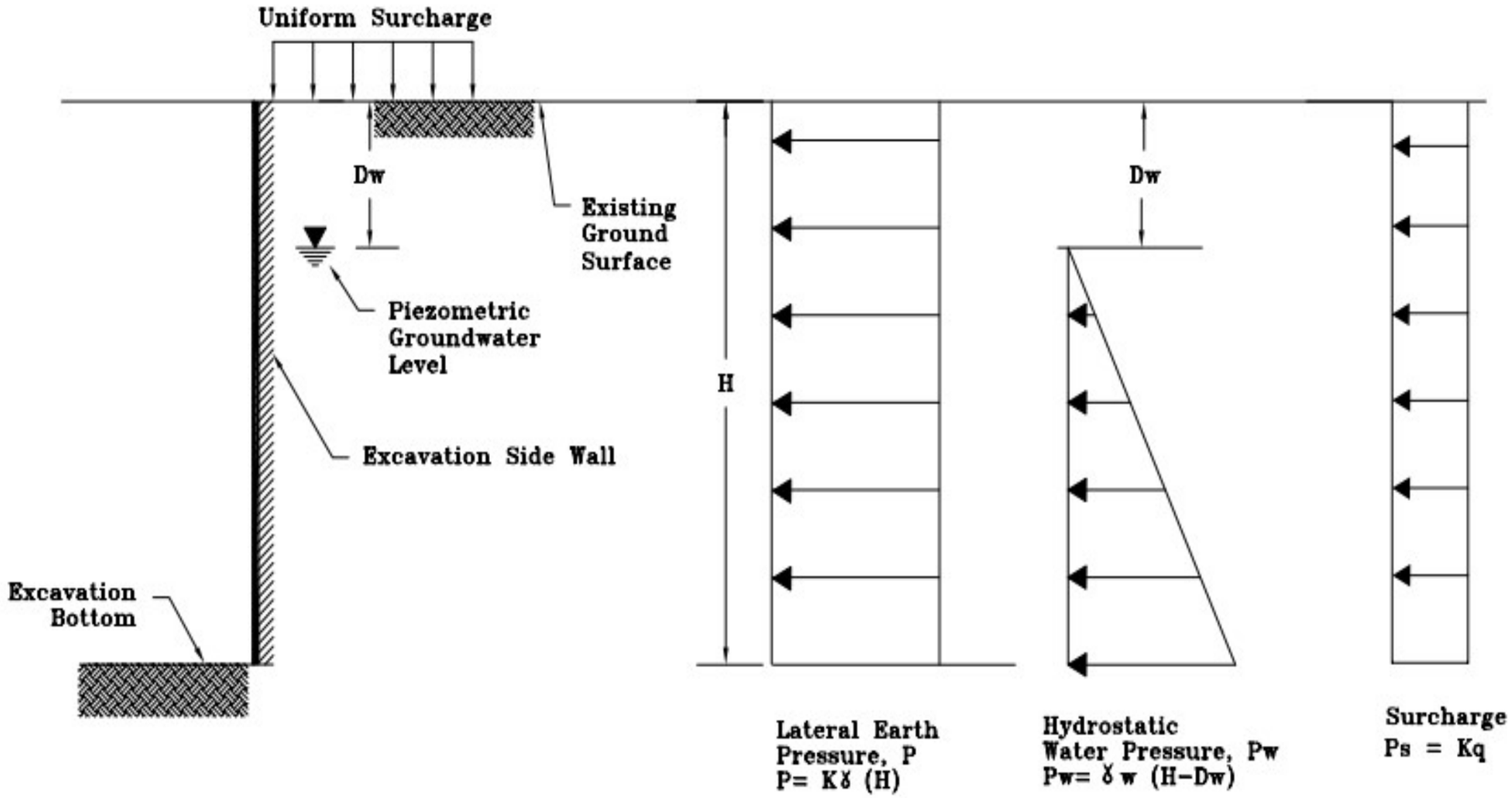
BRACED EXCAVATION
LATERAL EARTH PRESSURE DIAGRAM
(SAND OVER CLAY)

PROJECT NO.: HG2110011	DRAWING NO.: PLATE 5B



H, (ft) = Depth to Excavation Bottom

Ps, (psf) = Surcharge loading adjacent to Excavation wall

Dw, (ft) = Depth to groundwater below Existing grade

= Zero for temporary excavation

K = Lateral Earth Pressure coefficient

= Ka "active" for short-term conditions (use 0.35)

= Ko "at rest" for long-term conditions (use 0.50)

ɣ, (pcf) = Total unit weight above water table or submerged unit weight below groundwater level

ɣw, (pcf) = Unit weight of water = 62.4 pcf

Note: The pressure diagram shown is not appropriate for design of cantilever walls

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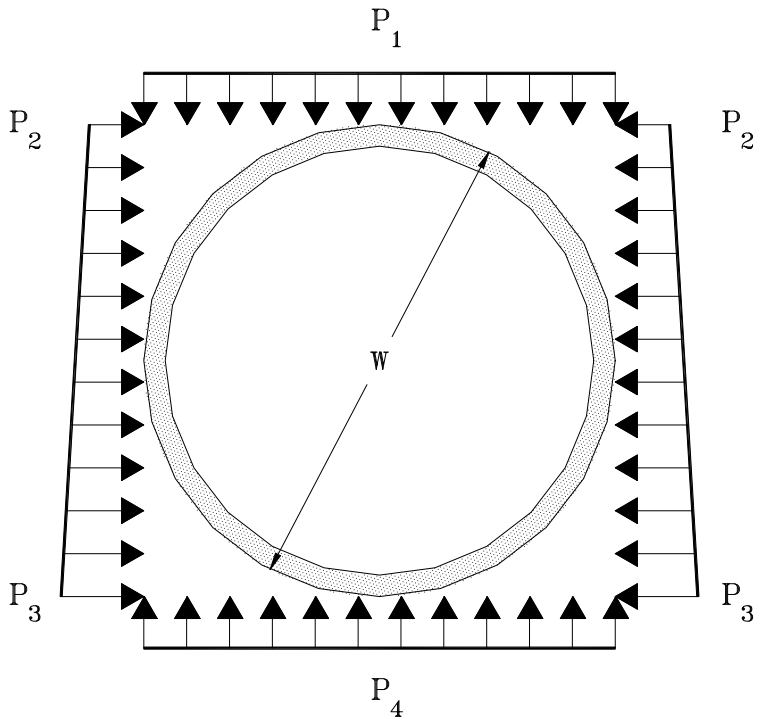
DATE: 3/25/2024	APPROVED BY: NK	PREPARED BY: ND

BRACED EXCAVATION
LATERAL EARTH PRESSURE DIAGRAM
(SAND/ SILT)

PROJECT NO.: HG2110011	DRAWING NO.: PLATE 5C



For

$D_w \leq H$

$P_1 = \gamma D_w + (H - D_w)(\gamma - \gamma_w) + P_s + (H - D_w)\gamma_w$

$P_2 = [\gamma D_w + (H - D_w)(\gamma - \gamma_w) + P_s]K_o + (H - D_w)\gamma_w$

$P_3 = [\gamma D_w + (H + W - D_w)(\gamma - \gamma_w) + P_s]K_o + (H + W - D_w)\gamma_w$

$P_4 = \gamma D_w + (H + W - D_w)(\gamma - \gamma_w) + P_s + (H + W - D_w)\gamma_w$

For

$H < D_w < H + W$

$P_1 = H\gamma + P_s$

$P_2 = (\gamma H + P_s)K_o$

$P_3 = [\gamma D_w + (H + W - D_w)(\gamma - \gamma_w) + P_s]K_o + (H + W - D_w)\gamma_w$

$P_4 = \gamma D_w + (H + W - D_w)(\gamma - \gamma_w) + P_s + (H + W - D_w)\gamma_w$

For

$D_w \geq (H + W)$

$P_1 = H\gamma + P_s$

$P_2 = (\gamma H + P_s)K_o$

$P_3 = [(H + W)\gamma + P_s]K_o$

$P_4 = (H + W)\gamma + P_s$

Where

P_1, P_2, P_3 = Pressure imposed on pipe, psf

D_w = Depth of groundwater, feet

H = Depth of top of pipe from ground surface, feet

W = Diameter of pipe, feet

γ = Total Unit weight of soil, pcf

γ_w = Unit weight of water, pcf

P_s = Surcharge load, psf

K_o = Coefficient of earth pressure, (1.0 for clays and 0.5 for sands)

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DATE: 3/27/2024	APPROVED BY: NK	PREPARED BY: ND

RIGID PIPE LOADS
SOUTH VAULT REPLACEMENT AT IAH

PROJECT NO.: HG2110011	DRAWING NO.: PLATE 6

APPENDIX A

BORING LOGS AND KEY TO TERMS & SYMBOLS

LOG OF BORING B-1

PROJECT: South Vault Replacement at IAH

PROJECT NO.: HG2110011

NORTHING: 13923519

EASTING: 3130722.84

COMPLETION DEPTH: 15 FT

SURFACE ELEVATION: 88.29 FT

DATE: 3/6/2024

SAMPLER: Shelby Tube/Split Spoon

DRY AUGER: 0 TO 15 FT

WET ROTARY: N/A TO N/A FT

ELEVATION, FT	DEPTH, FT	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
	0	Medium dense, light brown and light gray, CLAYEY SAND (SC)				16			
85	5		21	43.9		12	23	15	8
			18						
		Very stiff, gray and brown, SANDY LEAN CLAY (CL)		57.0	119	16	38	16	22
80	10								
		Medium dense, brown, SILTY SAND (SM)		21.9		8	NP	NP	NP
75			14						
	15		16			6			

UNDRAINED SHEAR STRENGTH, TSF

○ HAND PENETROMETER

● UNCONFINED COMPRESSION

■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION

△ TORVANE

0.5 1.0 1.5 2.0 2.5

DEPTH TO WATER IN BORING:

▽ FREE WATER DURING DRILLING: Not Observed

▼ WATER DEPTH 24 HOURS AFTER DRILLING: Not Recorded

Drilled By: SoilTech Logged By: FR

COH HG2110011.GPJ 3/26/24

LOG OF BORING B-2

PROJECT: South Vault Replacement at IAH

PROJECT NO.: HG2110011

NORTHING: 13923471.33

EASTING: 3130742.53

COMPLETION DEPTH: 30 FT

SURFACE ELEVATION: 88.29 FT

DATE: 3/6/2024

SAMPLER: Shelby Tube/Split Spoon

DRY AUGER: 0 TO 25 FT

WET ROTARY: 25 TO 30 FT

ELEVATION, FT	DEPTH, FT	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
	0	8" Concrete over 11" Lime Treated Base							
85	5	Medium dense, brown, CLAYEY SAND (SC)		43.0		16	22	14	8
						13			
				43.8		13	31	14	17
80	10		25	39.3		13	29	17	12
75	15	Medium dense, brown, SILTY SAND (SM)	27						
			18			11			
			14	23.0		15	NP	NP	NP
70			18			24			
	20	Very stiff, reddish brown and gray, LEAN CLAY (CL)							
65	25			88.7	109	20	31	17	14
60	30					25			

UNDRAINED SHEAR STRENGTH, TSF

○ HAND PENETROMETER

● UNCONFINED COMPRESSION

■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION

△ TORVANE

0.5 1.0 1.5 2.0 2.5

COH HG2110011.GPJ 3/26/24

DEPTH TO WATER IN BORING:

▽ FREE WATER DURING DRILLING: 20.0 FT

▼ WATER DEPTH 24 HOURS AFTER DRILLING: Not Recorded

Drilled By: SoilTech Logged By: FR

LOG OF BORING B-3

PROJECT: South Vault Replacement at IAH

PROJECT NO.: HG2110011

NORTHING: 13923443.35

EASTING: 3130715.76

COMPLETION DEPTH: 30 FT

SURFACE ELEVATION: 88.01 FT

DATE: 3/6/2024

SAMPLER: Shelby Tube/Split Spoon

DRY AUGER: 0 TO 25 FT

WET ROTARY: 25 TO 30 FT

ELEVATION, FT	DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
	0			Medium dense, light brown, CLAYEY SAND (SC)	22	43.4		13	24	16	8
85					18						
	5					40.6	114	14	24	16	8
					17						
80						42.8		14	30	18	12
	10			Medium dense, light gray, SILTY SAND (SM)	11						
75					14	13.9		10	NP	NP	NP
	15				15						
					14						
70				Stiff to hard, gray and brown, LEAN CLAY (CL)		93.4	88	36	47	17	30
	20										
65					33			22			
	25										
60				Very stiff, reddish brown and gray, SANDY FAT CLAY (CH)		69.1		24	51	20	31
	30										

UNDRAINED SHEAR STRENGTH, TSF

○ HAND PENETROMETER

● UNCONFINED COMPRESSION

■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION

△ TORVANE

0.5 1.0 1.5 2.0 2.5

DEPTH TO WATER IN BORING:

▽ FREE WATER DURING DRILLING: 18.9 FT

▼ WATER DEPTH 24 HOURS AFTER DRILLING: Not Recorded

Drilled By: SoilTech Logged By: FR

COH HG2110011.GPJ 3/26/24

SOIL SYMBOLS

Soil Types


Clay


Silt


Sand


Gravel

Modifiers


Clayey


Silty


Sandy


Cemented

Construction Materials


Asphaltic Concrete


Stabilized Base


Fill or Debris


Portland Cement Concrete

SAMPLER TYPES


Thin Walled Shelby Tube


No Recovery


Split Barrel


Core


Liner Tube


Jar Sample

WATER LEVEL SYMBOLS

Groundwater level after drilling in open borehole or piezometer


Groundwater level determined during drilling operations

SOIL GRAIN SIZE

Classification	Particle Size	Particle Size or Sieve No. (U.S. Standard)
Clay	< 0.002 mm	< 0.002 mm
Silt	0.002 - 0.075 mm	0.002 mm - #200 sieve
Sand	0.075 - 4.75 mm	#200 sieve - #4 sieve
Gravel	4.75 - 75 mm	#4 sieve - 3 in.
Cobble	75 - 200 mm	3 in. - 8 in.
Boulder	> 200 mm	> 8 in.

DENSITY OF COHESIONLESS SOILS

Descriptive Term	Penetration Resistance "N" * Blows/Foot
Very Loose	0 - 4
Loose	4 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	> 50

CONSISTENCY OF COHESIVE SOILS

Consistency	Undrained Shear Strength (tsf)	Penetration Resistance "N" * Blows/Foot
Very Soft	0 - 0.125	0 - 2
Soft	0.125 - 0.25	2 - 4
Firm	0.25 - 0.5	4 - 8
Stiff	0.5 - 1.0	8 - 16
Very Stiff	1.0 - 2.0	16 - 32
Hard	> 2.0	> 32

PENETRATION RESISTANCE

3/6	Blows required to penetrate each of three consecutive 6-inch increments per ASTM D-1586 *
50/4"	If more than 50 blows are required, driving is discontinued and penetration at 50 blows is noted
0/18"	Sampler penetrated full depth under weight of drill rods and hammer

* The N value is taken as the blows required to penetrate the final 12 inches

TERMS DESCRIBING SOIL STRUCTURE

Slickensided	Fracture planes appear polished or glossy, sometimes striated
Fissured	Breaks along definite planes of fracture with little resistance to fracturing
Inclusion	Small pockets of different soils, such as small lenses of sand scattered through a mass of clay
Parting	Inclusion less than 1/4 inch thick extending through the sample
Seam	Inclusion 1/4 inch to 3 inches thick extending through the sample
Layer	Inclusion greater than 3 inches thick extending through the sample
Laminated	Soil sample composed of alternating partings of different soil type
Stratified	Soil sample composed of alternating seams or layers of different soil type
Intermixed	Soil sample composed of pockets of different soil type and laminated or stratified structure is not evident
Calcareous	Having appreciable quantities of calcium carbonate
Ferrous	Having appreciable quantities of iron
Nodule	A small mass of irregular shape

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KEY TO TERMS AND SYMBOLS USED ON BORING LOGS

PROJECT NO.: HG2110011

DRAWING NO.: APPENDIX A-4

APPENDIX B

SUMMARY OF LABORATORY TEST RESULTS

Company Name: HVJ Associates, Inc.

Project: South Vault Replacement at IAH

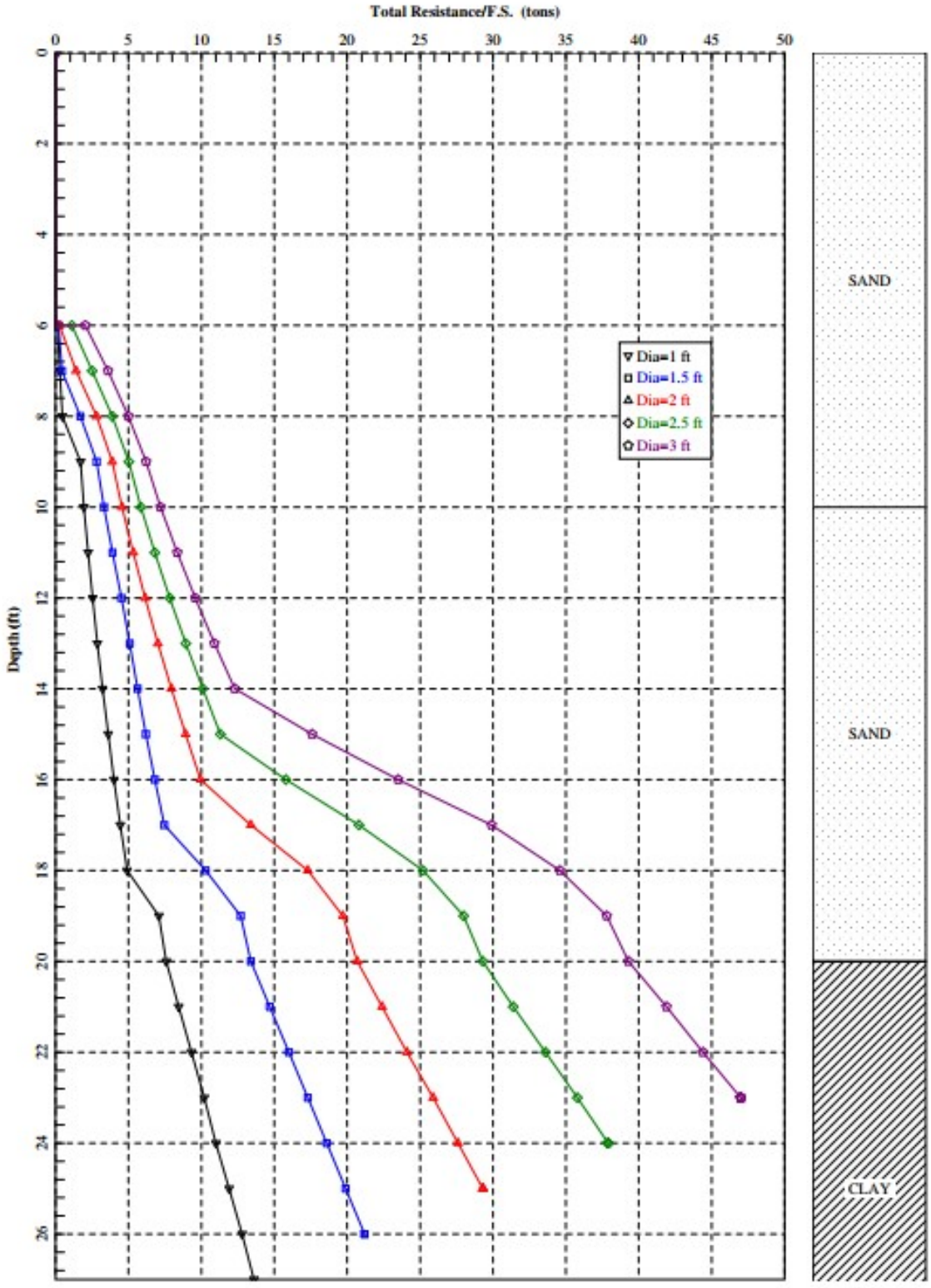
Project Number: HG2110011

Borehole	Depth (feet)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	% Passing #200 Sieve	Moisture content (%)	Total Unit Weight (pcf)	Shear Strength (UC) (tsf)	Shear Strength (UU) (tsf)	Shear Strength (Pocket Pen) (tsf)
B-1	1					16				0.83
B-1	3	23	15	8	43.9	12				
B-1	7	38	16	22	57.0	16	138	1.99		1.50
B-1	9									1.17
B-1	11	NP	NP	NP	21.9	8				0.33
B-1	15					6				
B-2	3	22	14	8	43.0	16				0.83
B-2	5					13				1.50
B-2	7	31	14	17	43.8	13				1.50
B-2	9									1.17
B-2	11	29	17	12	39.3	13				
B-2	15					11				
B-2	17	NP	NP	NP	23.0	15				
B-2	19					24				
B-2	24	31	17	14	88.7	20	131		1.05	1.33
B-2	29					25				1.50
B-3	1	24	16	8	43.4	13				
B-3	5	24	16	8	40.6	14	130	0.61		1.50
B-3	7									
B-3	9	30	18	12	42.8	14				0.67
B-3	13	NP	NP	NP	13.9	10				
B-3	19	47	17	30	93.4	36	120		1.08	0.83
B-3	24					22				
B-3	29	51	20	31	69.1	24				1.50
Total:		**14**	**14**	**14**	**14**	**21**	**4**	**2**	**2**	**14**

NP denotes Non-Plastic

APPENDIX C

DRILLED SHAFT CAPACITY CURVES



Note:

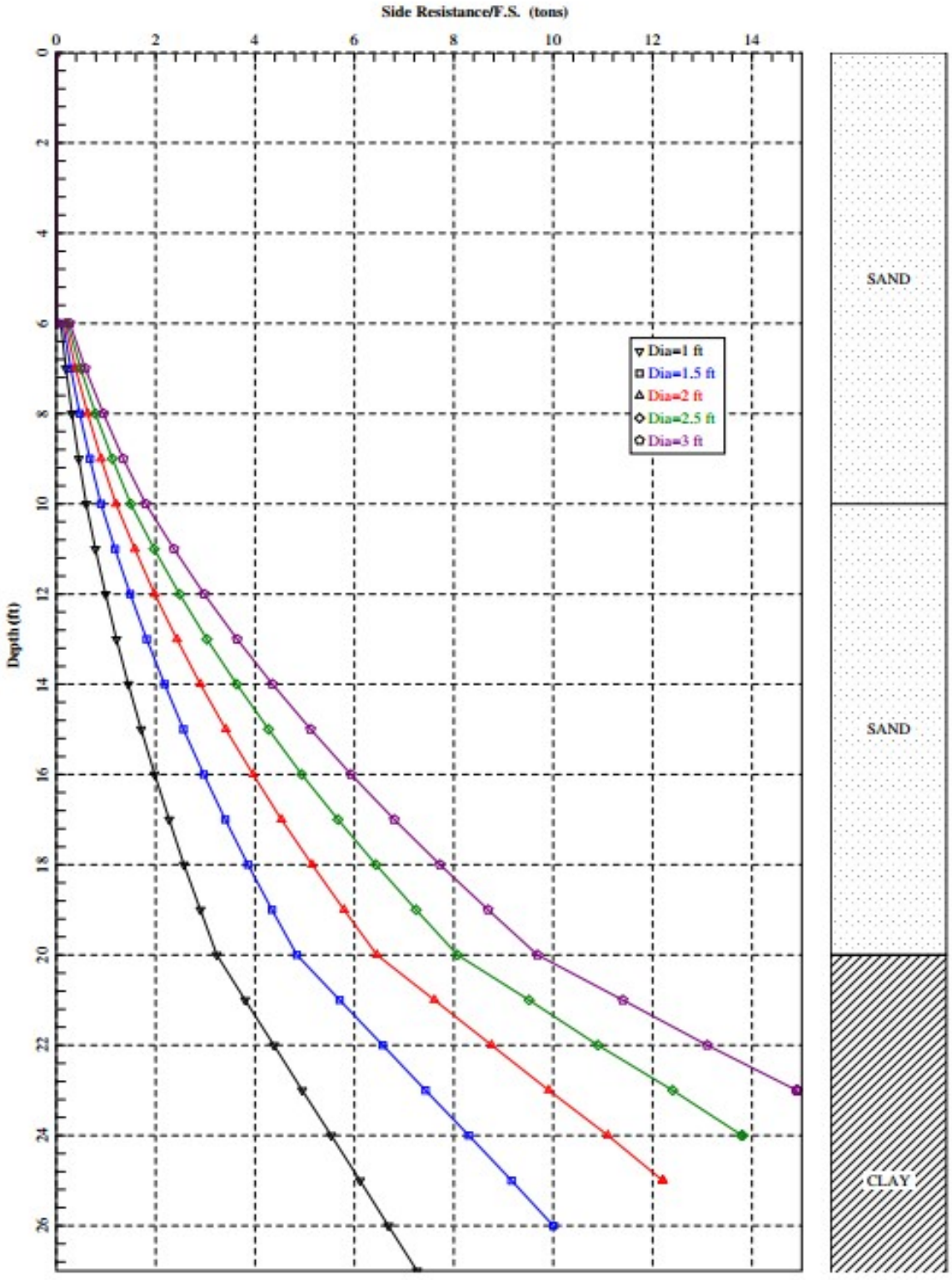
* Allowable axial compressive capacity was calculated by applying a factor of safety of 2 to the ultimate skin friction and ultimate tip resistance.
* Depth is from the existing grade level at the shaft locations.
* Skin friction contributed in the top 5 feet is ignored to account for construction disturbances.

HVJ ASSOCIATES
6120 S. Dairy Ashford Road
Houston, Texas 77072-1010
281.933.7388 Ph
281.933.7293 Fax

DATE: 3/23/2024	APPROVED BY: NK	PREPARED BY: ND

ALLOWABLE COMPRESSIVE CAPACITY
OF DRILLED SHAFTS –
SOUTH VAULT REPLACEMENT AT IAH

PROJECT NO.: HG2110011	DRAWING NO.: APPENDIX C-1A



Note:

* Allowable uplift capacity was calculated by applying a factor of safety of 3 to the ultimate skin friction.
* Depth is from the existing grade level at the shaft locations.
* Skin friction contributed in the top 5 feet is ignored to account for construction disturbances.

HVJ ASSOCIATES
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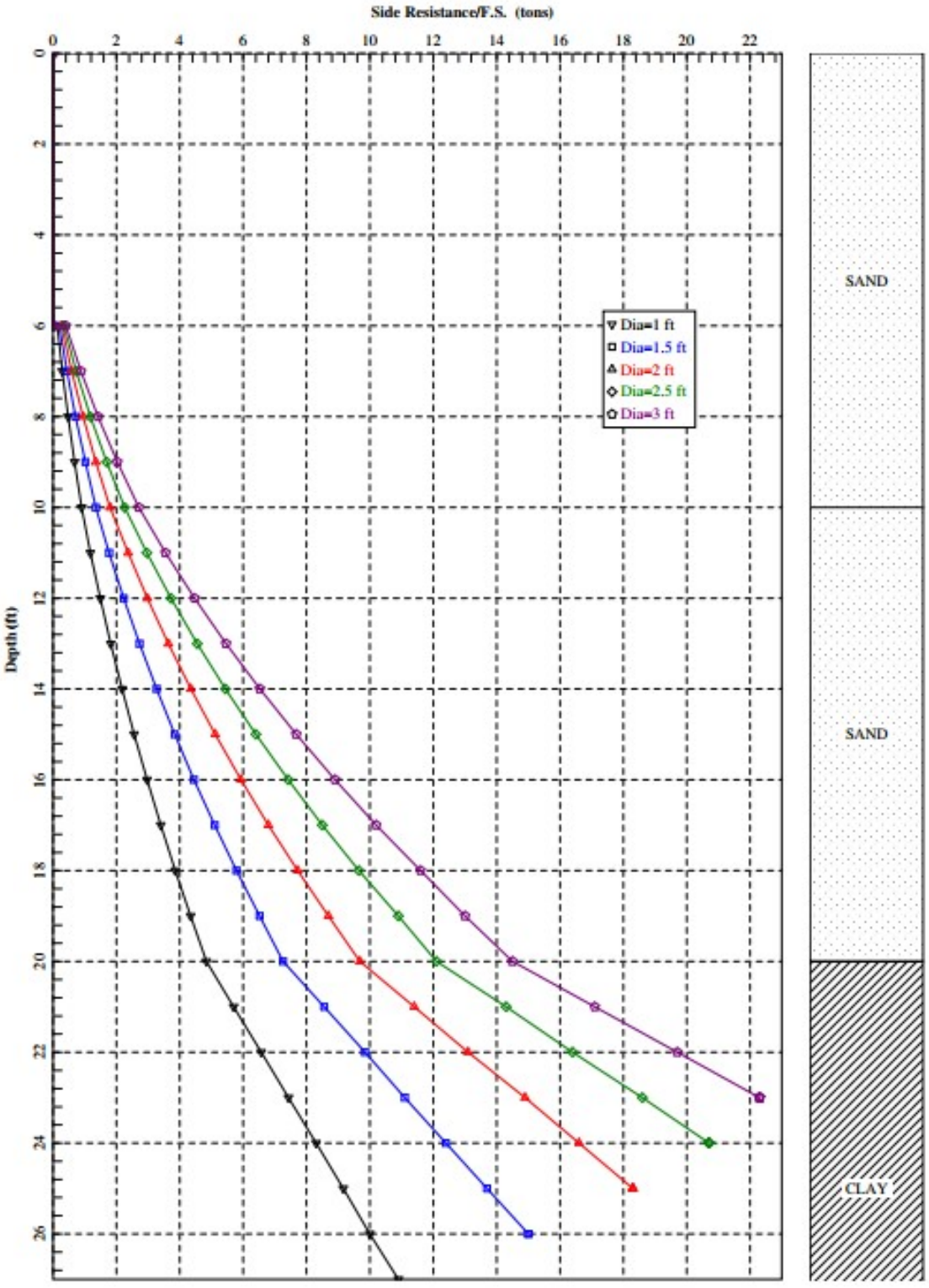
DATE: 3/23/2024	APPROVED BY: NK	PREPARED BY: ND

ALLOWABLE UPLIFT CAPACITY
OF DRILLED SHAFTS –
SOUTH VAULT REPLACEMENT AT IAH

PROJECT NO.: HG2110011	DRAWING NO.: APPENDIX C-1B



Note:

* Allowable skin friction was calculated by applying a factor of safety of 2 to the ultimate skin friction.
* Depth is from the existing grade level at the shaft locations.
* Skin friction contributed in the top 5 feet is ignored to account for construction disturbances.

HVJ ASSOCIATES
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Houston, Texas 77072-1010
281.933.7388 Ph
281.933.7293 Fax

DATE: 3/23/2024	APPROVED BY: NK	PREPARED BY: ND

ALLOWABLE SIDE RESISTANCE
OF DRILLED SHAFTS –
SOUTH VAULT REPLACEMENT AT IAH

PROJECT NO.: HG2110011	DRAWING NO.: APPENDIX C-1C

APPENDIX D

LPILE PARAMETERS

Project Name: South Vault Replacement at IAH

Project Number: HG2110011

Boring No.	Groundwater Depth (feet)	LPILE Parameters						
		Depth (feet)	P-Y Curve Model	Effective Unit Weight (pcf)	Undrained Cohesion, Su (psf)	Friction Angle, ϕ (deg)	Static Modulus of Subgrade Reaction (pci)	Strain Factor, ε_{50}
B-2 and B-3	19.0	0-10	Sand (Reese)	120	---	28	25	---
		10-19	Sand (Reese)	120	---	31	90	---
		19-20	Sand (Reese)	58	---	31	60	---
		20-30	Stiff Clay Without Free Water	63	2000	0	500	0.007

CASH ALLOWANCE TABLE:

Item No.	Spec Ref.	Cash Allowance Short Title	Cash Allowance in figures (1)
[1]		Building Permitting Costs	$26,071
[2]		Electrical Utility (Centerpoint Energy) Costs	$50,000
TOTAL CASH ALLOWANCES			[Insert Total]

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TYPE AC (BX) AND MC CABLE ARE PROHIBITED.

HOUSTON AIRPORT SYSTEM

PLANS FOR CONSTRUCTION

OF

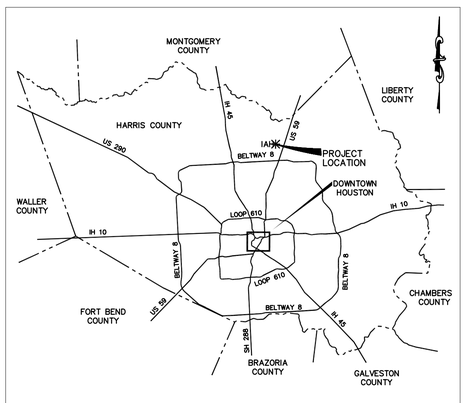
SOUTH LIGHTING VAULT RENOVATION

AT

GEORGE BUSH INTERCONTINENTAL AIRPORT / HOUSTON

HAS PROJECT No. 952

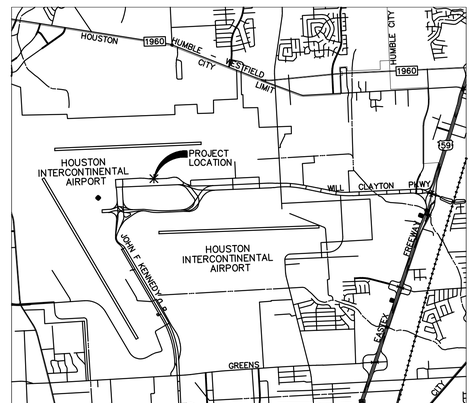
CIP No. A-000687
BSG No. 2024-31-IAH
TIP No. 24-28-IAH



AREA MAP
N.T.S.

PREPARED BY

Jacobs



VICINITY MAP
N.T.S.

KEY MAP NO. 374A **GIMS MAP NO. 5467C**

HOUSTON AIRPORT SYSTEM

Jacobs
818 Town & Country Blvd.
Suite 500
Houston, TX 77024
(281) 721-8400
www.jacobs.com TBPE Firm #2966

REVISIONS

NO.	DESCRIPTION	DATE
	ISSUED FOR CONSTRUCTION	03/15/24
1	ADDENDUM 1	04/19/24

HOUSTON AIRPORT SYSTEM
PROJECT 952 SOUTH LIGHTING VAULT RENOVATION
GEORGE BUSH INTERCONTINENTAL AIRPORT / HOUSTON
4104 WILL CLAYTON PARKWAY, HOUSTON, TX 77032
SOUTH VAULT RENOVATIONS
COVER SHEET

PROJECT MGR: AEO
DESIGNER: AO
DRAWN BY: SH
CHECK BY: NM

DATE:

STATE OF TEXAS
ARTHUR E. OTTO
75035
REGISTERED PROFESSIONAL ENGINEER
4/19/24

APPROVED BY:

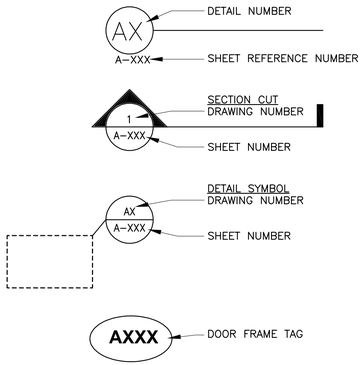
DIRECTOR
HOUSTON AIRPORT SYSTEM

JACOBS NO. WHXK7125
A.I.P. NO.
C.I.P. NO. A-000687
B.S.G. NO. 2024-31-IAH
H.A.S. NO. PN 952
T.I.P. NO. 24-28-IAH

SHEET NO.

SV-G0.01

LEGEND:



OCCUPANCY CLASSIFICATION

OCCUPANCIES	DESCRIPTION	SEPARATION	SECTION
F–1	MODERATE HAZARD ELECTRICAL	NON–SEPARATED USE	306

TYPES OF CONSTRUCTION

TYPE IIB, UNPROTECTED, NONCOMBUSTIBLE CONSTRUCTION

THERE IS NO CHANGE IN BUILDING USE.

TABLE 1004.1.2: MAXIMUM FLOOR AREA ALLOWANCE PER OCCUPANT = 300 GROSS S.F.

TOTAL OCCUPANTS = 5

THE FOLLOWING WILL BE PROVIDED BY THE CONTRACTOR AS A DELAYED SUBMITTAL FOR PERMIT:
1. EMERGENCY RESPONDER RADIO COVERAGE COMPLIANCE SUBMITTAL.
2. ELECTRONIC DOOR LOCK PERMIT SUBMITTAL
3. FIRE ALARM PERMIT SUBMITTAL

CODES AND GUIDELINES

JURISDICTION: CITY OF HOUSTON

2021 INTERNATIONAL BUILDING CODE WITH CITY OF HOUSTON AMENDMENTS.

2021 INTERNATIONAL FIRE CODE WITH CITY OF HOUSTON AMENDMENTS.

2021 UNIFORM MECHANICAL CODE WITH CITY OF HOUSTON AMENDMENTS.

2023 NATIONAL ELECTRICAL CODE WITH CITY OF HOUSTON AMENDMENTS.

2021 UNIFORM PLUMBING CODE WITH CITY OF HOUSTON AMENDMENTS.

2021 INTERNATIONAL ENERGY CONSERVATION CODE WITH CITY OF HOUSTON AMENDMENTS.

TEXAS ARCHITECTURAL BARRIERS ACT, ARTICLE 9102, TEXAS CIVIL STATUTES.

TEXAS ACCESSIBILITY STANDARDS (TAS)

FAA 150/5300–13B AIRPORT DESIGN.

FAA 150/5340–30 DESIGN AND INSTALLATION DETAILS FOR AIRPORT VISUAL AIDS

FAA 150/5360–13A PLANNING AND DESIGN.

GUIDELINES FOR AIRPORT TERMINAL FACILITIES.

HOUSTON AIRPORT SYSTEM (HAS) STANDARDS AND DESIGN MANUAL 2023

HOUSTON AIRPORT SYSTEM (HAS) IT 2023 STANDARDS

GEORGE BUSH INTERCONTINENTAL AIRPORT, HOUSTON SURVEYORS HANDBOOK.

BUILDING/PROJECT ADDRESS: GEORGE BUSH INTERCONTINENTAL AIRPORT
4104 WILL CLAYTON PARKWAY
(SOUTH AIRFIELD LIGHTING VAULT)
HOUSTON, TX 77032

SCOPE OF WORK:

1. THE WORK TO BE DONE SHALL BE ACCORDING TO THESE DRAWINGS AND SPECIFICATIONS AND FACILITIES CRITERIA DOCUMENT OF THE HOUSTON AIRPORT SYSTEM.
2. THE WORK INCLUDES MINOR DEMOLITION; SAW CUTTING AND REMOVING OF PORTIONS OF BUILDING WALLS, CEILINGS, WALL & FLOOR FINISHES AND ASSOCIATED MECHANICAL, PLUMBING, AND ELECTRICAL DEMOLITION.
3. THE WORK INCLUDES NEW CONSTRUCTION AT IAH SOUTH VAULT. THE WORK INCLUDES BUT IS NOT LIMITED TO THE FOLLOWING:
   a. INTERIOR BUILDING IMPROVEMENTS INCLUDING WALLS, CEILINGS, ACCESSORIES, FINISHES.
   b. DEMOLITION OF EXISTING INTERIOR WALLS AND DOORS. REPLACEMENT OF EXISTING EXTERIOR DOORS AND ADDITION OF NEW EXTERIOR DOORS.
   c. REPLACEMENT OF INTERIOR BUILDING LIGHTING, LIGHTING CONTROLS AND RECEPTACLES.
   d. REPLACEMENT OF EXTERIOR BUILDING LIGHTING, LIGHTING CONTROLS AND SERVICE RECEPTACLES.
   e. REPLACEMENT OF BUILDING MAIN DISCONNECTS, AUTOMATIC TRANSFER SWITCHES, MAIN SWITCHBOARD, PANELBOARDS, AND STEP-DOWN TRANSFORMERS.
   f. NEW ENCLOSED EQUIPMENT YARD WITH NEW DIESEL GENERATOR, AND NEW OUTDOOR SWITCHBOARD AND CAMLOCK ENCLOSURES.
   g. REPLACEMENT OF AIRFIELD LIGHTING REGULATORS IN THE SOUTH VAULT.
   h. REPLACEMENT OF AIRFIELD LIGHTING CONTROL SYSTEMS FOR THE SOUTH VAULT
   i. REPLACEMENT OF AIRFIELD LIGHTING CONTROL SYSTEMS COMPONENTS IN THE NORTH VAULT, WEST VAULT, AIR TRAFFIC CONTROL TOWER, AND AIRFIELD SERVICE COMPLEX FOR COMPLETED AIRFIELD LIGHTING CONTROL SYSTEM WITH INTERFACES TO EXISTING COMPONENTS IN THE NORTH VAULT AND WEST VAULT.
   i. NORTH VAULT

1. REPLACE ALCMS NODE WITH NEW RACK WITH REDUNDANT PCS.
2. ALCMS I/O REQUIRED: GENERATOR AVAILABLE, GENERATOR ONLINE, UTILITY AVAILABLE, UTILITY ONLINE, GENERATOR ALARM, GENERATOR START/STOP, RW 8 LAHSO, RW 26 LAHSO
3. RETROFIT CCRS WITH NEW ACE 3 DOORS/COMPATIBLE INTERNALS AND EXISTING CORES OR REPLACE (41) 20KW AND (23) 30KW THYRISTOR, SWITCHGEAR STYLE LIBERTY CCRS.
   ii. WEST VAULT
1. REPLACE ALCMS NODE WITH NEW RACK WITH REDUNDANT PCS.
2. ALCMS I/O REQUIRED: GENERATOR AVAILABLE, GENERATOR ONLINE, UTILITY AVAILABLE, UTILITY ONLINE, GENERATOR ALARM, GENERATOR START/STOP.
3. RETROFIT CCRS WITH NEW ACE 3 DOORS AND REPLACE ROLL-OUT "SLEDS" WITH NEW SLEDS UTILIZING EXISTING CORES. 48 FERRORESONANT SWITCHGEAR STYLE LIBERTY CCRS. EXISTING CCRS ARE ARRANGED AS SWITCHGEAR LINEUPS BUT FED WITH INDIVIDUAL 480V CIRCUITS (NO BUSWORK INTERNAL TO SWITCHGEAR).
   iii. AIR TRAFFIC CONTROL TOWER
1. REPLACE ALCMS NODE WITH NEW RACK WITH REDUNDANT PCS.
2. REPLACE (2) TOUCHSCREENS IN TOWER CAB.
3. PROVIDE PRICING OPTION FOR AN ADDITIONAL NETWORKED PC WITH MONITOR FOR TOWER TRAINING.
   iv. AIRFIELD SERVICE CENTER
1. REPLACE ALCMS NODE WITH NEW DESKTOP PC/MONITOR AND FIBER OPTIC SWITCH ENCLOSURE.
2. PROVIDE ADDITIONAL SEPARATE COST, IF ANY, FOR CONTROL MODE CAPABILITY VS. VIEW ONLY AT AIRFIELD SERVICE CENTER
   v. RADIO BACKUP SYSTEM
1. REPLACE ETHERNET RADIO BACKUP SYSTEM AT ALL (5) NODES TO PROVIDE RADIOS, ANTENNAS, AND OTHER ASSOCIATED EQUIPMENT AND REQUIRED PROGRAMMING OF ALCMS TO REPLACE RADIO BACKUP SYSTEM AT ALL NODES.
4. MECHANICAL AND PLUMBING SYSTEMS ARE TO REMAIN, EXCEPT WHERE NOTED OTHERWISE. THE SUMP PUMPS AND SUMP PUMP CONTROLS IN THE WIRE VAULT LEVEL ARE TO BE REPLACED. THE HVAC UNITS IN THE SOUTH VAULT ARE EXISTING TO REMAIN BUT TEMPORARY RELOCATION MAY BE REQUIRED TO ENABLE INSTALLATION OF THE NEW AIRFIELD LIGHTING REGULATORS.
5. THE WORK REQUIRES CAREFUL AND THOROUGH COORDINATION WITH OWNER SYSTEMS AND APPROVAL OF CONSTRUCTION SEQUENCES AND WORK PLANS WITH HOUSTON AIRPORT SYSTEM OPERATIONS.

DRAWING LIST

TYPE AC (BX) AND MC CABLE ARE PROHIBITED.

SV-G0.01	COVER SHEET	ADDENDUM 1	04/19/24
SV-G0.02	CODES AND GUIDELINES AND DRAWING LIST	ADDENDUM 1	04/19/24
SV-G0.03	OVERAL LOCATION PLAN	ISSUED FOR CONSTRUCTION	03/15/24
SV-G0.04	ATCT LINE OF SIGHT STUDY	ISSUED FOR CONSTRUCTION	03/15/24
SV-AD1.01	ARCHITECTURAL DEMOLITION PLAN	ISSUED FOR CONSTRUCTION	03/15/24
SV-AD2.01	ARCHITECTURAL DEMOLITION ELEVATIONS	ISSUED FOR CONSTRUCTION	03/15/24
SV-A1.01	ARCHITECTURAL PLAN	ISSUED FOR CONSTRUCTION	03/15/24
SV-A1.02	ARCHITECTURAL VAULT CEILING PLAN AND EGRESS PLAN	ISSUED FOR CONSTRUCTION	03/15/24
SV-A1.03	ARCHITECTURAL SCHEDULES	ISSUED FOR CONSTRUCTION	03/22/24
SV-A2.01	ARCHITECTURAL ELEVATIONS	ISSUED FOR CONSTRUCTION	03/15/24
C0.01	CIVIL CONSTRUCTION NOTES	ISSUED FOR CONSTRUCTION	03/15/24
C1.00	CIVIL DEMOLITION PLAN	ISSUED FOR CONSTRUCTION	03/15/24
C2.00	CIVIL SITE PLAN	ISSUED FOR CONSTRUCTION	03/15/24
C3.00	CIVIL GRADING AND DRAINAGE PLAN	ISSUED FOR CONSTRUCTION	03/15/24
C4.00	CIVIL SWPP PLAN	ISSUED FOR CONSTRUCTION	03/15/24
C5.00	CIVIL DETAILS	ISSUED FOR CONSTRUCTION	03/15/24
C6.00	REFERENCE INFORMATION	ISSUED FOR CONSTRUCTION	03/22/24
SV-E0.01	ELECTRICAL ABBREVIATIONS, SYMBOLS AND NOTES	ADDENDUM 1	04/19/24
SV-E1.01	ELECTRICAL SITE PLAN	ISSUED FOR CONSTRUCTION	03/15/24
SV-ED2.01	ELECTRICAL SOUTH VAULT ELECTRICAL POWER DEMOLITION PLAN	ISSUED FOR CONSTRUCTION	03/15/24
SV-ED2.02	ELECTRICAL WIRE VAULT DEMOLITION PLAN	ISSUED FOR CONSTRUCTION	03/15/24
SV-EP2.01	ELECTRICAL POWER PLAN	ADDENDUM 1	04/19/24
SV-EP2.02	ELECTRICAL WIRE VAULT POWER PLAN	ADDENDUM 1	04/19/24
SV-EP2.03	ELECTRICAL GROUNDING PLAN	ADDENDUM 1	04/19/24
SV-EP2.04	ELECTRICAL GROUNDING SITE PLAN	ISSUED FOR CONSTRUCTION	03/15/24
SV-EP2.05	ELECTRICAL LIGHTNING PROTECTION PLAN	ISSUED FOR CONSTRUCTION	03/15/24
SV-ED3.01	ELECTRICAL LIGHTING DEMOLITION PLAN	ISSUED FOR CONSTRUCTION	03/15/24
SV-ED3.02	ELECTRICAL WIRE VAULT LIGHTING DEMOLITION PLAN	ISSUED FOR CONSTRUCTION	03/15/24
SV-EL3.01	ELECTRICAL LIGHTING PLAN	ISSUED FOR CONSTRUCTION	03/15/24
SV-EL3.02	ELECTRICAL WIRE VAULT LIGHTING PLAN	ISSUED FOR CONSTRUCTION	03/15/24
SV-EL3.03	ELECTRICAL SITE LIGHTING PLAN	ISSUED FOR CONSTRUCTION	03/15/24
SV-EF3.01	FIRE ALARM COORDINATION PLAN	ADDENDUM 1	04/19/24
SV-EF3.02	FIRE ALARM WIRE VAULT COORDINATION PLAN	ISSUED FOR CONSTRUCTION	03/15/24
SV-ED4.01	ELECTRICAL DEMO ONE LINE DIAGRAM	ISSUED FOR CONSTRUCTION	03/15/24
SV-E4.01	ELECTRICAL ONE LINE DIAGRAM	ADDENDUM	04/19/24
SV-E5.01	ELECTRICAL DETAILS	ISSUED FOR CONSTRUCTION	03/15/24
SV-E5.02	ELECTRICAL DETAILS	ISSUED FOR CONSTRUCTION	03/15/24
SV-E6.01	ELECTRICAL SCHEDULES	ADDENDUM 1	04/19/24
SV-E6.02	ELECTRICAL SCHEDULES	ADDENDUM 1	04/19/24
SV-E6.03	CONSTRUCTION SEQUENCE OVERVIEW	ISSUED FOR CONSTRUCTION	03/15/24
SV-E7.01	OVERALL ALCMS PROPOSED ARCHITECTURE DIAGRAM	ISSUED FOR CONSTRUCTION	03/15/24
SV-E7.02	SOUTH LIGHTING VAULT PROPOSED CCR SCHEDULE	ISSUED FOR CONSTRUCTION	03/15/24
SV-E7.03	WEST LIGHTING VAULT PROPOSED CCR SCHEDULE	ISSUED FOR CONSTRUCTION	03/15/24
SV-E7.04	NORTH LIGHTING VAULT PROPOSED CCR SCHEDULE	ISSUED FOR CONSTRUCTION	03/15/24
ASC-EL7.01	ASC VAULT ELECTRICAL PLAN	ADDENDUM 1	04/19/24
ATCT-EL7.01	ATCT VAULT ELECTRICAL PLAN	ADDENDUM 1	04/19/24
NV-EL7.01	NORTH VAULT ELECTRICAL PLAN	ADDENDUM 1	04/19/24
NV-EL7.02	NORTH VAULT ELECTRICAL PLAN	ADDENDUM 1	04/19/24
WV-EL7.01	WEST VAULT ELECTRICAL PLAN	ADDENDUM 1	04/19/24
WV-EL7.02	WEST VAULT ELECTRICAL PLAN	ADDENDUM 1	04/19/24
SV-PD1.01	PLUMBING DEMOLITION PLAN	ISSUED FOR CONSTRUCTION	03/15/24
SV-P1.01	PLUMBING PLAN	ISSUED FOR CONSTRUCTION	03/15/24
SV-S0.01	STRUCTURAL GENERAL NOTES	ISSUED FOR CONSTRUCTION	03/15/24
SV-S0.02	STRUCTURAL GENERAL NOTES	ISSUED FOR CONSTRUCTION	03/15/24
SV-S0.03	STRUCTURAL GENERAL NOTES	ISSUED FOR CONSTRUCTION	03/15/24
SV-S1.00	STRUCTURAL SITE PLAN	ISSUED FOR CONSTRUCTION	03/15/24
SV-S1.01	STRUCTURAL SITE SECTIONS	ISSUED FOR CONSTRUCTION	03/15/24
SV-S1.02	STRUCTURAL SITE DETAILS	ISSUED FOR CONSTRUCTION	03/15/24
SV-S1.03	STRUCTURAL SITE DETAILS	ISSUED FOR CONSTRUCTION	03/22/24
SV-S1.10	STRUCTURAL EXISTING AND DEMO PLAN	ISSUED FOR CONSTRUCTION	03/15/24
SV-S1.11	STRUCTURAL EXISTING AND DEMO DETAILS	ISSUED FOR CONSTRUCTION	03/15/24
SV-S1.12	STRUCTURAL EXISTING AND NEW PLAN	ISSUED FOR CONSTRUCTION	03/15/24
SV-S3.00	STRUCTURAL TYPICAL FOUNDATION DETAILS - CONCRETE COVER REQUIREMENTS	ISSUED FOR CONSTRUCTION	03/15/24
SV-S3.01	STRUCTURAL TYPICAL FOUNDATION DETAILS - DEVELOPMENT AND SPLICE LENGTHS	ISSUED FOR CONSTRUCTION	03/15/24
SV-S3.02	STRUCTURAL TYPICAL FOUNDATION DETAILS - SLAB ON GRADE	ISSUED FOR CONSTRUCTION	03/15/24
SV-S4.00S	STRUCTURAL TYPICAL MASONRY DETAILS	ISSUED FOR CONSTRUCTION	03/15/24
T0.00	TELECOM INDEX	ISSUED FOR CONSTRUCTION	03/15/24
T1.01	TELECOM LEVEL 1 TELECOM PLAN	ISSUED FOR CONSTRUCTION	03/15/24
TY0.00	SECURITY INDEX	ISSUED FOR CONSTRUCTION	03/15/24
TY1.01	SECURITY LEVEL 1 - SECURITY PLAN	ISSUED FOR CONSTRUCTION	03/15/24
TY5.00	SECURITY CAMERA DETAILS	ISSUED FOR CONSTRUCTION	03/15/24
TY5.01	SECURITY DOOR DETAILS	ISSUED FOR CONSTRUCTION	03/15/24

HOUSTON AIRPORT SYSTEM

Jacobs
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www.jacobs.com TBPE Firm #2966

REVISIONS

NO.	DESCRIPTION	DATE
	ISSUED FOR CONSTRUCTION	03/15/24
1	ADDENDUM 1	04/19/24

HOUSTON AIRPORT SYSTEM
PROJECT 952 SOUTH LIGHTING VAULT RENOVATION
GEORGE BUSH INTERCONTINENTAL AIRPORT / HOUSTON
4104 WILL CLAYTON PARKWAY, HOUSTON, TX 77032
SOUTH VAULT RENOVATIONS
CODES, GUIDELINES AND DRAWING LIST

PROJECT MGR: AEO
DESIGNER: AO
DRAWN BY: SH
CHECK BY: NM
DATE:

STATE OF TEXAS
ARTHUR E. OTTO
75035
REGISTERED PROFESSIONAL ENGINEER
4/19/24

APPROVED BY:

DIRECTOR
HOUSTON AIRPORT SYSTEM

JACOBS NO. WHXK7125
A.I.P. NO.
C.I.P. NO. A–000687
B.S.G. NO. 2024–31–IAH
H.A.S. NO. PN 952
T.I.P. NO. 24–28–IAH

SHEET NO.

SV-G0.02

TYPE AC (BX) AND MC CABLE ARE PROHIBITED.

ABBREVIATIONS

(ALL ABBREVIATIONS SHOWN ARE NOT NECESSARILY USED ON DRAWINGS)

A

A/C	AIR CONDITIONING
ABV	ABOVE
AC	ALTERNATING CURRENT
ADJ	ADJUSTABLE
AF	AMPERE FUSE
AFF	ABOVE FINISHED FLOOR
AIC	AMPERE INTERRUPTING CAPACITY
AL	ALUMINUM
ALCMS	AIRFIELD LIGHITNG CONTROL AND MONITORING SYSTEM
A, AMPS	AMPERES
ANSI	AMERICAN NATIONAL STANDARDS INSTITUTE
ARCH	ARCHITECT, ARCHITECTURAL
AS	AMPERE SWITCH
ASC	AIRFIELD SERVICES CENTER
ATCT	AIR TRAFFIC CONTROL TOWER
AUX	AUXILIARY
AWG	AMERICAN WIRE GAUGE

B

BKR	BREAKER
BLDG	BUILDING

C

C	CONDUIT
CATV	CABLE TELEVISION SYSTEM
CCR	CONSTANT CURRENT REGULATOR
CCTV	CLOSED CIRCUIT TELEVISION
CKT	CIRCUIT
℄	CENTERLINE
CLG	CEILING
CU	COPPER

D

DC	DIRECT CURRENT
DIA	DIAMETER
DISC	DISCONNECT
DN	DOWN
DP	DISTRIBUTION PANEL
DPDT	DOUBLE-POLE, DOUBLE-THROW
DPST	DOUBLE-POLE, SINGLE-THROW
DWG	DRAWING

E

EA	EACH
EF	EXHAUST FAN
ELEC	ELECTRICAL
ENCL	ENCLOSURE
EQUIP	EQUIPMENT
EWC	ELECTRICAL WATER COOLER
EXH	EXHAUST
EXIST	EXISTING

F

F	FUSE
FA	FIRE ALARM
FACP	FIRE ALARM CONTROL PANEL
FLA	FULL LOAD AMPS
FLEX	FLEXIBLE
FS	FUSED SWITCH
FT	FEET
FVNR	FULL-VOLTAGE, NON-REVERSING
FV2SP	FULL-VOLTAGE, TWO SPEED
FWE	FURNISHED WITH EQUIPMENT

G

G,GND	GROUND
GA	GAUGE
GALV	GALVANIZED
GFCI	GROUND FAULT CIRCUIT INTERRUPTER
GFI	GROUND FAULT INTERRUPTER
GFR	GROUND FAULT RELAY

H

HOA	HAND-OFF-AUTO
HORIZ	HORIZONTAL
HP	HORSEPOWER
HTR	HEATER
HVAC	HEATING, VENTILATION, AND AIR CONDITIONING
HZ	HERTZ

I

IAC	INTERRUPTING AMP CAPACITY
ID	INSIDE DIAMETER
IEEE	INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS
IES	ILLUMINATING ENGINEERING SOCIETY
IG	ISOLATED GROUND
IN	INCHES
IP##	INGRESS PROTECTION (RATED PER ##)

J

J-BOX	JUNCTION BOX

K

K	KILO (1000)
KCMIL	1000 CIRCULAR MILS
KK	KIRK KEY
KV	KILOVOLT
KSCA	KILO SHORT CIRCUIT AMPS
KVA	KILOVOLT-AMPS
KW	KILOWATT
KWH	KILOWATT-HOUR

L

LF	LINEAR FEET
LRA	LOCKED ROTOR AMPS
LSIG	BREAKER TRIP: LONG/SHORT/INSTANTANEOUS/GROUND FAULT LIGHTING
LTG	

M

MAX	MAXIMUM
MCA	MINIMUM CIRCUIT AMPACITY
MCB	MAIN CIRCUIT BREAKER
MD	MOTORIZED DAMPER
MECH	MECHANICAL
MFGR	MANUFACTURER
MG	MOTOR GENERERATOR
MIN	MINIMUM
MLO	MAIN LUGS ONLY
MTD	MOUNTED

N

N/A	NOT APPLICABLE
N.C.	NORMALLY CLOSED
NEC	NATIONAL ELECTRIC CODE
NEMA	NATIONAL ELECTRIC MANUFACTURER'S ASSOCIATION
NEMA #	NEMA ENCLOSURE RATING #X (1,3R,4X)
NFPA	NATIONAL FIRE PROTECTION ASSOCIATION
NIC	NOT IN CONTRACT
N.O.	NORMALLY OPEN
N.T.S.	NOT TO SCALE

O

O.C.	ON CENTER
OD	OUTSIDE DIAMETER
OH	OVERHEAD
OS	OCCUPANCY / VACANCY SENSOR
OS&Y	OUTSIDE STEM & YOKE

P

P	POLE
PF	POWER FACTOR
PH	PHASE
PLBG	PLUMBING
PNL	PANEL
PVC	POLYVINYL CHLORIDE

Q

QTY	QUANTITY

R

RA	RETURN AIR
RCP	REFLECTED CEILING PLAN
RE:	REFERENCE, REFER
REQD	REQUIRED
REV	REVISED, REVISION, REVISE
RGS	RIGID GALVANIZED STEEL
RLA	RUNNING LOAD AMPS
RM	ROOM

S

S1	S1 AIRFIELD LIGHTING CIRCUIT CUTOUT
SCA	SHORT CIRCUIT AMPS
SECT	SECTION
SF	SQUARE FEET
SHT	SHEET
SIM	SIMILAR
SPEC	SPECIFICATIONS
SPD	SURGE PROTECTION DEVICE
SQ	SQUARE
SS	STAINLESS STEEL
STD	STANDARD
SURF	SURFACE
SUSP	SUSPEND
SWBD	SWITCHBOARD
SWGR	SWITCHGEAR

T

TFMR	TRANSFORMER
THRU	THROUGH
TYP	TYPICAL

U

U/F	UNDERFLOOR
U/G, UG	UNDERGROUND
U/S	UNDERSLAB
UL	UNDERWRITERS LABORATORIES, INC.
UON, UNO	UNLESS OTHERWISE NOTED UNLESS NOTE OTHERWISE
UPS	UNINTERRUPTIBLE POWER SUPPLY

V

V	VOLT
VA	VOLT-AMPERE
VAC	VACUUM
VERT	VERTICAL
VFD	VARIABLE FREQUENCY DRIVE
VSD	VARIABLE SPEED DRIVE

W

W	WATT, WIDTH
W/	WITH
W/O	WITHOUT
WR	WEATHER RESISTANT

X

XFMR	TRANSFORMER

OTHER

4X	NEMA 4X STAINLESS STEEL

ELECTRICAL SYMBOLS

(ALL SYMBOLS SHOWN ARE NOT NECESSARILY USED ON DRAWINGS)

LIGHTING

- SURFACE OR RECESSED LIGHTING FIXTURE, LETTER DENOTES TYPE
- WALL WASHER LIGHTING FIXTURE, LETTER DENOTES
- EXIT SIGN, ARROWS AS INDICATED, LETTER DENOTES TYPE DARKENED AREA DENOTES LIGHTED FACE
- STRIP LED LIGHTING FIXTURE, LETTER DENOTES TYPE
- LIGHT FIXTURE ON EMERGENCY OR UNSWITCHED CIRCUIT, LETTER DENOTES TYPE
- LED LIGHT FIXTURE, LETTER DENOTES TYPE,
- WALL MOUNTED LIGHT FIXTURE, LETTER DENOTES TYPE
- EMERGENCY LIGHTING FIXTURE WITH BATTERY PACK
- SITE LIGHT. LETTER INDICATES TYPE.

SWITCHES

- SWITCH, SPST, 20A, 120/277V
- SWITCH, 20A, 120/277V, "2" DENOTES DPST, "3" DENOTES THREE-WAY, "4" DENOTES FOUR-WAY
- SWITCH, SPDT, CENTER OFF, MOMENTARY CONTACT
- SWITCH, SPST, 20A, 120/277V, "K" DENOTES KEY SWITCH, "P" DENOTES PILOT LIGHT
- DIMMER CONTROL SWITCH, 1000 WATT PRESET WITH ON/OFF UNLESS OTHERWISE NOTED
- OCCUPANCY SENSOR. WALL MOUNTED.
- OCCUPANCY SENSOR. CEILING MOUNTED.
- OCCUPANCY SENSOR RELAY ABOVE CEILING.

RECEPTACLES AND OUTLETS

- SIMPLEX WALL RECEPTACLE, NEMA 5-20R, 20A, 125V
- DUPLEX WALL RECEPTACLE, NEMA 5-20R, 20A, 125V,
- FOURPLEX WALL RECEPTACLE. NEMA 5-20R, 20A, 125V
- DUPLEX WALL RECEPTACLE GFCI
- FOURPLEX WALL RECEPTACLE GFCI
- DUPLEX WALL RECEPTACLE ISOLATED GROUND NEMA 5-20R, 20A, 125V.
- DUPLEX WALL RECEPTACLE MOUNTED 6" ABOVE COUNTER OR BACKSPLASH.
- DUPLEX WALL RECEPTACLE. "WR" DENOTES WEATHER RESISTANT
- SPECIAL RECEPTACLE, NEMA CONFIGURATION AS NOTED
- FLUSH FLOOR RECEPTACLE
- COMBINATION RECEPTACLE AND TELEPHONE/DATA IN FLUSH FLOOR BOX.
- MULTI-OUTLET SURFACE RACEWAY WITH NEMA 5-20R, 20A, 125V RECEPTACLES AT 12" ON CENTER
- JUNCTION BOX
- DIRECT CONNECTION TO EQUIPMENT

CIRCUITING AND WIRING

- CIRCUIT CONCEALED IN WALL OR CEILING
- CIRCUIT BELOW SLAB OR GRADE OR CAST IN SLAB ABOVE GRADE UNLESS OTHERWISE NOTED.
- 3LA-2,4 HOMERUN TO PANEL WITH CIRCUIT NUMBER(S) AS INDICATED.
- CONDUIT UP
- CONDUIT DOWN

ELECTRICAL EQUIPMENT

- SWITCHBOARD, DISTR. PNL OR MOTOR CONTROL CENTER
- PANELBOARD (FLUSH OR SURFACE MOUNT) AS INDICATED ON PANEL SCHEDULE.
- DRY-TYPE TRANSFORMER
- GAP GENERATOR REMOTE ANNUNCIATOR PANEL
- PLYWOOD TERMINAL BOARD, TYPE AS NOTED, 4' X 8' X 3/4" UNLESS OTHERWISE NOTED
- BUS DUCT

PANEL DESIGNATIONS

- 2HA "2" DENOTES FLOOR WHERE PANEL IS LOCATED
- 2LA "H" DENOTES VOLTAGE - "H"=480Y/277V, "L"=208Y/120V "A" DENOTES PANEL SEQUENCE
- E2HA "E" DENOTES EMERGENCY POWER

COMMUNICATION OUTLETS

- TELEPHONE OUTLET "P" DENOTES PAY/PUBLIC TELEPHONE "H" INDICATES HANDICAP.
- DATA OUTLET
- ABOVE COUNTER DATA OUTLET
- COMBINATION TELEPHONE/DATA OUTLET
- ABOVE COUNTER COMBINATION TELEPHONE/DATA OUTLET
- FLUSH FLOOR TELEPHONE OUTLET
- FLUSH FLOOR DATA OUTLET
- FLUSH FLOOR COMBINATION TELEPHONE/DATA OUTLET
- TELEVISION OUTLET
- SPEAKER

MOTORS AND CONTROLS

- SINGLE OR THREE PHASE MOTOR (NUMBER INSIDE SYMBOL CAN INDICATE HORSEPOWER)
- EDH ELECTRIC DUCT HEATER
- DISCONNECT (SAFETY) SWITCH "200/3/150" DENOTES AMPERES/POLE/FUSE, "NF" DENOTES NON-FUSED
- MOTOR STARTER, NEMA SIZE AS NOTED. 'VFD' INDICATES VARIABLE FREQUENCY DRIVE.
- COMBINATION DISCONNECT (SAFETY) SWITCH AND MOTOR STARTER, "30/3/15/1" DENOTES AMPERES/POLES/ /FUSE(OR BREAKER)/ NEMA STARTER SIZE, "NF" DENOTES NON-FUSED.
- MANUAL MOTOR STARTER WITH THERMAL OVERLOAD
- LIGHTING CONTACTOR
- PHOTOCELL
- PUSH BUTTON STATION
- DOOR CONTACT SWITCH
- TS TIME SWITCH
- VFD VARIABLE FREQUENCY DRIVE

ONE LINE AND RISER DIAGRAMS

- T1 45KVA TRANSFORMER, DESIGNATION AND RATINGS AS NOTED
- 800A SWITCH, RATINGS AS SHOWN, 3 POLE UNLESS OTHERWISE NOTED
- 400A FUSE, RATING AS SHOWN
- 200A CIRCUIT BREAKER, TRIP RATING AS SHOWN, 3 POLE UNLESS OTHERWISE NOTED
- 800A DRAWOUT CIRCUIT BREAKER, TRIP RATING AS SHOWN, 3 POLE UNLESS OTHERWISE NOTED
- XX / YY CIRCUIT BREAKER. XX = FRAME SIZE; YY = TRIP SETTING
- ST SHUNT TRIP
- GFR GROUND FAULT RELAY
- E ELECTRIC INTERLOCK
- K KIRK-KEY INTERLOCK
- A 0-2000 AMMETER, RANGE AS SHOWN
- AS AMMETER SWITCH
- V 0-600 VOLTMETER, RANGE AS SHOWN
- VS VOLTMETER SWITCH
- DM DIGITAL MULTI-FUNCTION METER
- 1200:5 CURRENT TRANSFORMER(CT), RATED AS SHOWN
- 12.47KV / 120V POTENTIAL TRANSFORMER(PT), RATING AS SHOWN
- GROUND CONNECTION
- LIGHTNING ARRESTOR
- AUTOMATIC TRANSFER SWITCH
- DISCONNECT SWITCH
- XX,XXX INDICATES AVAILABLE FAULT CURRENT. AMPS RMS SYM
- INDICATES NEW FEEDER AND EQUIPMENT
- INDICATES EXISTING FEEDER AND EQUIPMENT TO REMAIN
- DIESEL GENERATOR

BREAKER SPEC/TRIP CODE:
L=LONG-TIME ADJ.
S=SHORT TIME ADJ.
I=INSTANTANEOUS ADJ.
G=GROUND FAULT TRIP
ST=SHUNT TRIP
100%=100% RATED

MISCELLANEOUS

(1) DRAWING NOTE REFERENCE (NOTES BY SYMBOL)

GENERAL NOTES

A. REFER TO SPECIFICATIONS FOR MATERIALS AND METHODS FOR ELECTRICAL CONSTRUCTION. INSTALL ALL WORK IN ACCORDANCE WITH NFPA 70, LATEST EDITION.

B. REFER TO ARCHITECTURAL REFLECTED CEILING PLANS FOR THE EXACT LOCATION OF ALL CEILING MOUNTED DEVICES.

C. REFER TO ARCHITECTURAL INTERIOR ELEVATION DRAWINGS, WHERE THE ARCHITECT HAS DRAWN SUCH ELEVATIONS, FOR THE LOCATIONS OF ALL WALL MOUNTED DEVICES.

D. COORDINATE EXACT LOCATION OF ALL LIGHTING FIXTURES IN MECHANICAL / ELECTRICAL SPACES WITH EQUIPMENT, DUCTWORK AND PIPING. TO PROVIDE MAXIMUM LIGHT IN WORK AREAS.

E. ALL CIRCUITING: 2#10 1#10G, UNLESS NOTED OTHERWISE ON THE DRAWINGS OR IN THE SPECIFICATIONS.

F. MINIMUM SIZE CONDUIT FOR HOMERUNS IS 3/4" C. UNLESS OTHERWISE NOTED

G. ROUTE CONDUIT SERVING ROOFTOP MECHANICAL EQUIPMENT WITHIN THE RESPECTIVE ROOF CURB.

H. COORDINATE ALL SLAB PENETRATIONS AND SLEEVES PRIOR TO EACH CONCRETE POUR.

I. FURNISH ACCESS DOORS FOR INSTALLATION IN WALLS AND CEILINGS WHERE ACCESS IS REQUIRED TO CONCEALED ELECTRICAL EQUIPMENT.

J. ARRANGE WITH AUTHORITIES AND UTILITY COMPANIES FOR PERMITS, FEES, AND SERVICE CONNECTIONS, VERIFYING LOCATIONS AND ARRANGEMENT AND PAYING ALL CHARGES, INCLUDING INSPECTIONS.

K. COORDINATE WORK WITH ARCHITECTURAL FEATURES AND COORDINATE WORK SO THAT INTERFERENCES BETWEEN CONDUITS, LIGHTING, EQUIPMENT, PLUMBING WORK, MECHANICAL WORK, AND BUILDING STRUCTURE WILL BE AVOIDED.

L. FOR CONNECTIONS TO AIR HANDLING UNITS WITH INTERNALLY MOUNTED MOTORS, PROVIDE JUNCTION BOX ON SIDE OF UNIT. DRILL OPENING IN UNIT WALL (AVOIDING ACCESS PANELS AND SUPPORT MEMBERS) AND CONNECT TO MOTOR TERMINAL BOX WITH FLEXIBLE CONDUIT. PROVIDE AIRTIGHT SEAL BETWEEN JUNCTION BOX AND UNIT WALL.

M. DISCONNECT SWITCHES SERVING MECHANICAL EQUIPMENT ARE NOT TO BE MOUNTED ON THE EQUIPMENT BUT ADJACENT TO AND CONNECTED USING FLEXIBLE CONDUIT.

N. PERFORM ALL WORK IN ACCORDANCE WITH THE 2023 EDITION OF THE NATIONAL ELECTRICAL CODE WITH LOCAL AMENDMENTS AND ALL OTHER APPLICABLE BUILDING CODES AS INTERPRETED BY THE LOCAL AUTHORITY HAVING JURISDICTION INCLUDING BUT NOT EXCLUSIVE OF CODES AND STANDARDS LISTED ON SI-G0.02 AND LOCAL CITY OF HOUSTON AMENDMENTS 2024 NFPA 70E, OSHA 1904, OSHA 1910 AND OSHA 1926. (1)

O. ALL ELECTRICAL EQUIPMENT SHALL BE LISTED AND LABELED FOR THE QUALIFIED USE.

P. ALL MOUNTING HEIGHTS INDICATED ARE MEASURED FROM FINISHED FLOOR TO THE CENTER OF DEVICE UNLESS OTHERWISE SHOWN OR NOTED.

Q. SOME LEGEND SYMBOLS MIGHT NOT BE USED. SEE FLOOR PLANS FOR APPLICABLE DEVICES.

R. THE ELECTRICAL DRAWINGS ARE DIAGRAMMATICAL IN NATURE AND INDICATE THE GENERAL LOCATION OF OUTLETS. EQUIPMENT AND THE CIRCUIT ARRANGEMENT OF THE REQUIRED WIRING. ALTHOUGH THE DRAWINGS DO NOT NECESSARILY INDICATE

S. THE ACTUAL ROUTES OF CONDUITS, WHERE INDICATED, SHALL BE FOLLOWED AS CLOSELY AS PROPER COORDINATION WITH THE WORK OF OTHER TRADES AND SPACE WILL PERMIT. THE DRAWINGS ARE NOT INTENDED TO BE SCALED AND THE ELECTRICAL CONTRACTOR SHALL REFER TO THE COMPLETE SET OF CONSTRUCTION DRAWINGS FOR COORDINATION. THESE DRAWINGS ARE DIAGRAMMATIC IN NATURE AND INDICATE THE GENERAL EXTENT OF THE WORK. THE ELECTRICAL CONTRACTOR SHALL PROVIDE ALL PULL BOXES, JUNCTION BOXES AND INCIDENTAL MATERIALS AND LABOR FOR COMPLETELY FULLY FUNCTIONAL SYSTEMS. EXISTING SURFACE AND SUBSURFACE STRUCTURES (GAS MAINS, WATER MAINS, STORM SEWERS, TELEPHONE CABLES, ETC.) ARE SHOWN ON THE PLANS BASED ON RECORD DRAWINGS AND/OR OBSERVATIONS, BUT IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO SURVEY THE EXISTING INSTALLATION, AVOID DAMAGE AT HIS OWN EXPENSE AND RESTORE THE STRUCTURE TO ITS FULLY FUNCTIONAL USE.

T. ALL REUSED EQUIPMENT SHOULD BE CLEANED OF DEBRIS AND CORROSION. COPPER BUS BARS SHALL BE CLEANED PRIOR TO MAKING CONNECTIONS TO REMOVE SURFACE OXIDATION. CLEAN SURFACES OF DEVICES AND EQUIPMENT TO BE BONDED TO BARE METAL, PER NEC 250-12.

U. A COPY OF THE ONE LINE DIAGRAM WILL BE FRAMED, COVERED WITH A TRANSPARENT PLASTIC (PLEXIGLASS) COVER, AND MOUNTED WHERE APPROVED BY THE IAH ENGINEER OR ELECTRICAL SUPERINTENDENT. THIS LOCATION MAY BE A CONVENIENT WALL OR THE BACK OF THE ELECTRICAL ROOM DOOR.

V. WHERE LOW VOLTAGE EQUIPMENT RATED (1000 VOLTS AND BELOW) 800 AMPS OR MORE AND ALL MEDIUM VOLTAGE EQUIPMENT (RATED ABOVE 1000 VOLTS) THAT CONTAINS OVERCURRENT DEVICES, SWITCHING DEVICES, OR CONTROL DEVICES IS INSTALLED AND THERE IS A PERSONNEL DOOR(S) INTENDED FOR ENTRANCE TO AND EGRESS FROM THE WORKING SPACE LESS THAN 7.6 M (25 FT) FROM THE EDGE OF THE WORKING SPACE, THE DOOR(S) SHALL OPEN IN THE DIRECTION OF EGRESS AND BE EQUIPPED WITH LISTED PANIC HARDWARE. ARTICLE 110.26(C)(3) 2023 N.E.C AND 110.33(A)(3).

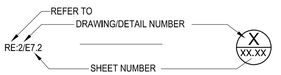
W. WHERE LOW VOLTAGE EQUIPMENT RATED (1000 VOLTS AND BELOW) 1200 AMPS OR MORE AND OVER 6 FOOT WIDE AND MEDIUM VOLTAGE EQUIPMENT (RATED ABOVE 1000 VOLT) OVER 6 FOOT WIDE THAT CONTAINS OVERCURRENT DEVICES, SWITCHING DEVICES, OR CONTROL DEVICES IS INSTALLED THERE WILL BE PERSONNEL DOOR(S) INTENDED FOR ENTRANCE TO AND EGRESS FROM THE WORKING SPACE AT EACH END OF THE WORKING SPACE. ARTICLE 110.26(C)(2) 2023 N.E.C AND 110.33(A)(1).

X. THE GROUNDING, BONDING, AND LIGHTNING PROTECTION RECORD DRAWINGS AND AS-BUILTS WILL BE SUBMITTED ON SEPARATE PLANS WITH SUPPORTING DOCUMENTATION, CALCULATIONS AND TESTING REPORTS CERTIFIED AND NOTARIZED WITH THE MASTER ELECTRICIANS SIGNATURE.

Y. LIGHTNING PROTECTION MUST BE INSTALLED AND PROVIDED PER NFPA 780, LPI AND UL96. A LETTER CERTIFYING THAT THESE STANDARDS ARE MET AND NOTARIZED WITH MASTER ELECTRICIANS SIGNATURE WILL BE REQUIRED FOR ELECTRICAL FINAL SUBMITTAL .

Z. GENERATOR MUST INCLUDE ALL ACCESSORIES, CONTROLS AND INTERFACES TO MEET ALL FAA REQUIREMENTS.

DRAWING/DETAIL REFERENCE KEY



MOUNTING HEIGHTS

(UNLESS OTHERWISE NOTED)

WALL SWITCHES-42" A.F.F. TO CENTER OF SWITCH.
WALL RECEPTACLES:
FINISHED AREAS-18" A.F.F. TO CENTER OF RECEPTACLE.
UNFINISHED AREAS- 42" A.F.F. TO CENTER OF RECEPTACLE.
WALL TELEPHONE/DATA OUTLETS:
FINISHED AREAS-18" A.F.F. TO CENTER OF OUTLET.
UNFINISHED AREAS- 42" A.F.F. TO CENTER OF OUTLET.
PUBLIC TELEPHONES-42" A.F.F. TO CENTER OF OUTLET.
HANDICAP TELEPHONES-32" A.F.F. TO CENTER OF OUTLET.
WALL DIMMER SWITCHES-42" A.F.F. TO CENTER OF SWITCH.
WALL MOUNTED EMERGENCY LIGHT FIXTURE-84" A.F.F. TO CENTER OF FIXTURE.
CLOCK OUTLET-84" A.F.F. TO CENTER OF OUTLET.
FIRE ALARM PULL STATION-42" A.F.F. TO CENTER OF STATION.
FIRE ALARM AV SIGNAL-80" A.F.F. TO BOTTOM OF HORN OR BELL.

GENERAL CIRCUITING NOTES

5 24" — WIRING DEVICE, DISCONNECT SWITCH, STARTER, ETC. SUBSCRIPT INDICATES CIRCUIT NUMBER AND MOUNTING HEIGHT (IF OTHER THAN STANDARD HEIGHT)

5 INDICATES CIRCUIT NUMBER
24" INDICATES MOUNTING HEIGHT

B a 3 — LIGHTING FIXTURE SUBSCRIPTS INDICATE FIXTURE TYPE, CONTROLLING SWITCH AND CIRCUIT NUMBER.

B INDICATES FIXTURE TYPE
a INDICATES CONTROLLING SWITCH (IF NOT APPARENT)
3 INDICATES CIRCUIT NUMBER

REFER TO INDIVIDUAL SHEETS FOR ADDITIONAL CIRCUIT IDENTIFICATION INFORMATION.

LIGHTING FIXTURE CIRCUITING NOTES

A. THE LIGHTING PLANS INDICATE SWITCHING AND BRANCH CIRCUIT NUMBERS FOR ALL LIGHTING FIXTURES. LOWER CASE LETTERS AT SWITCHES AND LIGHT FIXTURES INDICATE SWITCHING WHERE THE CONTROL PATTERN IS NOT OBVIOUS. INSTALL BRANCH CIRCUIT WIRING IN RACEWAY TO ALL RIGIDLY ATTACHED LIGHT FIXTURES AND TO JUNCTION BOXES FOR ALL LAY-IN LIGHT FIXTURES, AS REQUIRED TO PROVIDE SWITCHING AND CIRCUITING AS SHOWN ON THE DRAWINGS. RE: SPECIFICATIONS FOR ADDITIONAL REQUIREMENTS.

B. PER H A S STANDARDS, NO MORE THAN 3 BRANCH CIRCUITS PER CONDUIT. LIMIT 120V OR 277V BRANCH CIRCUIT HOMERUNS IN A SINGLE CONDUIT TO THREE CIRCUITS (ON DIFFERENT PHASES), EACH WITH AN INDIVIDUAL NEUTRAL CONDUCTOR AND A SINGLE GROUND CONDUCTOR.

C. ALL LAY-IN LIGHTING FIXTURES SHALL BE CONNECTED TO A BRANCH CIRCUIT JUNCTION BOX WITH FLEXIBLE CONDUIT(WHIP), A MAXIMUM OF FOUR FIXTURE WHIPS SHALL BE CONNECTED TO A SINGLE JUNCTION BOX. FIXTURE TO FIXTURE WIRING OF LAY-IN LIGHTING FIXTURES IS NOT PERMITTED.

POWER PLAN CIRCUITING NOTES

A. PER H A S STANDARDS, NO MORE THAN 3 BRANCH CIRCUITS PER CONDUIT. LIMIT 120V OR 277V BRANCH CIRCUIT HOMERUNS IN A SINGLE CONDUIT TO THREE CIRCUITS (ON DIFFERENT PHASES), EACH WITH AN INDIVIDUAL NEUTRAL CONDUCTOR AND A SINGLE GROUND CONDUCTOR.

FIRE ALARM

- FACP FIRE ALARM CONTROL PANEL (FLUSH)
- RAA FIRE ALARM REMOTE GRAPHIC ANNUNCIATOR
- RLA FIRE ALARM REMOTE LED ANNUNCIATOR
- F FIRE ALARM MANUAL PULL STATION. SEMI-FLUSH MTD
- AV FIRE ALARM SPEAKER, WITH VISUAL STROBE LIGHT.
- A FIRE ALARM SPEAKER. FLUSH WALL MTD
- A FIRE ALARM SPEAKER. FLUSH CEILING MTD
- V FIRE ALARM VISUAL STROBE LIGHT. FLUSH WALL MTD
- H HEAT DETECTOR - RATE OF RISE. CEILING MTD
- S AREA SMOKE DETECTOR. CEILING MTD
- DS DUCT MOUNTED SMOKE DETECTOR. "S" SUPPLY, "R" RETURN
- PS SPRINKLER FLOW SWITCH
- TS VALVE TAMPER SWITCH
- FIREMANS TELEPHONE OUTLET
- FIREMANS TELEPHONE OUTLET WITH HANDSET

W Z X Y Y — SUBSCRIPT INDICATES ZONE IDENTIFICATION'
ZONE NUMBER
FLOOR
ZONE TYPE
A = AUDIBLE
D = DETECTION
F = FLOW SWITCH
M = MANUAL PULL
T = TAMPER SWITCH
V = VISUAL
C = CONTROL

HOUSTON AIRPORT SYSTEM

Jacobs
818 Town & Country Blvd.
Suite 500
Houston, TX 77024
(281) 721-8400
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REVISIONS

NO.	DESCRIPTION	DATE
	ISSUED FOR CONSTRUCTION	03/15/24
1	ADDENDUM 1	04/19/24

PROJECT 952 SOUTH LIGHTING VAULT RENOVATION
GEORGE BUSH INTERCONTINENTAL AIRPORT / HOUSTON
4104 WILL CLAYTON PARKWAY, HOUSTON, TX 77032

SOUTH VAULT RENOVATIONS
ABBREVIATIONS SYMBOLS, AND NOTES

PROJECT MGR: AEO
DESIGNER: AO
DRAWN BY: SH
CHECK BY: NM

DATE:

STATE OF TEXAS
ARTHUR E. OTTO
75035
REGISTERED
PROFESSIONAL ENGINEER
4/19/24

APPROVED BY:

DIRECTOR
HOUSTON AIRPORT SYSTEM

JACOBS NO. WHXK7125
A.I.P. NO.
C.I.P. NO. A-000687
B.S.G. NO. 2024-31-IAH
H.A.S. NO. PN 952
T.I.P. NO. 24-28-IAH

SHEET NO.

SV-E0.01

TYPE AC (BX) AND MC CABLE ARE PROHIBITED.

GENERAL NOTES

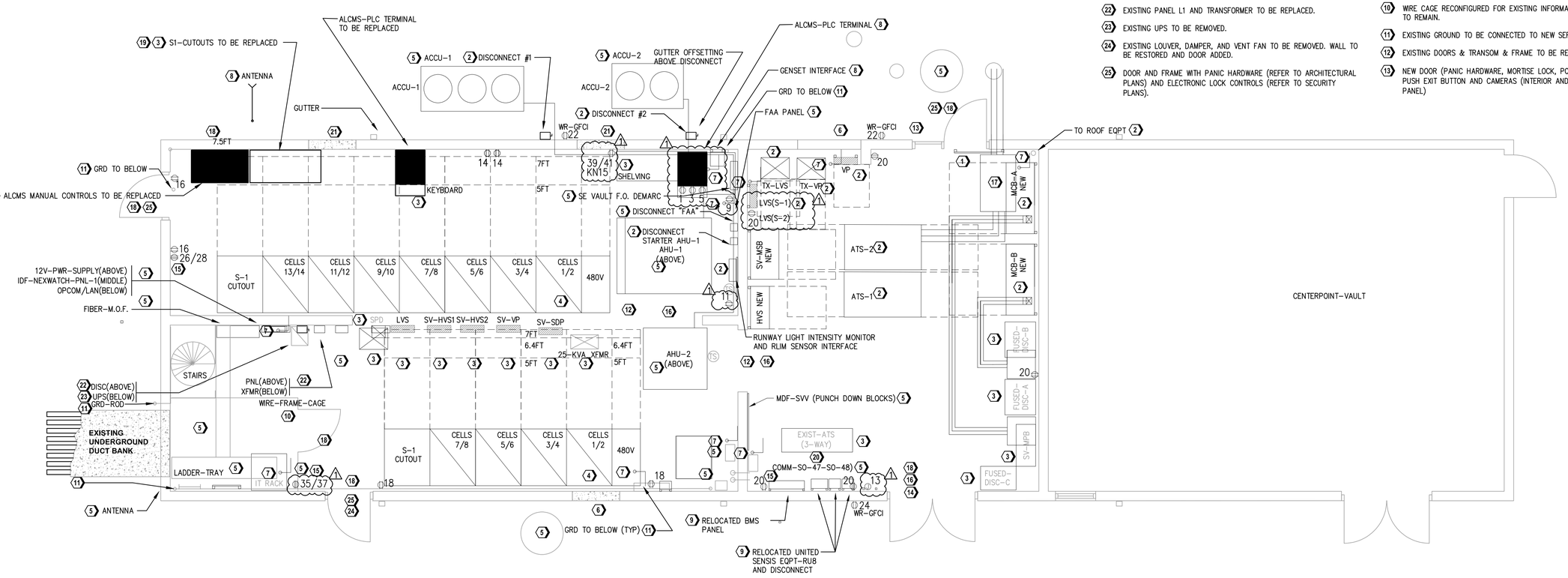
A. REFER TO SHEET SV-E0.01 FOR SYMBOLS, ABBREVIATIONS AND GENERAL NOTES.
B. EQUIPMENT INSTALLATION TO BE PHASED WITH ENABLING WORK FOR NEW EQUIPMENT TO REPLACE EXISTING EQUIPMENT, INSTALLATION OF NEW SERVICE FROM CENTERPOINT VAULT, INTERCONNECTION AND TESTING OF NEW EQUIPMENT, ENERGIZATION OF NEW EQUIPMENT, PHASED TRANSFER OF EXISTING LOADS TO NEW EQUIPMENT, DEMOLITION OF EQUIPMENT TO BE REMOVED. PHASING PLAN AND OUTAGES TO BE SUBMITTED TO OPERATIONS FOR APPROVAL 1 MONTH PRIOR AND COORDINATED WITH OPERATIONS AND CENTERPOINT ENERGY.
C. HIGH VOLTAGE CIRCUITS (AIRFIELD LIGHTING 5000 VOLT SERIES CIRCUITS AND OTHER CIRCUITS RATED ABOVE 600 VOLTS) AND LOW VOLTAGE CIRCUITS (RATED 600 VOLTS AND BELOW) SHALL NOT BE INSTALLED IN THE SAME WIREWAY, CONDUIT, DUCT, RACEWAY, JUNCTION STRUCTURE, OR HANDHOLE.
D. SUBSCRIPT INDICATES CIRCUIT NUMBER:
   1 INDICATES CIRCUIT NUMBER
   ◌1 PANEL LVS UNLESS OTHERWISE NOTED

KEYED NOTES

14. EXISTING DOORS TO BE REPLACED WITH NEW DOUBLE DOOR AND FRAME DOOR WITH PANIC HARDWARE. (REFER TO ARCHITECTURAL PLANS) AND ELECTRONIC LOCK CONTROLS (REFER TO SECURITY PLANS).
15. RECEPTACLE FOR PORTABLE AHU (NEMA L6-30R)
16. AHU AND TRANSOM TO BE TEMPORARILY RELOCATED TO FACILITATE RIGGING OF NEW REGULATOR SWITCHGEAR INTO ROOM.
17. PROVIDE INTERNAL CONDUIT SEALS AND TEST FOR AIR TIGHTNESS UNDER 20 PSIG.
18. REFER TO SECURITY DRAWINGS FOR DEVICES AND CONDUIT AND BACK BOX REQUIREMENTS. SECURITY POWER FOR MAGLOCKS, CAMERAS, AND POWER SHALL BE CONNECTED TO LVS-15 (EAST DOOR), LVS-17 (WEST DOOR), LVS-19 (EQUIPMENT YARD DOOR), LVS-21 (SOUTHWEST DOOR), LVS-23 (SOUTHEAST DOOR) AND LVS-25 (IT CAGE AND DOOR). 1
19. EXISTING S-1 CABINET TO REMAIN IN SERVICE UNTIL ALL LOADS ARE TRANSFERRED TO NEW S-1 SECTION AT END OF SWTCHGEAR LINE UP. DURING INITIAL PHASE OF REGULATOR SWGR SGR-2, SGR-2 INITIAL REGULATORS WILL SUPPLY NEW TEMPORARY FEEDERS AND SPLICE IN EXISTING S-1 CABINET FOR INTERIM SUPPLY TO AIRFIELD LIGHTING CIRCUITS. DURING LATER PHASE AFTER INSTALLATION OF SGR-2 S1 CABINET, NEW MEDIUM VOLTAGE FEEDERS WILL BE SUPPLIED FROM NEW S-1 SECTION AT END OF SGR-2 TO SPLICE TO EXISTING MEDIUM VOLTAGE CABLE IN CABLE TRAY IMMEDIATELY BEFORE CABLE DROP TO EXIT FROM CABLE VAULT TO EXISTING UNDERGROUND DUCTBANK. COORDINATE WITH HAS OPERATIONS FOR SPLICE LOCATION TO ALLOW FOR FUTURE MEDUM VOLTAGE CABLE TO SPLICE IN FIRST AIRFIELD MANHOLE TO CONNECT TO EXISTING AIRFIELD LIGHTING CIRCUITS REPLACED UNDER OTHER PROJECTS. SUBMIT SPLICING PLAN TO AIRPORT ELECTRIC SHOP FOR APPROVAL OF SPLICING LOCATIONS.
20. LOCATION FOR REGULATOR LOAD BANK AFTER DEMOLITION OF EXISTING ATS.
21. EXISTING INTAKE LOUVER AND DAMPERS BELOW TO BE REMOVED AND THE WALL RESTORED. EXISTING EXHAUST LOUVER ABOVE TO BE REPLACED. EXISTING DAMPER AND VENT FAN ABOVE TO BE REMOVED AND REPLACED WITH 2" INSULATED PANEL WITH 24" X 24" INSULATED ACCESS DOOR FOR FUTURE TEMPORARY SPOT COOLER DUCTS.
22. EXISTING PANEL L1 AND TRANSFORMER TO BE REPLACED.
23. EXISTING UPS TO BE REMOVED.
24. EXISTING LOUVER, DAMPER, AND VENT FAN TO BE REMOVED. WALL TO BE RESTORED AND DOOR ADDED.
25. DOOR AND FRAME WITH PANIC HARDWARE (REFER TO ARCHITECTURAL PLANS) AND ELECTRONIC LOCK CONTROLS (REFER TO SECURITY PLANS).

KEYED NOTES

1. 3 / 8" X 4"X42" INSULATED COPPER BUS MAIN GROUND BAR ON WALL.
2. NEW EQUIPMENT TO REPLACE EXISTING EQUIPMENT.
3. EXISTING EQUIPMENT TO BE DEMOLISHED AFTER LOADS / CONTROL SYSTEMS ARE TRANSFERRED TO NEW EQUIPMENT.
4. NEW MEDIUM VOLTAGE CABLE FROM SWITCHGEAR STYLE REGULATORS TO SPLICES AT CABLE TRAY NEAREST WIRE VAULT CABLE TRAY DROP FOR EXIT TO UNDERGROUND DUCTBANK. COORDINATE WITH HAS OPERATIONS FOR SPLICE LOCATION TO ALLOW FOR FUTURE MEDIUM VOLTAGE CABLE TO SPLICE IN FIRST AIRFIELD MANHOLE FOR FUTURE CONNECTION TO EXISTING AIRFIELD LIGHTING CIRCUITS REPLACED UNDER OTHER PROJECTS. SUBMIT SPLICING PLAN TO AIRPORT ELECTRIC SHOP FOR APPROVAL OF SPLICING LOCATIONS.
5. EXISTING EQUIPMENT TO REMAIN.
6. EXISTING INTAKE AND EXHAUST LOUVERS, DAMPERS, AND VENT FAN TO BE REMOVED AND WALL RESTORED.
7. PROVIDE TWO SUPPLEMENTAL 250 KCMIL GROUND CONDUCTORS FROM ELECTRICAL EQUIPMENT WITH ONE TO MAIN GROUND BAR IN ELECTRICAL ROOM AND ONE TO GROUND LOOP SECURED TO WALLS OF EQUIPMENT ROOMS. PROVIDE NEW 250 KCMIL LOOP ON ALL WALLS OF REGULATOR AND ELECTRICAL ROOMS AND TERMINATE WITH 250 KCMIL GROUND CONDUCTOR FROM ELECTRICAL EQUIPMENT TO NEW 42" X 4" MAIN GROUND BAR IN ELECTRICAL ROOM. TERMINATE GROUND LEADS FROM EXISTING GROUND RODS WIRING TO NEW GROUND LOOP. REMOVE EXISTING WALL MOUNTED GROUND LOOP AFTER REMOVAL OF EXISTING REGULATORS. PROVIDE NEW 250 KCMIL GROUND WIRE FROM NEW MAIN GROUND BAR TO NEW 24" X 4" CPI GROUND BAR IN IDF IT EQUIPMENT CAGE AND RETERMINATE ALL IT EQUIPMENT GROUNDS TO THE IDF GROUND BAR. RETERMINATE ALL EXISTING COMMUNICATION AND FAA EQUIPMENT GROUND LEADS TO NEW WALL MOUNTED GROUND LOOP. ALL GROUNDS SHALL BE BARE COPPER WITH CADWELDED CONNECTIONS TO MAIN GROUND BAR FROM EARTH GROUNDING CONDUCTORS AND EXCEPT WHERE OTHERWISE NOTED. DOUBLE BOLT CONNECTIONS WITH LONG BARREL CRIMP CONNECTIONS AT GROUND BAR.. PROVIDE BENDS OF 5 FOOT RADIUS WHERE POSSIBLE (24" MINIMUM WHERE 5 FOOT RADIUS ARE NOT POSSIBLE.
8. NEW ALCMS EQUIPMENT.
9. EXISTING EQUIPMENT RELOCATED TO LOCATION SHOWN.
10. WIRE CAGE RECONFIGURED FOR EXISTING INFORMATION TECHNOLOGY EQUIPMENT TO REMAIN.
11. EXISTING GROUND TO BE CONNECTED TO NEW SERVICE GROUND.
12. EXISTING DOORS & TRANSOM & FRAME TO BE REMOVED.
13. NEW DOOR (PANIC HARDWARE, MORTISE LOCK, POSITION SENSOR, CARD READER, PUSH EXIT BUTTON AND CAMERAS (INTERIOR AND EXTERIOR) TO SECURITY PANEL)



1 / – SOUTH VAULT ELECTRICAL POWER PLAN
SCALE: 1/4" = 1'-0"

0 4 8 12
GRAPHIC SCALE: 1/4" = 1'-0"

HOUSTON AIRPORT SYSTEM

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REVISIONS		
NO.	DESCRIPTION	DATE
ISSUED FOR PERMIT		03/01/24
1	ADDENDUM 1	04/19/24

HOUSTON AIRPORT SYSTEM
PROJECT 952 SOUTH LIGHTING VAULT RENOVATION
GEORGE BUSH INTERCONTINENTAL AIRPORT / HOUSTON
4104 WILL CLAYTON PARKWAY, HOUSTON, TX 77032

SOUTH VAULT RENOVATIONS
ELECTRICAL POWER PLAN

PROJECT MGR: AEO
DESIGNER: AO
DRAWN BY: SH
CHECK BY: NM

DATE:

STATE OF TEXAS
ARTHUR E. OTTO
75035
REGISTERED PROFESSIONAL ENGINEER
4/19/24

APPROVED BY:

DIRECTOR
HOUSTON AIRPORT SYSTEM

JACOBS NO. WHXK7125
A.I.P. NO.
C.I.P. NO. A-000687
B.S.G. NO. 2024-31-IAH
H.A.S. NO. PN 952
T.I.P. NO. 24-28-IAH

SHEET NO.

SV-EP2.01

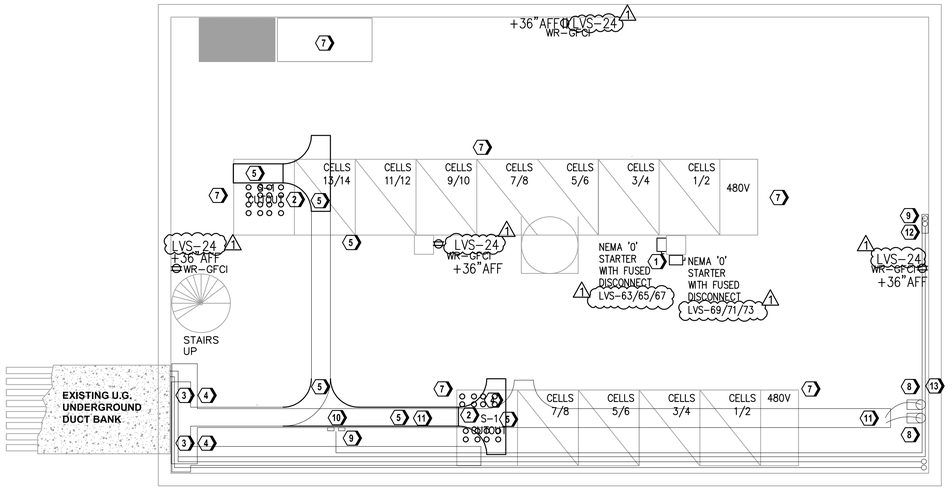
TYPE AC (BX) AND MC CABLE ARE PROHIBITED.

GENERAL NOTES

A. REFER TO SHEET SV-E0.01 FOR SYMBOLS, ABBREVIATIONS AND GENERAL NOTES.
B. NEW 5KV CABLES FROM NEW S1 CABINETS TO BE ROUTED TO WIRE VAULT LEVEL. PROVIDE NEW GALVANIZED CABLE TRAY SUPPORTED ON STAINLESS STEEL UNISTRUT FOR 5 KV CABLES TO CONNECT FROM S1 CABINETS AND EXIT AT SOUTH END OF WIRE VAULT. SUBMIT PROPOSED SPLICE LOCATION TO OPERATIONS FOR APPROVAL AT LEAST 4 WEEKS PRIOR TO INSTALLATION OF NEW SPLICE TO CONNECT NEW CABLE TO EXISTING CABLE EXITING THE WIRE VAULT. WHERE NOT UTILIZED FOR CABLE ROUTING, THE EXISTING CABLE TRAY AND UNISTRUT IS TO BE REMOVED AS REQUIRED FOR INSTALLATION OF THE NEW CABLE TRAY AND THE REMAINDER OF THE EXISTING CABLE TRAY REMOVED UPON COMPLETION OF THE NEW INSTALLATION.
C. ALL CONDUIT IN WIRE VAULT IS TO BE WEATHER RESISTANT PVC COATED RIGID GALVANIZED CONDUIT (RGC) WITH PVC COATED OR STAINLESS STEEL (316L) PROVIDE INTERIOR CONDUIT SEALS PENETRATIONS TO LEVEL ABOVE AND TO EXTERIOR. JUNCTION BOXES AND BACK BOXES SHALL BE CAST IRON FS/FD RATED WITH SEALANT ON FITTING THREADS.

KEYED NOTES

1. TWO NEW SUBMERSIBLE SUMP PUMPS IN EXISTING SUMP. PUMPS TO BE SUPPLIED WITH SEPARATE CIRCUITS FROM EXISTING PANEL LVS IN INTERIM AND RELOCATED TO NEW PANEL LVS FOR FINAL INSTALLATION. PROVIDE MULTIPLE FLOATS FOR PUMP 1 ON AT LOW LEVEL, PUMP 2 ON AT INTERMEDIATE LEVEL AND HIGH ALARM AT HIGH LEVEL TO BUILDING MANAGEMENT ALARMS AT IT CAGE ON LEVEL ABOVE. DEMOLISH EXISTING PUMPS AND ELECTRICAL INSTALLATION BACK TO PANEL ON LEVEL ABOVE.
2. PROVIDE NEW FLOOR PENETRATIONS FOR CABLES FROM NEW S1 CABINET ON LEVEL ABOVE. REFER TO STRUCTURAL TYPICAL DETAILS AND SPECIFICATIONS. COORDINATE LOCATION WITH EXISTING STRUCTURE AND S1 CABINET MANUFACTURERS INSTALLATION REQUIREMENTS. ROUTE CABLES IN NEW AND EXISTING POWER CABLE TRAYS (LOWER LEVEL CABLE TRAYS) TO WIRE EXIT IN SOUTHWEST CORNER OF WIRE VAULT. REUSE EXISTING POWER CABLE TRAY WITH MODIFIED CABLE TRAY ROUTED TO NEW PENETRATIONS TO REGULATORS ABOVE. EXISTING CABLE TRAY TO BE REPLACED IN PHASES TO SUPPORT EXISTING CABLES UNTIL ALL EXISTING REGULATORS ARE REPLACED AND NEW CABLES ROUTED FROM NEW REGULATORS TO SPLICE POINT NEAR CABLE VAULT EXIT TO UNDERGROUND DUCTBANK. PROVIDE NEW MEDIUM VOLTAGE CABLE FROM SWITCHGEAR STYLE REGULATORS TO SPLICES AT CABLE TRAY NEAREST WIRE VAULT CABLE TRAY DROP FOR EXIT TO UNDERGROUND DUCTBANK. COORDINATE WITH HAS OPERATIONS FOR SPLICE LOCATION TO ALLOW FOR FUTURE MEDIUM VOLTAGE CABLE TO SPLICE IN FIRST AIRFIELD MANHOLE FOR FUTURE CONNECTION TO EXISTING AIRFIELD LIGHTING CIRCUITS REPLACED UNDER OTHER PROJECTS. SUBMIT SPLICING PLAN TO AIRPORT ELECTRIC SHOP FOR APPROVAL OF SPLICING LOCATIONS. EXISTING CABLE TRAY UNISTRUT SUPPORTS AND HARDWARE TO BE REPLACED WITH NEW STAINLESS STEEL UNISTRUT AND HARDWARE SECURED TO THE EXISTING TRAY AND FLOOR IN PHASES TO MAINTAIN SUPPORT OF THE EXISTING TRAY. AFTER CABLES HAVE BEEN REPLACED AND SECTIONS OF THE TRAY ARE NO LONGER IN USE, CAP THE ENDS OF THE ACTIVE SECTION WITH CABLE TRAY MANUFACTURED END CLOSURES. REPLACE ALL EXISTING GROUNDS AND GROUND STRAPS IN THE CABLE TRAY FOR A NEW A COMPLETE CABLE TRAY GROUNDING SYSTEM.
3. PROVIDE INTERNAL CONDUIT SEALS AT ALL CONDUIT PENETRATIONS OF THE EXTERIOR WALL AND TEST FOR WATER TIGHT.
4. EXISTING POWER CABLE TRAY (LOWER LEVEL) TO BE MODIFIED FOR NEW ROUTE. EXISTING CABLE TRAY SUPPORTS TO BE REPLACED WITH 316L STAINLESS STEEL FOR UNISTRUT AND ALL HARDWARE. EXISTING CABLE TRAY TO BE MODIFIED FOR THE NEW ROUTING.
5. NEW POWER CABLE TRAY (LOWER LEVEL) ROUTED FROM NEW PENETRATIONS TO NEW S1 CABINETS ABOVE AT END OF REGULATOR SWITCHGEAR LINE UP ABOVE.
6. EXISTING POWER CABLE TRAY (LOWER LEVEL) ROUTED FROM EXISTING S1 CABINET AND PREVIOUS REGULATOR LOCATIONS TO BE REDUCED AND ORIGINAL CABLE TRAY MANUFACTURER END CAPS INSTALLED TO CLOSE CABLE TRAY ENDS FOR CABLE TRAY SECTIONS TO REMAIN IN USE FOR FINAL CONDITION..
7. NEW REGULATORS, NEW S1 CABINETS, AND EXISTING S1 CABINET ABOVE SHOWN FOR REFERENCE.
8. EXISTING CONDUIT FITTING WITH EXISTING COMMUNICATION CABLES FROM TRAY TO ABOVE TO REMAIN.
9. NEW CONDUIT WITH NEW CABLES FOR CONNECTION TO RELOCATED RVR CTS..
10. NEW LOCATION FOR CURRENT TRANSDUCERS FOR RVR. PROVIDE NEW 2" CONDUIT TO EXISTING JUNCTION BOX ON NORTH WALL AND NEW SENSING WIRES FROM CURRENT TRANSDUCERS TO RVR EQUIPMENT ON LEVEL ABOVE.
11. EXISTING COMMUNICATIONS CABLE TRAY (UPPER LEVEL) TO REMAIN. CABLE TRAY SUPPORTS TO BE REPLACED WITH 316L STAINLESS STEEL FOR UNISTRUT AND ALL HARDWARE.
12. EXISTING JUNCTION BOX AND CONDUIT TO ABOVE WITH NEW RVR CABLES.
13. EXISTING CONDUIT FROM JUNCTION BOX TO REMAIN WITH NEW ALCMS CABLES.



1 WIRE VAULT ELECTRICAL POWER PLAN
SCALE: 1/4" = 1'-0"

0 4 8 12
GRAPHIC SCALE: 1/4" = 1'-0"

HOUSTON AIRPORT SYSTEM

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REVISIONS

NO.	DESCRIPTION	DATE
	ISSUED FOR CONSTRUCTION	03/15/24
1	ADDENDUM 1	04/19/24

HOUSTON AIRPORT SYSTEM
PROJECT 952 SOUTH LIGHTING VAULT RENOVATION
GEORGE BUSH INTERCONTINENTAL AIRPORT / HOUSTON
4104 WILL CLAYTON PARKWAY, HOUSTON, TX 77032

SOUTH VAULT RENOVATIONS
WIRE VAULT ELECTRICAL POWER PLAN

PROJECT MGR: AEO
DESIGNER: AO
DRAWN BY: SH
CHECK BY: NM

DATE:

STATE OF TEXAS
ARTHUR E. OTTO
75035
REGISTERED PROFESSIONAL ENGINEER
4/19/24

APPROVED BY:

DIRECTOR
HOUSTON AIRPORT SYSTEM

JACOBS NO. WHXK7125
A.I.P. NO.
C.I.P. NO. A-000687
B.S.G. NO. 2024-31-IAH
H.A.S. NO. PN 952
T.I.P. NO. 24-28-IAH

SHEET NO.

SV-EP2.02

TYPE AC (BX) AND MC CABLE ARE PROHIBITED.

GENERAL NOTES

A. REFER TO SHEET SV–E0.01 FOR SYMBOLS, ABBREVIATIONS AND GENERAL NOTES.
B. EQUIPMENT INSTALLATION TO BE PHASED WITH ENABLING WORK FOR NEW EQUIPMENT TO REPLACE EXISTING EQUIPMENT, INSTALLATION OF NEW SERVICE FROM CENTERPOINT VAULT, INTERCONNECTION AND TESTING OF NEW EQUIPMENT, ENERGIZATION OF NEW EQUIPMENT, PHASED TRANSFER OF EXISTING LOADS TO NEW EQUIPMENT, DEMOLITION OF EQUIPMENT TO BE REMOVED. PHASING PLAN AND OUTAGES TO BE SUBMITTED TO OPERATIONS FOR APPROVAL 1 MONTH PRIOR AND COORDINATED WITH OPERATIONS AND CENTERPOINT ENERGY.

KEYED NOTES

(1) 3 / 8" X 4"X42" INSULATED COPPER BUS MAIN GROUND BAR ON WALL.

(2) NEW EQUIPMENT TO REPLACE EXISTING EQUIPMENT.

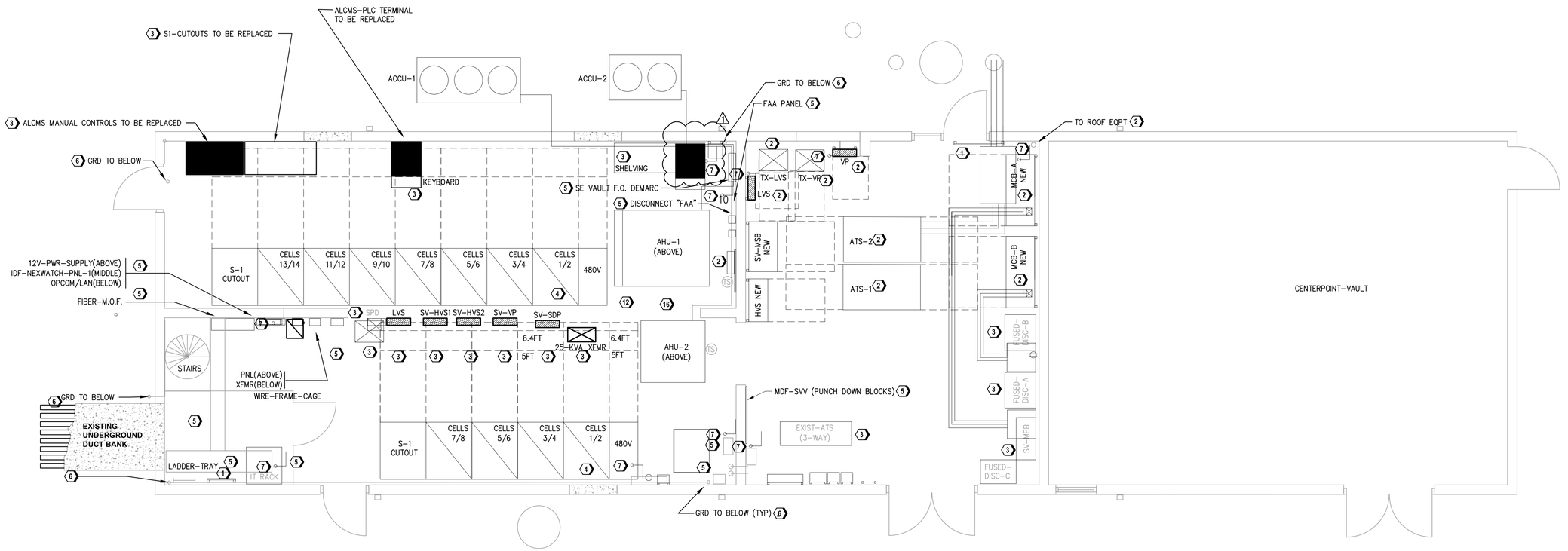
(3) EXISTING EQUIPMENT TO BE DEMOLISHED AFTER LOADS / CONTROL SYSTEMS ARE TRANSFERRED TO NEW EQUIPMENT.

(4) NEW SWITCHGEAR STYLE REGULATORS WITH NEW 5 KV CABLE AND SPLICES IN FIRST AIRFIELD MANHOLE TO CONNECT NEW WRIGN TO EXISTING AIRFIELD LIGHTING CIRCUITS REPLACED UNDER OTHER PROJECTS.

(5) EXISTING EQUIPMENT TO REMAIN.

(6) EXISTING GROUND TO BE CONNECTED TO NEW BUILDING GROUND SYSTEM..

(7) PROVIDE TWO SUPPLEMENTAL 4 / 0 AWG GROUND CONDUCTORS FROM ELECTRICAL EQUIPMENT WITH ONE TO MAIN GROUND BAR IN ELECTRICAL ROOM AND ONE TO GROUND LOOP SECURED TO WALLS OF EQUIPMENT ROOMS. PROVIDE NEW 4 / 0 AWG LOOP ON ALL WALLS OF REGULATOR AND ELECTRICAL ROOMS AND TERMINATE WITH TWO 4 / 0 AWG GROUND CONDUCTOR FROM ELECTRICAL EQUIPMENT TO NEW 42" X 4" MAIN GROUND BAR IN ELECTRICAL ROOM. TERMINATE GROUND LEADS FROM EXISTING GROUND RODS WIRING TO NEW GROUND LOOP. REMOVE EXISTING WALL MOUNTED GROUND LOOP AFTER REMOVAL OF EXISTING REGULATORS. PROVIDE NEW 4/0 AWG GROUND WIRE FROM NEW MAIN GROUND BAR TO NEW 24" X 4" CPI GROUND BAR IN IDF IT EQUIPMENT CAGE AND RETERMINATE ALL IT EQUIPMENT GROUNDS TO THE IDF GROUND BAR. RETERMINATE ALL EXISTING COMMUNICATION AND FAA EQUIPMENT GROUND LEADS TO NEW WALL MOUNTED GROUND LOOP. ALL GROUNDS SHALL BE BARE COPPER WITH CADWELDED CONNECTIONS TO MAIN GROUND BAR FROM EARTH GROUNDING CONDUCTORS AND EXCEPT WHERE OTHERWISE NOTED. DOUBLE BOLT CONNECTIONS WITH LONG BARREL CRIMP CONNECTIONS AT GROUND BAR.. PROVIDE BENDS OF 5 FOOT RADIUS WHERE POSSIBLE (24" MINIMUM WHERE 5 FOOT RADIUS ARE NOT POSSIBLE.



1 / – SOUTH VAULT ELECTRICAL GROUNDING PLAN
SCALE: 1/4" = 1'–0"

0 4 8 12
GRAPHIC SCALE: 1/4" = 1'–0"

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REVISIONS

NO.	DESCRIPTION	DATE
	ISSUED FOR CONSTRUCTION	03/15/24
1	ADDENDUM 1	04/19/24

HOUSTON AIRPORT SYSTEM
PROJECT 952 SOUTH LIGHTING VAULT RENOVATION
GEORGE BUSH INTERCONTINENTAL AIRPORT / HOUSTON
4104 WILL CLAYTON PARKWAY, HOUSTON, TX 77032

SOUTH VAULT RENOVATIONS
ELECTRICAL GROUNDING PLAN

PROJECT MGR: AEO
DESIGNER: AO
DRAWN BY: SH
CHECK BY: NM
DATE:

STATE OF TEXAS
ARTHUR E. OTTO
75035
REGISTERED PROFESSIONAL ENGINEER
4/19/24

APPROVED BY:

DIRECTOR
HOUSTON AIRPORT SYSTEM

JACOBS NO. WHXK7125
A.I.P. NO.
C.I.P. NO. A–000687
B.S.G. NO. 2024–31–IAH
H.A.S. NO. PN 952
T.I.P. NO. 24–28–IAH

SHEET NO.

SV-EP2.03

TYPE AC (BX) AND MC CABLE ARE PROHIBITED.

GENERAL NOTES

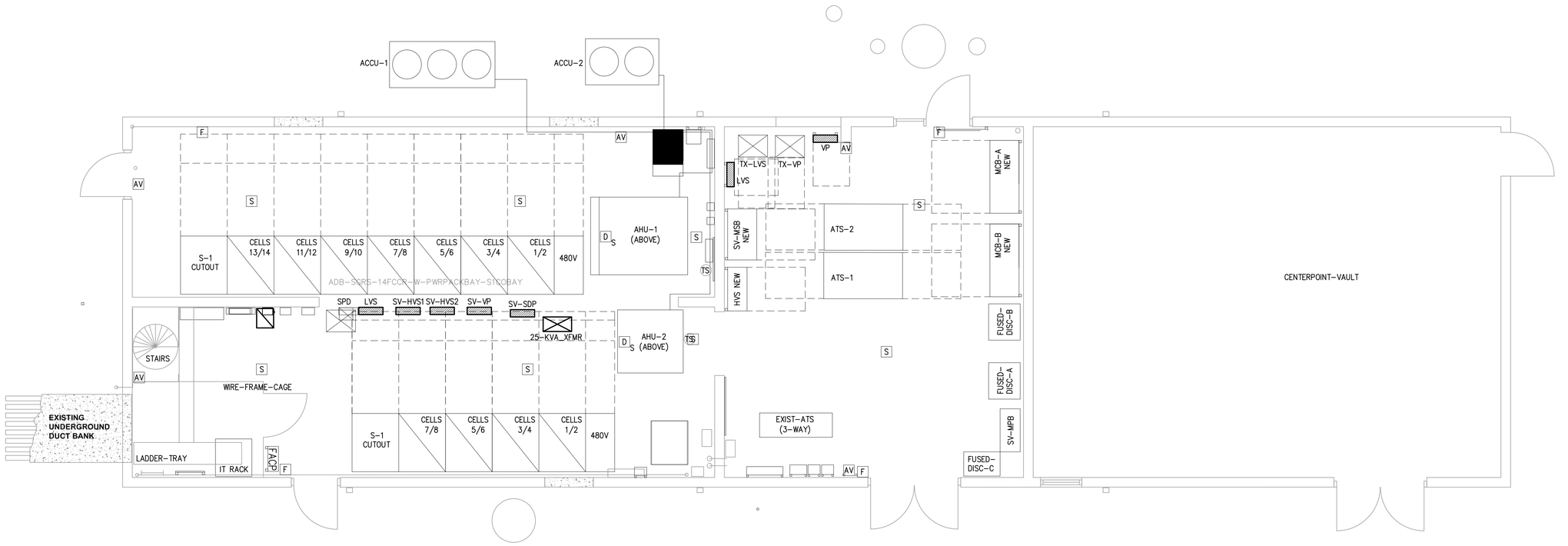
A. REFER TO SHEET SV-E0.01 FOR SYMBOLS, ABBREVIATIONS AND GENERAL NOTES.

B. FIRE ALARM DEVICES ARE SHOWN FOR COORDINATION.

C. FIRE ALARM DESIGN WILL BE DEFERRED SUBMITTAL BY FIRE ALARM CONTRACTORS NICET LEVEL 3 DESIGN TEAM.

D. ALL FIRE ALARM DEVICES AND CABLING WILL BE INSTALLED IN JUNCTION BOXES AND CONDUIT.

1 E. PROVIDE NEW FIRE ALARM PANEL WITH NEW CONNECTION TO CAMPUS NETWORK IN TERMINALS.



1 / - SOUTH VAULT FIRE ALARM COORDINATION PLAN
SCALE: 1/4" = 1'-0"

0 4 8 12
GRAPHIC SCALE: 1/4" = 1'-0"

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REVISIONS

NO.	DESCRIPTION	DATE
	ISSUED FOR CONSTRUCTION	03/15/24
1	ADDENDUM 1	04/19/24

HOUSTON AIRPORT SYSTEM
PROJECT 952 SOUTH LIGHTING VAULT RENOVATION
GEORGE BUSH INTERCONTINENTAL AIRPORT / HOUSTON
4104 WILL CLAYTON PARKWAY, HOUSTON, TX 77032

SOUTH VAULT RENOVATIONS
FIRE ALARM COORDINATION PLAN

PROJECT MGR: AEO
DESIGNER: AO
DRAWN BY: SH
CHECK BY: NM

DATE:

STATE OF TEXAS
ARTHUR E. OTTO
75035
REGISTERED PROFESSIONAL ENGINEER
4/19/24

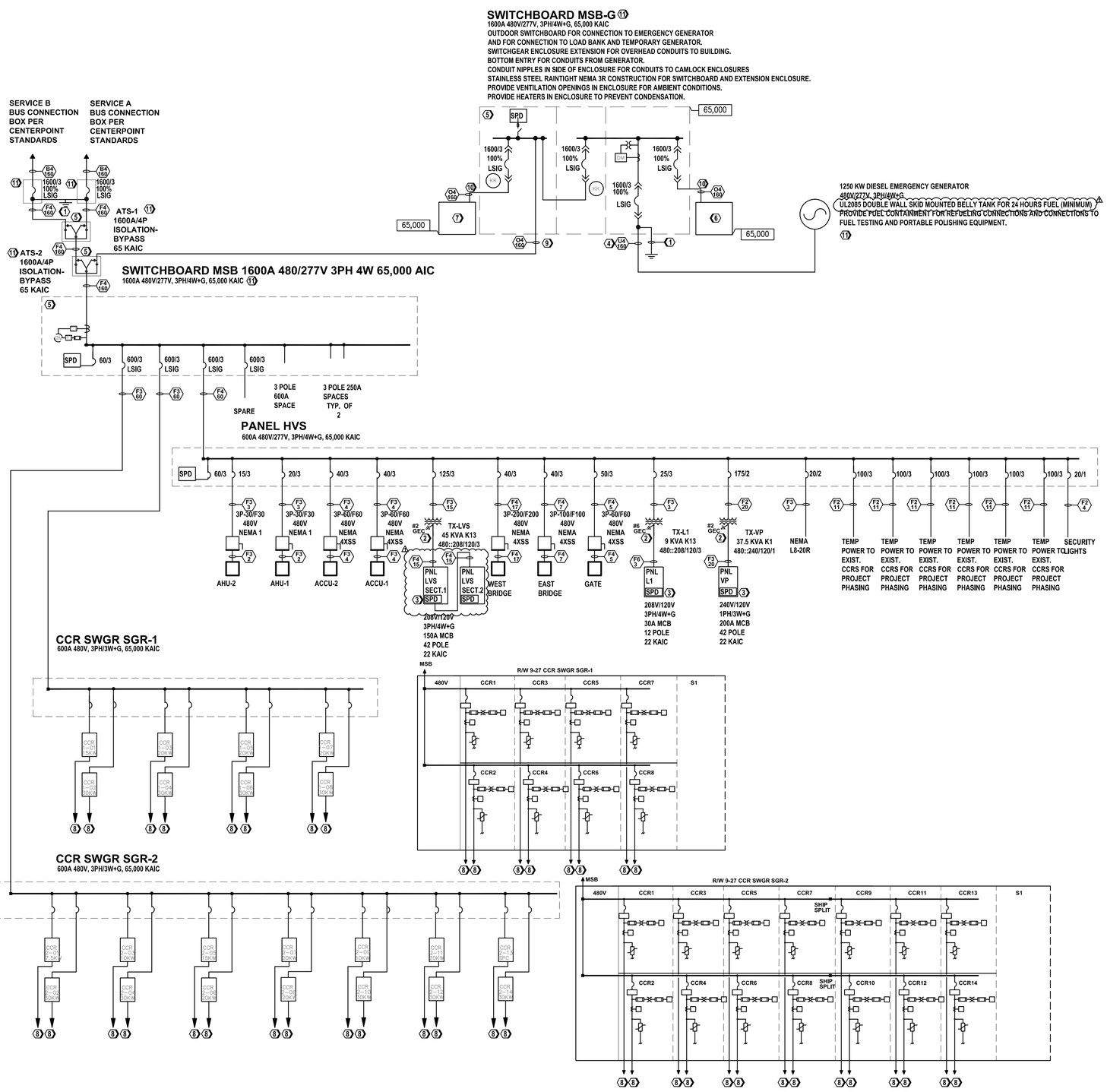
APPROVED BY:

DIRECTOR
HOUSTON AIRPORT SYSTEM

JACOBS NO. WHXK7125
A.I.P. NO.
C.I.P. NO. A-000687
B.S.G. NO. 2024-31-IAH
H.A.S. NO. PN 952
T.I.P. NO. 24-28-IAH

SHEET NO.

SV-EF3.01



TYPE AC (BX) AND MC CABLE ARE PROHIBITED.

GENERAL NOTES

A. REFER TO SHEET SV-E0.01 FOR SYMBOLS, ABBREVIATIONS AND GENERAL NOTES.
B. EQUIPMENT INSTALLATION TO BE PHASED WITH ENABLING WORK FOR NEW EQUIPMENT TO REPLACE EXISTING EQUIPMENT, INSTALLATION OF NEW SERVICE FROM CENTERPOINT VAULT, INTERCONNECTION AND TESTING OF NEW EQUIPMENT, ENERGIZATION OF NEW EQUIPMENT, PHASED TRANSFER OF EXISTING LOADS TO NEW EQUIPMENT, DEMOLITION OF EQUIPMENT TO BE REMOVED. PHASING PLAN AND OUTAGES TO BE SUBMITTED TO OPERATIONS FOR APPROVAL 1 MONTH PRIOR AND COORDINATED WITH OPERATIONS AND CENTERPOINT ENERGY.
C. PERFORM SHORT CIRCUIT STUDY, COORDINATION STUDY AND ARC FLASH STUDY AS SPECIFIED BY 260573.13, 260573.16, 260573.19. ADJUST CIRCUIT BREAKERS AND PLACE ARC-FLASH LABEL ON ALL ELECTRICAL EQUIPMENT. MEG-OHM TEST ALL FEEDER AND SERVICE ENTRANCE CONDUCTORS. ALL TESTING DOCUMENTATION SHALL BE DOCUMENTED, RECORDED AND SIGNED BY MASTER ELECTRICIAN.
D. TORQUE AND MARK ALL FEEDER AND SERVICE ENTRANCE CONDUCTOR TERMINATIONS. ALL TESTING DOCUMENTATION SHALL BE DOCUMENTED, RECORDED AND SIGNED BY MASTER ELECTRICIAN.
E. TEST AND DOCUMENT ALL FEEDER, SERVICE ENTRANCE CONDUCTOR, TRANSFORMER, BRANCH CIRCUIT AND RECEPTACLE POLARITIES. ALL TESTING DOCUMENTATION SHALL BE DOCUMENTED, RECORDED AND SIGNED BY MASTER ELECTRICIAN.
F. ALL TESTING DOCUMENTATION SHALL BE DOCUMENTED, RECORDED AND SIGNED BY MASTER ELECTRICIAN.

——— NEW CONSTRUCTION
——— EXISTING TO REMAIN

XX,XXX INDICATES AVAILABLE FAULT CURRENT. AMPS RMS SYM

BREAKER SPEC/TRIP CODE:

L=LONG-TIME ADJ.
S=SHORT TIME ADJ.
I=INSTANTANEOUS ADJ.
G=GROUND FAULT TRIP
ST=SHUNT TRIP
EO=ELECTRICALLY OPERATED

KEYED NOTES

(1) TEST EXISTING GROUND SYSTEM AND ADD GROUND RODS AS REQUIRED FOR 3 OHMS TO EARTH PER SOIL TESTING. CONNECT MAIN GROUND BAR TO BUILDING STRUCTURAL STEEL, BUILDING METAL PIPING, CONCRETE ENCASED REINFORCING BARS OF BUILDING. PROVIDE SEPARATE INSULATED DOWNLEADS AND GROUNDING FIELD FOR NEW LIGHTNING PROTECTION SYSTEM WITH 10 FOOT MINIMUM BETWEEN THE TWO GROUNDING SYSTEMS. BOND LIGHTNING PROTECTION SYSTEM WITH INSULATED CONDUCTOR TO MAIN GROUND BAR IN ELECTRICAL ROOM. PROVIDE 4"X36" INSULATED COPPER BUS GROUND BAR AT 108" ON WALL. CONDUIT FOR TERMINATION OF CONDUCTORS FROM SERVICE EARTH GROUND AND TO STEP DOWN TRANSFORMERS, CABLE TRAY, AND CONDUIT BOND RINGS AND EQUIPMENT. CONDUITS FOR GROUND CONDUCTORS SHALL BE BONDED AT EACH END.

(2) PROVIDE GROUND CONDUCTORS FROM TRANSFORMERS TO BUILDING STEEL AND TO 4"X24" INSULATED COPPER BUS GROUND BAR (KEY NOTE 5). CONDUITS FOR GROUND CONDUCTORS SHALL BE BONDED AT EACH END.

(3) REPLACE EXISTING PANEL WITH NEW PANEL WITH BREAKERS TO MATCH EXISTING PANEL AND RECONNECT TO EXISTING FEEDERS. NEW TRANSFORMER TO BE LOCATED ADJACENT TO EXISTING PANEL FOR 10 FT OR LESS WIRE LENGTH FROM TRANSFORMER TO MAIN CIRCUIT BREAKER IN PANEL.

(4) FEEDER IN CONCRETE ENCASED DUCTBANK.

(5) PROVIDE PERMANENT LAMINATED ENGRAVED PLACARD DENOTING THE LOCATION OF ALL OTHER ELECTRICAL SERVICES PER NEC ARTICLE 230.2(E) AND FAULT CURRENT PER NEC 110.24.

(6) CAMLOCK CONNECTION FOR PORTABLE GENERATOR LOAD BANK

(7) CAMLOCK CONNECTION FOR FUTURE TEMPORARY GENERATOR

(8) NEW REGULATOR WITH NEW 5 KV CABLE TO S1 CABINET AND TO NEW SPLICE POINT IN BASEMENT TO SPLICE TO EXISTING AIRFIELD LIGHTING CIRCUIT.

(9) FEEDER ON OVERHEAD PIPE SUPPORTS.

(10) FEEDER NIPPLES BETWEEN SWITCHGEAR AND CAMLOCK BOX.

(11) PROVIDE INFRARED SCANNING PORTS ON SWITCHBOARDS, TRANSFORMERS, MAIN ENCLOSED BREAKERS, GENERATOR TERMINALS, AND AUTOMATIC TRANSFER SWITCHES FOR INFRARED SCANNING OF CABLE TERMINATIONS AND BUS JOINTS.

HOUSTON AIRPORT SYSTEM

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REVISIONS

NO.	DESCRIPTION	DATE
ISSUED FOR CONSTRUCTION		03/15/24
1	ADDENDUM 1	04/19/24

HOUSTON AIRPORT SYSTEM
PROJECT 952 SOUTH LIGHTING VAULT RENOVATION
GEORGE BUSH INTERCONTINENTAL AIRPORT / HOUSTON
4104 WILL CLAYTON PARKWAY, HOUSTON, TX 77032

SOUTH VAULT RENOVATIONS
ELECTRICAL ONE LINE DIAGRAM

PROJECT MGR: AEO
DESIGNER: AO
DRAWN BY: SH
CHECK BY: NM
DATE:

STATE OF TEXAS
ARTHUR E. OTTO
75035
REGISTERED PROFESSIONAL ENGINEER
4/19/24

APPROVED BY:

DIRECTOR
HOUSTON AIRPORT SYSTEM

JACOBS NO. WHXK7125
A.I.P. NO.
C.I.P. NO. A-000687
B.S.G. NO. 2024-31-IAH
H.A.S. NO. PN 952
T.I.P. NO. 24-28-IAH

SHEET NO.

SV-E4.01

TYPE AC (BX) AND MC CABLE ARE PROHIBITED.

FEEDER SCHEDULE

MARK	CONDUIT	CONDUCTORS PER CONDUIT
F2 1	1"	2 #10, 1 #10G
F3 1	1"	3 #10, 1 #10G
F4 1	1"	3 #10, 1 #10 N, 1 #10G
F2 4	1"	2 #8, 1 #10G
F3 4	1"	3 #8, 1 #10G
F4 4	1"	4 #8, 1 #10G
F3 6	1"	3 #6, 1 #10G
F4 5	1"	3 #6, 1 #6 N, 1 #10G
F3 7	1"	3 #4, 1 #8G
F4 7	1-1/4"	3 #4, 1 #4 N, 1 #8G
F5 7	1-1/4"	3 #4, 2 #4 N, 1 #8G
F3 8	1-1/4"	3 #3, 1 #8G
F4 8	1-1/4"	3 #3, 1 #3 N, 1 #8G
F2 11	1-1/2"	2 #1, 1#6G
F3 11	1-1/2"	3 #1, 1#6G
F4 11	2"	3 #1, 1 #1 N, 1 #6G
F3 12	1-1/2"	3 #1/0, 1 #6G
F4 12	2"	3 #1/0, 1 #1/0N, 1 #6G
F3 15	1-1/2"	3 #1/0, 1#6G
F4 15	2"	3 #1/0, 1 #1/0 N, 1 #6G
F5 15	2"	3 #1/0, 2 #1/0 N, 1 #6G,
F3 17	2"	3 #2/0, 1 #6G
F4 17	2"	3 #2/0, 1 #2/0 N, 1 #6G
F2 20	2"	2 #3/0, 1 #6G
F3 20	2"	3 #3/0, 1 #6G
F4 20	2-1/2"	3 #3/0, 1 #3/0 N, 1 #6G
F3 22	2"	3 #4/0, 1 #4G
F4 22	2-1/2"	3 #4/0, 1 #4/0 N, 1 #4G
F5 22	3"	3 #4/0, 2 #4/0 N, 1 #4G,
F2 25	2-1/2"	2 #250kcmil, 1 #4G
F3 25	2-1/2"	3 #250kcmil, 1 #4G
F4 25	3"	3 #250kcmil, 1 #250kcmil N, 1 #4G
F2 30	3"	3 #350kcmil, 1 #4G
F3 30	3"	3 #350kcmil, 1 #4G
F3 30	3"	3 #350kcmil, 1 #4G
F4 30	3"	3 #350kcmil, 1 #350kcmil N, 1 #4G
F2 35	3"	2 #500kcmil, 1 #2G
F3 35	3"	3 #500kcmil, 1 #2G
F4 35	3-1/2"	3 #500kcmil, 1 #500kcmil N, 1 #2G
F2 40	3-1/2"	2 #600kcmil, 1 #2G
F3 40	4"	3 #600kcmil, 1 #2G
F4 40	4"	3 #600kcmil, 1 500kcmil N, 1#2G
F5 40	4"	3 #600kcmil, 2 #500kcmil N, 1#2G
F3 45	(2) 2"	3 #4/0, 1 #2G
F4 45	(2) 2-1/2"	3 #4/0, 1 #4/0 N, 1 #2G
F2 50	(2) 2-1/2"	2 #250kcmil, 1 #2G
F3 50	(2) 2-1/2"	3 #250kcmil, 1 #2G
F4 50	(2) 3"	3 #250kcmil, 1 #250kcmil N, 1 #2G
F5 50	(2) 3"	3 #250kcmil, 2 #250kcmil N, 1 #2G
F3 60	(2) 3"	3 #350kcmil, 1 #1G
F4 60	(2) 3"	3 #350kcmil, 1 #350kcmil N, 1 #1G
F3 80	(2) 4"	3 #600kcmil, 1 #1/0G
F4 80	(2) 4"	3 #600kcmil, 1 #600kcmil N, 1 #1/0G
F5 80	(2) 4"	3 #600kcmil, 2 #600kcmil N, 1 #1/0G
F3 100	(3) 3"	3 #400kcmil, 1 #2/0G
F4 100	(3) 3-1/2"	3 #400kcmil, 1 #400kcmil N, 1 #2/0G

FEEDER SCHEDULE

MARK	CONDUIT	CONDUCTORS PER CONDUIT
F3 120	(4) 3"	3 #350kcmil, 1 #3/0G
F4 120	(4) 4"	3 #350kcmil, 1 #350kcmil N, 1 #3/0G
F3 160	(5) 3"	3 #400kcmil, 1 #4/0G
F4 160	(5) 3-1/2"	3 #400kcmil, 1 #400kcmil N, 1 #250kcmilG
F4 200	(6) 3-1/2"	3 #400kcmil, 1 #400kcmil N, 1 #250kcmilG
F4 200	(7) 3-1/2"	3 #500kcmil, 1 #500kcmil N, 1 #350kcmilG
F4 300	(8) 3-1/2"	3 #500kcmil, 1 #500kcmil N, 1 #400kcmilG
F4 400	(11) 4"	3 #500kcmil, 1 #500kcmil N, 1 #500kcmil G
S3 11	2"	3 #1, 6 G FOR 240/3 OR 480/3 2 #1, 1 #1 N, 6 G FOR 240/120/1
S4 11	2"	3 #1, 1 #1 N, #6 G
S3 12	2"	3 #1/0, 6 G FOR 240/3 OR 480/3 2 #1/0, 1 #1/0 N, 6 G FOR 240/120/1
S3 15	2-1/2"	3 #1/0, #6 G FOR 240/3 OR 480/3 2 #1/0, 1 #1/0 N, #6 G FOR 240/120/1
S4 15	2"	3 #1/0, 1 #1/0 N, #6 G
S3 20	2-1/2"	3 #3/0, #4 G FOR 240/3 OR 480/3 2 #3/0, 1 #3/0 N, #4 G FOR 240/120/1
S3 22	2-1/2"	3 #4/0, #2 G FOR 240/3 OR 480/3 2 #4/0, 1 #4/0 N, #2 G FOR 240/120/1
S4 22	4"	3 #4/0, 1 #4/0 N, #2 G
S4 35	4"	3 #500 kcmil, 1 #500kcmil N, #1/0 G
S3 40	4"	3 #600kcmil, #1/0 G FOR 240/3 OR 480/3 2 #600kcmil, 1 #600 N, #1/0 G FOR 240/120/1
S3 45	(2) 2-1/2"	3 #4/0, 1/0 G FOR 240/3 OR 480/3 2 #4/0, 1 #4/0 N, #1/0 G FOR 240/120/1
S3 60	(2) 3"	3 #350kcmil, 2/0 G FOR 240/3 OR 480/3 2 #350kcmil, 1 #350kcmil N, #2/0 G FOR 240/120/1
S3 80	(2) 4"	3 #600kcmil, 3/0 G FOR 240/3 OR 480/3 2 #600 kcmil, 1 #600kcmil N, #3/0 G FOR 240/120/1
S4 80	(3) 4"	3 #600 kcmil, 1 #600kcmil N, #3/0 G
S3 100	(3) 3-1/2"	3 #400kcmil, 3/0 G FOR 240/3 OR 480/3 2 #400kcmil, 1 #400kcmil N, 3/0 G FOR 240/120/1
S4 120	(5) 4" +(1) 4" SPARE	3 #500kcmil, 1 #500kcmil N, 1# 350 kcmil G
S4 160	(7) 4" +(1) 4" SPARE	3 #500kcmil, 1 #500kcmil N, 1# 500 kcmil G
S4 250	(10) 4" +(1) 4" SPARE	3 #600kcmil, 1 #600kcmil N, 1# 600 kcmil G
U3 40	4"	3 #600kcmil, 1 #1/0G FOR 240/3 2 #600kcmil, 1 #600kcmil N, 1 #1/0G FOR 240/120/1
U3 80	(2) 3-1/2"	3 #500kcmil, 250G FOR 240/3 OR 480/3 3 #500kcmil, 1 #500kcmil N, 250G FOR 240/120/1
U4 160	(6) 4" +(2) 4" SPARE	3 #600kcmil, 1 #600kcmil N, 1# 600 kcmil G
O4 160	(6) 4" 4" SPARE	3 #600kcmil, 1 #600kcmil N, 1# 250 kcmil G
B4 160	1600A Feeder Busway	3 Phase 4 Wire Copper Bus NEMA 1 with bus collector, phenolic, and 3 hr fire rated bus penetration to utility.

FEEDER SCHEDULE GENERAL NOTES

1. PROVIDE SPARE CONDUIT WITH PULL WIRE IN ALL UNDERGROUND FEEDERS.
2. FEEDER SIZES INDICATED ARE MINIMUMS. INCREASE FEEDER SIZE WHERE REQUIRED BY THERMAL MODELING.
3. UNDERGROUND FEEDERS WTIH LESS THAN 3 CONDUITS WILL BE RUN SEPARATELY FROM OTHER UNDERGROUNG FEEDERS WITH SPACING AS REQUIRED BY THERMAL MODELING.
4. UNDERGROUND FEEDERS WITH MORE THAN 6 (5 + 1 SPARE) PARALLEL CONDUITS WILL BE ORGANIZED INTO SEPARATE DUCTBANKS OF 6 CONDUITS OR LESS PER DUCTBANK. 5 FOOT MINIMUM EDGE TO EDGE SPACING BETWEEN DUCTBANKS OR LARGER IS TO BE PROVIDED WHERE REQUIRED BY THERMAL MODELING.
5. ALL FEEDERS ARE COPPER WIRE WITH XHHW-2 INSULATION FOR UNDERGROUND FEEDERS LESS THAN OR EQUAL TO 480 VOLTS AND THHN/THWN FOR OTHER FEEDERS LESS THAN OR EQUAL TO 480 VOLTS.

TRANSFORMER SCHEDULE

MARK	KVA	VOLTAGE	PHASE	K-RATING	MOUNTING	SECONDARY FEEDER	XFMR GROUND
TX-LVS	45	480Δ-208/120Y	3	13	FLOOR	4#1/0, 1#2G, 2"C	#2G
TX-VP	37.5	480Δ-240/120/1	1	1	FLOOR	3#3/0, 1#2G, 2.5"C	#2G
TX-L1	9	480Δ-208/120Y	3	13	WALL	4#8, 1#6G, 1.25"C	#6G

SURGE SUPPRESSION DEVICE SCHEDULE

MARK		VOLTAGE	PHASE	MODES OF PROTECTION	SURGE CURRENT	
PNL-LVS		208/120Y	3	7	120 KAIC	
PNL-VP		240/120/1	1	6	120 KAIC	
PNL-L1		208/120Y	3	7	120 KAIC	
MSB		480/277Y	3	7	240 KAIC	
MSB-G		480/277Y	3	7	240 KAIC	
HVS		480/277Y	3	7	240 KAIC	

LIGHTING FIXTURE SCHEDULE

TYPE	MANUFACTURER , MODEL NUMBER & DESCRIPTION	LAMPS	HEIGHT/ MT.	VOLTS	WATTS EACH	NOTES
A	4-FT LED STRIPLIGHT WITH LENSED COVER "LITHONIA LIGHTING" FEML48 4000LM IMA-CD-WD MVOLT GZ10 40K 80CRI WET LOCATION BAA	LED	NOTES 1 & 2	MVOLT	32	1 & 2
AE	4-FT LED STRIPLIGHT WITH LENSED COVER "LITHONIA LIGHTING" FEML48 4000LM IMA-CD-WD MVOLT GZ10 E10WMCP 40K 80CRI WET LOCATION BAA	LED	NOTES 1 & 2	MVOLT	32	1,2,5
B	LED WALL LUMINAIRE WET LOCATION "VERSALED LIGHTING" #WP3.5-C-MCT 30W 4150 LUMEN 40K EM QT	LED	WALL	MVOLT	32	5
C1	LED WALL LUMINAIRE OUTDOOR "LITHONIA LIGHTING" #WDGE2 LED P3 40K 80CRI T3M MVOLT PBBW/SRM/AWS PE BAA, WEDGE2 LED WITH P3-PERFORMANCE PACKAGE, 4000K, 80CRI, TYPE 3 MEDIUM OPTIC	LED	WALL	MVOLT	32	3
C2	LED WALL LUMINAIRE OUTDOOR "LITHONIA LIGHTING" #WDGE2 LED P5 40K 80CRI VW, MVOLT CCE PBBW-BCE/SRM/AWS PE BAA, WEDGE2 LED WITH P5 PERFORMANCE PACKAGE, 4000K, 80CRI, VISUAL COMFORT WIDE OPTIC	LED	WALL	MVOLT	32	3
C3	LED WALL LUMINAIRE OUTDOOR "LITHONIA LIGHTING" #WDGE2 LED P5 40K 80CRI VW MVOLT E20WC CCE PBBW-BCE/SRM/AWS PE BAA, WEDGE2 LED WITH P5 PERFORMANCE PACKAGE, 4000K, 80CRI, VISUAL COMFORT WIDE OPTIC	LED	WALL	MVOLT	32	3,5
C4	LED WALL LUMINAIRE OUTDOOR "LITHONIA LIGHTING" #WDGE2 LED P3 40K 80CRI T3M MVOLT E20WC PBBW/SRM/AWS PE BAA, WEDGE2 LED WITH P3-PERFORMANCE PACKAGE, 4000K, 80CRI, TYPE 3 MEDIUM OPTIC	LED	WALL	MVOLT	32	3,5
X	"LITHONIA LIGHTING" #WLTE W 1 R EL SD	LED	WALL	120/277	3.6	3,5

NOTES:
1. MOUNT 4-FT LED STRIPLIGHTS TO STRUCTURAL TEES ABOVE. TYPICAL.
2. WHERE FIXTURE CANNOT BE MOUNTED TO TEES, MOUNT FIXTURE IN BEAM POCKET TO UNISTRUT ATTACHED TO TEES. ALIGN BOTTOM OF FIXTURE LENS WITH BOTTOM OF TEES.
3. SUBMIT FINISH COLOR SAMPLES DATA SHEET AND MOUNTING BRACKET FOR ARCHITECT APPROVAL.
4. PROVIDE EXTERNAL INVERTER BATTERY BACK LOCATED IN ELECTRICAL ROOM FOR BATTERY BACKUP SUPPLY TO FIXTURE.
5. PROVIDE INTERNAL 90 MINUTE BATTERY BACKUP WITH FIXTURE.

HOUSTON AIRPORT SYSTEM

Jacobs
818 Town & Country Blvd.
Suite 500
Houston, TX 77024
(281) 721-8400
www.jacobs.com TBPE Firm #2966

REVISIONS

NO.	DESCRIPTION	DATE
	ISSUED FOR PERMIT	03/01/24
1	ADDENDUM 1	04/19/24

PROJECT 952 SOUTH LIGHTING VAULT RENOVATION
GEORGE BUSH INTERCONTINENTAL AIRPORT / HOUSTON
4104 WILL CLAYTON PARKWAY, HOUSTON, TX 77032

HOUSTON AIRPORT SYSTEM
SOUTH VAULT RENOVATIONS
SCHEDULES

PROJECT MGR: AEO
DESIGNER: AO
DRAWN BY: SH
CHECK BY: NM

DATE:

STATE OF TEXAS
ARTHUR E. OTTO
75035
REGISTERED
PROFESSIONAL ENGINEER
4/19/24

APPROVED BY:

DIRECTOR
HOUSTON AIRPORT SYSTEM

JACOBS NO. WHXK7125
A.I.P. NO.
C.I.P. NO. A-000687
B.S.G. NO. 2024-31-IAH
H.A.S. NO. PN 952
T.I.P. NO. 24-28-IAH

SHEET NO.

SV-E6.01

TYPE AC (BX) AND MC CABLE ARE PROHIBITED.

PANEL: SWBD MSB

VOLTAGE: 277/480 | 3 PH | 3 W | AIC: 65,000 | REMARKS:
MAINS: 1600 AMPS | ■MLO □MCB | ■SURFACE □FLUSH
LUGS: □SUB-FEED □FEED-THRU | ■NEMA1 □NEMA 3R

C**	WIRE*	LOAD DESCRIPTION	kVA	BKR	CKT	CKT	BKR	kVA	LOAD DESCRIPTION	WIRE*	C**
		SURGE PROTECTION DEVICE	0.0	100/ 3	1	2	600/ 3	117.4	CCR SGR-2		
			0.0					120.7			
			0.0					121.9			
		CCR SGR-1	92.7	600/ 3	3	4	600/ 3	67.7	HVS		
			82.3					64.1			
			76.4					49.5			
		SPARE	0.0	600/ 3	5	6	600/ 3	0.0	SPARE		
			0.0					0.0			
			0.0					0.0			
		SPACE	0.0	250/ 3	7	8	250/ 3	0.0	SPACE		
			0.0					0.0			
			0.0					0.0			

774.9	kVA CONNECTED
887.1	kVA DEMAND
1067.5	AMPS DEMAND @ 480V

* REFER TO 1-LINE & SCHEDULES FOR FEEDERS UNLESS OTHERWSE NOTED
NOTES:

PANEL: CCR SGR-1

VOLTAGE: 480 | 3 PH | 4 W | AIC: 65,000 | REMARKS:
MAINS: 600 AMPS | ■MLO □MCB | ■SURFACE □FLUSH
LUGS: □SUB-FEED □FEED-THRU | ■NEMA1 □NEMA 3R

C**	WIRE*	LOAD DESCRIPTION	kVA	BKR	CKT	CKT	BKR	kVA	LOAD DESCRIPTION	WIRE*	C**
		CCR-1-01	10.0	100/ 2	1	2	100/ 2	19.6	CCR-1-02		
		15 KW	10.0	A-B			A-B	19.6	30 KW		
		CCR-1-03	13.4	100/ 2	3	4	100/ 2	19.6	CCR-1-04		
		20 KW	13.4	C-A			C-A	19.6	30 KW		
		CCR-1-05	13.4	100/ 2	5	6	100/ 2	19.6	CCR-1-06		
		20 KW	13.4	B-C			B-C	19.6	30 KW		
						8	100/ 2	19.6	CCR-1-08		
							A-B	19.6	30 KW		
						10	100/ 2	10.4	CCR-1-07		
							C-A	10.4	20 KW		

251.3	kVA CONNECTED
314.1	kVA DEMAND
378.0	AMPS DEMAND @ 480V

* REFER TO 1-LINE & SCHEDULES FOR FEEDERS UNLESS OTHERWISE NOTED
NOTES:

PANEL: CCR SGR-2

VOLTAGE: 480 | 3 PH | 4 W | AIC: 65,000 | REMARKS:
MAINS: 600 AMPS | ■MLO □MCB | ■SURFACE □FLUSH
LUGS: □SUB-FEED □FEED-THRU | ■NEMA1 □NEMA 3R

C**	WIRE*	LOAD DESCRIPTION	kVA	BKR	CKT	CKT	BKR	kVA	LOAD DESCRIPTION	WIRE*	C**
		CCR-2-01	5.0	100/ 2	1	2	100/ 2	13.4	CCR-2-06		
		7.5 KW	5.0	A-B			A-B	13.4	20 KW		
		CCR-2-03	6.7	100/ 2	3	4	100/ 2	19.6	CCR-2-04		
		10 KW	6.7	C-A			C-A	19.6	30 KW		
		CCR-2-05	10.0	100/ 2	5	6	100/ 2	19.6	CCR-2-02		
		15 KW	10.0	B-C			B-C	19.6	30 KW		
		CCR-2-09	6.7	100/ 2	7	8	100/ 2	13.4	CCR-2-08		
		10 KW	6.7	A-B			A-B	13.4	20 KW		
		CCR-2-07	13.4	100/ 2	9	10	100/ 2	19.6	CCR-2-10		
		20 KW	13.4	C-A			C-A	19.6	30 KW		
		CCR-2-11	13.4	100/ 2	11	12	100/ 2	19.6	CCR-2-12		
		20 KW	13.4	B-C			B-C	19.6	30 KW		
		CCR-2-13	0.0	100/ 2	13	14	100/ 2	19.6	CCR-2-14		
		SPC	0.0	A-B			A-B	19.6	30 KW		

360.1	kVA CONNECTED
450.1	kVA DEMAND
541.7	AMPS DEMAND @ 480V

* REFER TO 1-LINE & SCHEDULES FOR FEEDERS UNLESS OTHERWISE NOTED
NOTES:

PANEL: L1

SECTION 1
VOLTAGE: 120/208 | 3 PH | 4 W | AIC: 22,000 | REMARKS:
MAINS: 30 AMPS | □MLO ■MCB | ■SURFACE □FLUSH | S.E. LABEL: 200% NEUTRAL
LUGS: □SUB-FEED ■FEED-THRU | ■NEMA1 □NEMA 3R

C**	WIRE*	LOAD DESCRIPTION	kVA	BKR	CKT	CKT	BKR	kVA	LOAD DESCRIPTION	WIRE*	C**
		RECEPTACLE	0.4	20/ 1	1	2	20/ 1	0.4	RECEPTACLE		
		RECEPTACLE	0.4	20/ 1	3	4	20/ 1	0.4	RECEPTACLE		
		RECEPTACLE	0.4	20/ 1	5	6	20/ 1	0.4	RECEPTACLE		
		SPARE	0.0	20/ 1	7	8	30/ 3		SURGE PROTECTION DEVICE		
		SPARE	0.0	20/ 1	9	10	X		* COMPLY WITH MFCTR INSTRUCTIO		
		SPARE	0.0	20/ 1	11	12	X				

2.2	kVA CONNECTED
2.2	kVA DEMAND
6.0	AMPS DEMAND @ 208V

* ALL WIRING IS 2#10, 1#10G IN 3/4" C UNLESS OTHERWISE NOTED
NOTES:

PANEL: VP

VOLTAGE: 120/240 | 1 PH | 3 W | AIC: 22,000 | REMARKS:
MAINS: 200 AMPS | □MLO ■MCB | ■SURFACE □FLUSH | S.E. LABEL, 200% NEUTRAL
LUGS: □SUB-FEED ■FEED-THRU | ■NEMA1 □NEMA 3R

C**	WIRE*	LOAD DESCRIPTION	kVA	BKR	CKT	CKT	BKR	kVA	LOAD DESCRIPTION	WIRE*	C**
		REGULATOR ROOM LIGHTS	0.35	20/ 1	1	2	60/ 2	0.00	SURGE PROTECTOR	"	1
		SE REC AND BSMT LIGHTS	0.59	20/ 1	3	4	X	0.00	* COMPLY WITH MFCTR INSTRUCTIO		
		SPARE (WAS 2400V REG CTRL PWR	0.00	20/ 1	5	6	20/ 1	1.92	RVR (FAA)		
		CARD READER	1.20	20/ 1	7	8	20/ 1	0.00	SPARE		
		SPARE (WAS WEST INTAKE FANS)	0.00	20/ 1	9	10	20/ 1	0.00	SPARE (WAS EAST INTAKE FANS)		
		SPARE	0.00	20/ 2	11	12	20/ 1	0.60	FUEL LEAK DETECTION	2#8,#8G	2
		"	0.00	X	13	14	20/ 1	0.98	GEN BATT CHARGER	2#8,#8G	2
		MONITORING SYSTEM	1.00	20/ 1	15	16	20/ 1	0.00	SPARE (WAS XFMR RM FAN)		
		MULTIPLEXER	1.00	20/ 1	17	18	40/ 2	3.00	GEN JACKET HEATER	3#6,#6G	2
		MEGGER / MULTIPLEXER	1.00	20/ 2	19	20	X	3.00	"		
		MEGGER	1.00	X	21	22	20/ 1	0.50	REGULATOR ROOM LIGHTS		
		SPARE	0.00	20/ 1	23	24	20/ 1	1.44	NORTH RECEPTACLES		
		SENSIS (UNITED)	1.92	15/ 1	25	26	40/ 2	3.00	GEN HEATER	3#6,#6G	2
		SPARE	0.00	60/ 2	27	28	X	3.00	"		
		"	0.00	X	29	30	20/ 1	1.20	GEN VENT FAN	2#8,#8G	2
		SPARE	0.00	20/	31	32	20/ 1	0.00	SPARE		
		SPARE	0.00	20/	33	34	20/ 1	0.00	SPARE		
		SPARE	0.00	20/	35	36	20/ 1	0.00	SPARE		
		SPARE	0.00	20/	37	38	20/ 1	0.00	SPARE		
		SPARE	0.00	20/ 1	39	40	60/ 2		SURGE PROTECTION DEVICE		
		SPARE	0.00	20/ 1	41	42	X		* COMPLY WITH MFCTR INSTRNS		

Phase A	Phase B		
14.87	11.83	26.7	kVA CONNECTED
14.95	11.98	26.9	kVA DEMAND
124.6	99.8	124.6	AMPS HIGHEST PH DEMAND @240V

* ALL WIRING IS 2#12, 1#12G IN 3/4" C UNLESS OTHERWISE NOTED
NOTES: 1. PROVIDE GFCI CIRCUIT BREAKER.

PANEL: HVS (FINAL CONDITION)

VOLTAGE: 277/480 | 3 PH | 4 W | AIC: 65,000 | REMARKS:
MAINS: 600 AMPS | ■MLO □MCB | ■SURFACE □FLUSH
LUGS: □SUB-FEED □FEED-THRU | ■NEMA1 □NEMA 3R

C**	WIRE*	LOAD DESCRIPTION	kVA	BKR	CKT	CKT	BKR	kVA	LOAD DESCRIPTION	WIRE*	C**
		SPD	0.0	60/ 3	1	2	15/ 3	1.3	AHU-2		
			0.0					1.3			
			0.0					1.3			
		AHU-1	2.1	20/ 3	3	4	40/ 3	6.6	ACCU-2		
			2.1					6.6			
			2.1					6.6			
		ACCU-1	8.8	40/ 3	5	6	200/ 3	10.5	XFMR TX-LVS		
			8.8					9.9			
			8.8					11.0			
		WEST BRIDGE	8.9	40/ 3	7	8	40/ 3	8.9	EAST BRIDGE		
			8.9					8.9			
			8.9					8.9			
		GATE	1.3	50/ 3	9	10	30/ 3	0.7	XFMR TX-L1		
			1.3					0.7			
			1.3					0.7			
		SPARE	0.0	20/ 1	11	12	20/ 3	3.8	MUX - RECEPT		
		XFMR TX-VP	14.9	250/ 2	13			3.8			
			15.0			14	100/ 2	0.0	SPARE		
		SPARE	0.0	100/ 2	15			0.0			
			0.0			16	100/ 2	0.0	SPARE		
		SPARE	0.0	100/ 2	15			0.0			
			0.0			18	100/ 2	0.0	SPARE		
		SPARE	0.0	100/ 2	15			0.0			
			0.0				20/ 1	4.4	SECURITY LIGHTS		

181.3	kVA CONNECTED
197.8	kVA DEMAND
238.0	AMPS DEMAND @ 480V

* REFER TO 1-LINE & SCHEDULES FOR FEEDERS UNLESS OTHERWISE NOTED
NOTES:

PANEL: HVS (TEMPORARY CONDITION)

VOLTAGE: 277/480 | 3 PH | 4 W | AIC: 65,000 | REMARKS:
MAINS: 600 AMPS | ■MLO □MCB | ■SURFACE □FLUSH
LUGS: □SUB-FEED □FEED-THRU | ■NEMA1 □NEMA 3R

C**	WIRE*	LOAD DESCRIPTION	kVA	BKR	CKT	CKT	BKR	kVA	LOAD DESCRIPTION	WIRE*	C**
		SPD	0.0	60/ 3	1	2	15/ 3	1.3	AHU-2		
			0.0					1.3			
			0.0					1.3			
		AHU-1	2.1	20/ 3	3	4	40/ 3	6.6	ACCU-2		
			2.1					6.6			
			2.1					6.6			
		ACCU-1	8.8	40/ 3	5	6	200/ 3	10.5	XFMR TX-LVS		
			8.8					9.9			
			8.8					11.0			
		WEST BRIDGE	8.9	40/ 3	7	8	40/ 3	8.9	EAST BRIDGE		
			8.9					8.9			
			8.9					8.9			
		GATE	1.3	50/ 3	9	10	30/ 3	0.7	XFMR TX-L1		
			1.3					0.7			
			1.3					0.7			
		SPARE	0.0	20/ 1	11	12	20/ 3	3.8	MUX - RECEPT		
		XFMR TX-VP	14.9	250/ 2	13			3.8			
			15.0			14	100/ 2	19.6	TEMP POWER TO CCRS		
		TEMP POWER TO CCRS	19.6	100/ 2	15			19.6			
			19.6			16	100/ 2	19.6	TEMP POWER TO CCRS		
		TEMP POWER TO CCRS	19.6	100/ 2	15			19.6			
			19.6			18	100/ 2	19.6	TEMP POWER TO CCRS		
		TEMP POWER TO CCRS	19.6	100/ 2	15			19.6			
							20/ 1	4.4	SECURITY LIGHTS		

318.6	kVA CONNECTED
369.5	kVA DEMAND
444.7	AMPS DEMAND @ 480V

* REFER TO 1-LINE & SCHEDULES FOR FEEDERS UNLESS OTHERWISE NOTED
NOTES:

PANEL: LVS

SECTION 1
VOLTAGE: 120/208 | 3 PH | 4 W | AIC: 22,000 | REMARKS:
MAINS: 150 AMPS | □MLO ■MCB | ■SURFACE □FLUSH | S.E. LABEL; 200% NEUTRAL
LUGS: □SUB-FEED ■FEED-THRU | ■NEMA1 □NEMA 3R

C**	WIRE*	LOAD DESCRIPTION	kVA	BKR	CKT	CKT	BKR	kVA	LOAD DESCRIPTION	WIRE*	C**
		ALCMS PSA1	1.9	20/ 1	1	2	20/ 1	0.4	LIGHTING (LVL 1AE FIXTURES)	3#10+G	3/4"
		ALCMS PSA2	1.9	20/ 1	3	4	20/ 1	0.3	LIGHTING (LVL 1 A FIXTURES)	3#10+G	3/4"
		PC CABINET	1.9	20/ 1	5	6	20/ 1	0.4	LIGHTING (EXTERIOR FIXTURES)	3#10+G	1"
		SPARE	0.0	20/ 1	7	8	20/ 1	0.3	LIGHTING (WIRE VAULT)	3#10+G	1"
		GENERAL PURPOSE RECPTS.	0.2	20/ 1	9	10	20/ 1	0.3	LIGHTING (EXTERIOR FIXTURES)	3#10+G	1"
		GENERAL PURPOSE RECPTS.	0.2	20/ 1	11	12	20/ 1	0.3	LIGHTING (EXTERIOR FIXTURES)	3#10+G	1"
		TIME CLOCK	0.1	20/ 1	13	14	20/ 1	0.4	GENERAL PURPOSE RECPTS.		
		SECURITY (EAST DOOR)	0.6	20/ 1	15	16	20/ 1	0.4	GENERAL PURPOSE RECPTS.		
		SECURITY (WEST DOOR)	0.6	20/ 1	17	18	20/ 1	0.4	GENERAL PURPOSE RECPTS.		
		SECURITY (EQPT YARD DOOR)	0.6	20/ 1	19	20	20/ 1	0.9	GENERAL PURPOSE RECPTS.		
		SECURITY (SOUTHWEST DOOR)	0.6	20/ 1	21	22	20/ 1	0.4	GENERAL PURPOSE RECPTS.	3#10+G	1"
		SECURITY (SOUTHEAST DOOR)	0.6	20/ 1	23	24	20/ 1	0.7	GENERAL PURPOSE RECPTS.	3#10+G	1"
		SECURITY (IT CAGE & DOOR)	0.6	20/ 1	25	26	30/ 2	2.1	PORTABLE AHU RECPT.	3#10+G	3/4"
		SPARE	0.0	20/ 1	27	28		2.1	"		
		SPARE	0.0	20/ 1	29	30	20/ 1	0.6	OUTDOOR SWGR HEATERS		
		SPARE	0.0	20/ 1	31	32	20/ 1	0.0	SPARE		
		SPARE	0.0	20/ 1	33	34	20/ 1	0.0	SPARE		
3/4"	3#10+G	PORTABLE AHU RECPT.	2.1	30/ 2	35	36	20/ 1	0.0	SPARE		
		"	2.1		37	38	60/ 3		SURGE PROTECTION DEVICE		
3/4"	3#10+G	PORTABLE AHU RECPT.	2.1	30/ 2	39	40	X		* COMPLY WITH MFCTR INSTRUCTIO		
		"	2.1		41	42	X				

31.3	kVA CONNECTED
31.9	kVA DEMAND
88.5	AMPS DEMAND @ 208V

* ALL WIRING IS 2#10, 1#10G IN 3/4" C UNLESS OTHERWISE NOTED
NOTES:

PANEL: LVS

SECTION 2
VOLTAGE: 120/208 | 3 PH | 4 W | AIC: 22,000 | REMARKS:
MAINS: 225 AMPS | ■MLO □MCB | ■SURFACE □FLUSH
LUGS: □SUB-FEED □FEED-THRU | ■NEMA1 □NEMA 3R

C**	WIRE*	LOAD DESCRIPTION	kVA	BKR	CKT	CKT	BKR	kVA	LOAD DESCRIPTION	WIRE*	C**
		SPARE		20/ 1	43	44	20/ 1		SPARE		
		SPARE		20/ 1	45	46	20/ 1		SPARE		
		SPARE		20/ 1	47	48	20/ 1		SPARE		
		SPARE		20/ 1	49	50	20/ 1		SPARE		
		SPARE		20/ 1	51	52	20/ 1		SPARE		
		SPARE		20/ 1	53	54	20/ 1		SPARE		
		SPARE		20/ 1	55	56	20/ 1		SPARE		
		SPARE		20/ 1	57	58	20/ 1		SPARE		
		SPARE		20/ 1	59	60	20/ 1		SPARE		
		SPARE		20/ 1	61	62	20/ 1		SPARE		
1"C.	3#10+G	SUMP PUMP	0.55	20/ 3	63	64	20/ 1		SPARE		
	"		0.55	|	65	66	20/ 1		SPARE		
	"		0.55	|	67	68	20/ 1		SPARE		
1"C.	3#10+G	SUMP PUMP	0.55	20/ 3	69	70	20/ 1		SPARE		
	"		0.55	|	71	72	20/ 1		SPARE		
	"		0.55	|	73	74	20/ 1		SPARE		
		SPARE		20/ 1	75	76	20/ 1		SPARE		
		SPARE		20/ 1	77	78	20/ 1		SPARE		
		SPARE		20/ 1	79	80	20/ 1		SPARE		
		SPARE		20/ 1	81	82	20/ 1		SPARE		
		SPARE		20/ 1	83	84	20/ 1		SPARE		

3.3	kVA CONNECTED
3.3	kVA DEMAND
9.2	AMPS DEMAND 208V

* ALL WIRING IS 2#10, 1#10G IN 3/4" C UNLESS OTHERWISE NOTED
NOTES:

ELECTRICAL LOAD ANALYSIS

LOAD CATEGORY	CONNECTED LOAD	NEC FACTOR	NEC LOAD	NEC LOAD
LOAD CATEGORY	KVA		KVA	AMPS
AIRFIELD LIGHTING				
SWGR 1	257	125%	321	387
SWGR 2	360	125%	450	542
SUB-TOTAL	617	125%	771	928
LTG (INTERIOR)	2.9	125% OF LARGEST OF NEC MIN. OR ACTUAL	3.6	4
LTG (EXTERIOR)	0.8	125%	1	1
HVAC	56	LOAD + 25 % LARGEST MOTOR BELOW	56	68
BRIDGES	53	125%	67	64
GATE	4	100%	4	5
EQUIPMENT	37	100%	37	45
RECEPTACLES	10	1ST 10 KVA @ 100% + 50% REMAINDER	10	11
OTHER	80	100%	80	96
SUB-TOTAL	861		1030	1223
LARGEST MOTOR	14	25%	3	4
SUB-TOTAL	875		1033	1227
25% SPARE	219		258	307
SUM	1080		1292	1530

NEC LOAD FACTORS FOR LOAD ANALYSIS CALCULATIONS

LOAD CATEGORY	NEC ARTICLES	LOAD DATA	NEC LOAD FACTOR
LIGHTING	220.45, 220.42	LARGEST OF ACTUAL OR NEC TABLE 220.42(A) MINIMUM VA PER SQ. FT.	125%
MOTORS	220.14, 220.50	LARGEST OF NAMEPLATE OR NEC TABLE 430.250	LOAD + 25 % OF LARGEST MOTOR
COOLING AND HEATING	220.60, 220.50	LARGEST OF COOLING OR HEATING	100%
EQUIPMENT	220.14		100%
RECEPTACLES	220.47		1ST 10 KVA @ 100% + 50% REMAINDER
OTHER	220.14		100%

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REVISIONS

NO.	DESCRIPTION	DATE
	ISSUED FOR PERMIT	03/01/24
1	ADDENDUM 1	04/19/24

HOUSTON AIRPORT SYSTEM
PROJECT 952 SOUTH LIGHTING VAULT RENOVATION
GEORGE BUSH INTERCONTINENTAL AIRPORT / HOUSTON
4104 WILL CLAYTON PARKWAY, HOUSTON, TX 77032

SOUTH VAULT RENOVATIONS
SCHEDULES

PROJECT MGR: AEO
DESIGNER: AO
DRAWN BY: SH
CHECK BY: NM

DATE:

STATE OF TEXAS
ARTHUR E. OTTO
75035
REGISTERED
PROFESSIONAL ENGINEER
4/19/24

APPROVED BY:

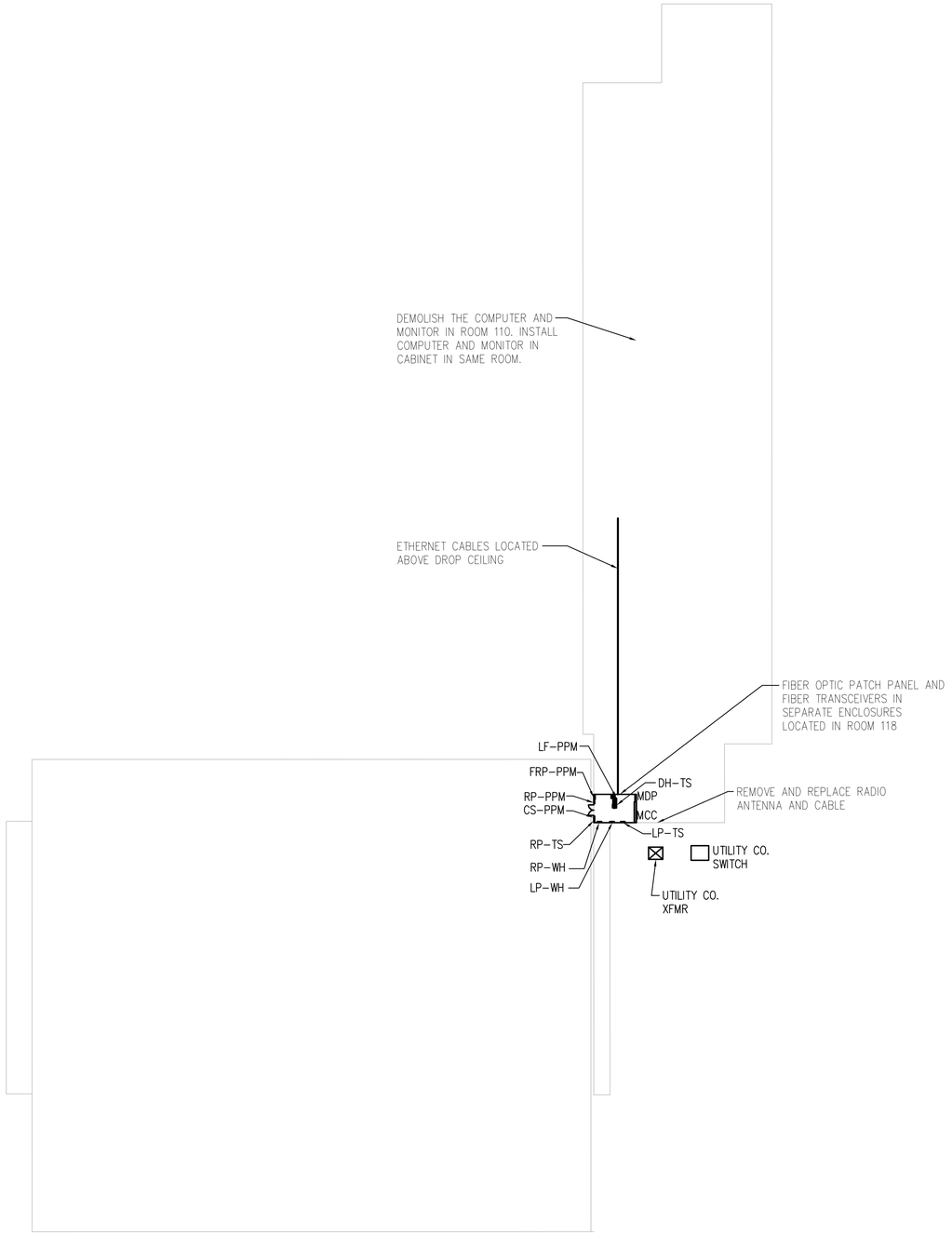
DIRECTOR
HOUSTON AIRPORT SYSTEM

JACOBS NO. WHXK7125
A.I.P. NO.
C.I.P. NO. A-000687
B.S.G. NO. 2024-31-IAH
H.A.S. NO. PN 952
T.I.P. NO. 24-28-IAH

SHEET NO.

SV-E6.02

TYPE AC (BX) AND MC CABLE ARE PROHIBITED.



1 ASC VAULT ELECTRICAL LIGHTING PLAN
SCALE: 1/4" = 1'-0"

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GEORGE BUSH INTERCONTINENTAL AIRPORT / HOUSTON
4104 WILL CLAYTON PARKWAY, HOUSTON, TX 77032

ASC VAULT RENOVATIONS
ELECTRICAL LIGHTING PLAN

PROJECT MGR: AEO
DESIGNER: AO
DRAWN BY: SH
CHECK BY: NM

DATE:

STATE OF TEXAS
ARTHUR E. OTTO
75035
REGISTERED
PROFESSIONAL ENGINEER
4/19/24

APPROVED BY:

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SHEET NO.

ASC-EL7.01

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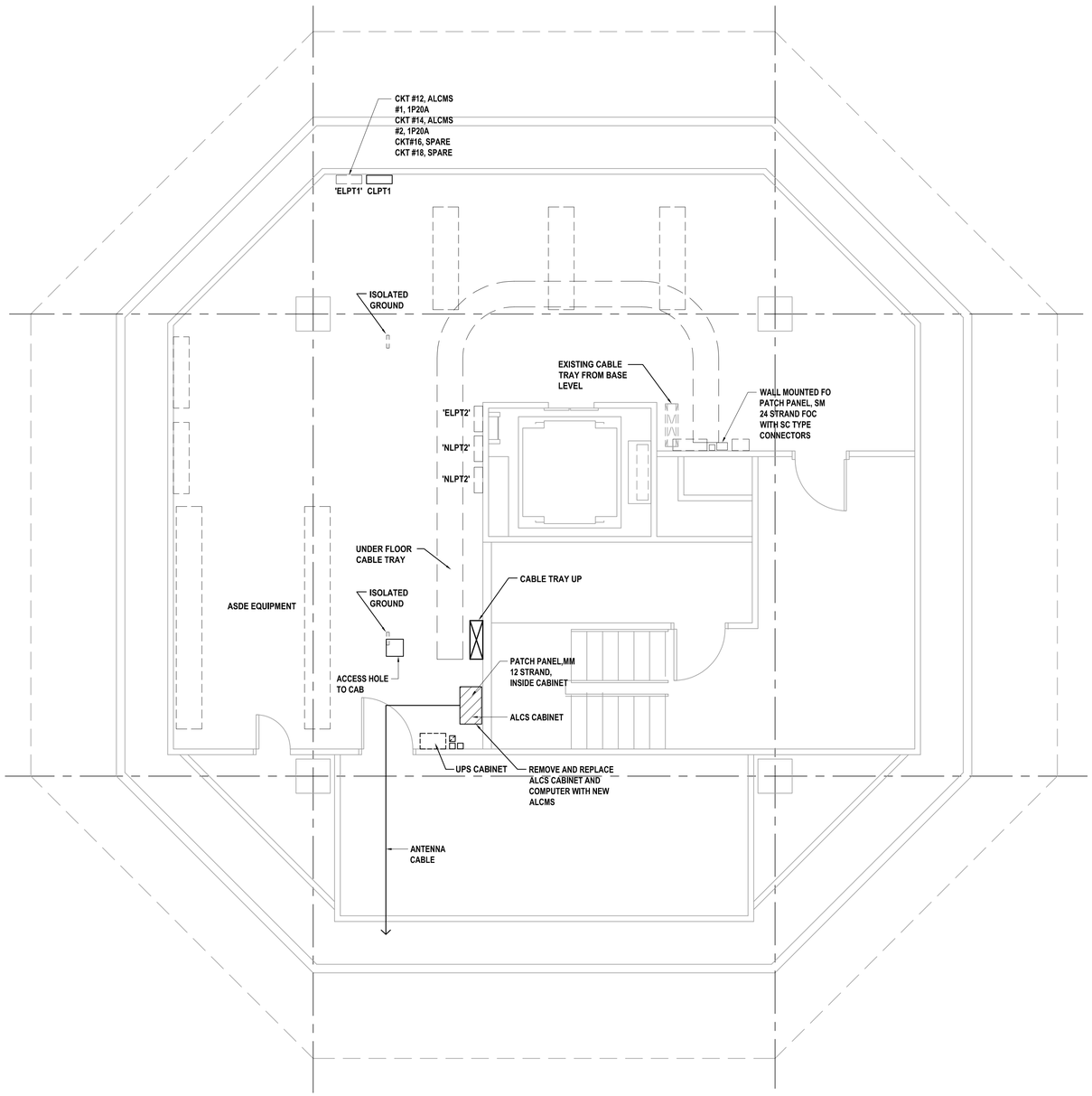
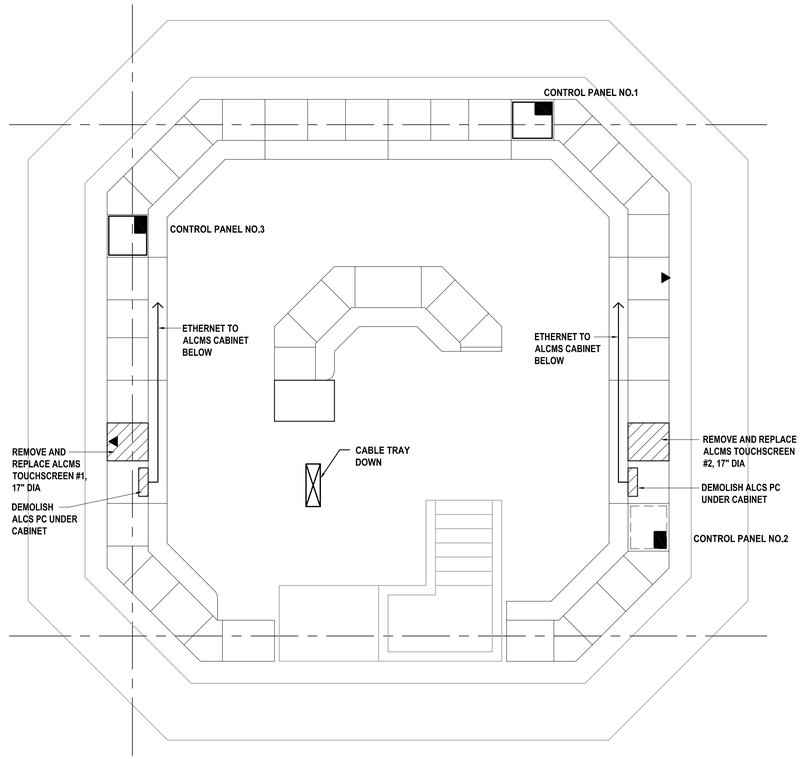


1 – ATCT SUB–JUNCTION LEVEL ELECTRICAL PLAN
SCALE: 1/4" = 1'–0"



2 – TOWER CAB LEVEL ELECTRICAL PLAN
SCALE: 1/4" = 1'–0"

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HOUSTON AIRPORT SYSTEM
PROJECT 952 SOUTH LIGHTING VAULT RENOVATION
GEORGE BUSH INTERCONTINENTAL AIRPORT / HOUSTON
4104 WILL CLAYTON PARKWAY, HOUSTON, TX 77032

ATCT VAULT RENOVATIONS
ELECTRICAL LIGHTING PLAN

PROJECT MGR: AEO
DESIGNER: AO
DRAWN BY: SH
CHECK BY: NM

DATE:

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T.I.P. NO. 24–28–IAH

SHEET NO.

ATCT-EL7.01

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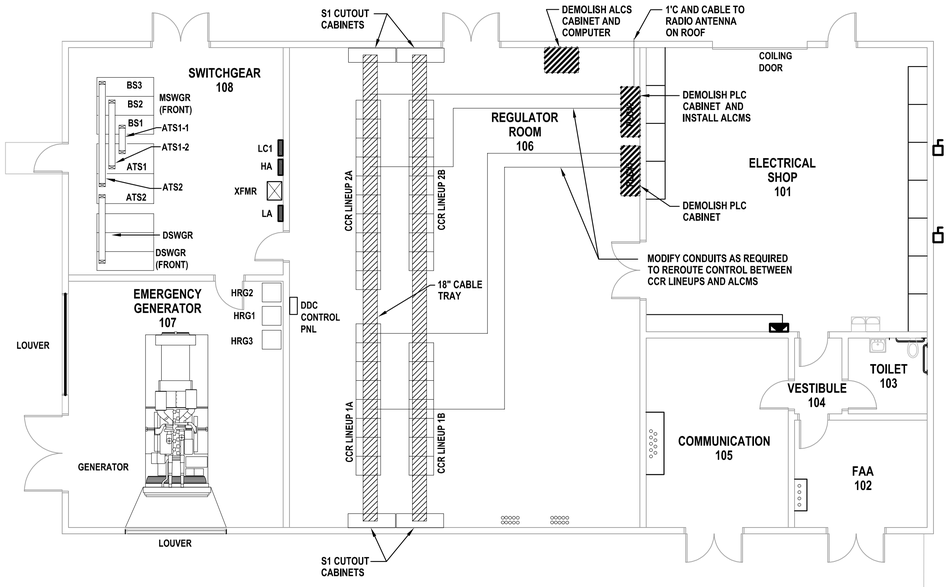

1 NORTH VAULT ELECTRICAL LIGHTING PLAN
SCALE: 1/4" = 1'-0"

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GEORGE BUSH INTERCONTINENTAL AIRPORT / HOUSTON
4104 WILL CLAYTON PARKWAY, HOUSTON, TX 77032

NORTH VAULT RENOVATIONS
ELECTRICAL LIGHTING PLAN

PROJECT MGR: AEO
DESIGNER: AO
DRAWN BY: SH
CHECK BY: NM

DATE:

STATE OF TEXAS
ARTHUR E. OTTO
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4/19/24

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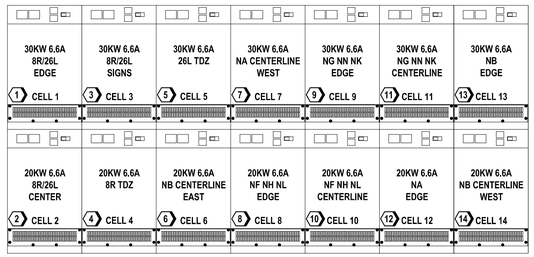
H.A.S. NO. PN 952
T.I.P. NO. 24-28-IAH

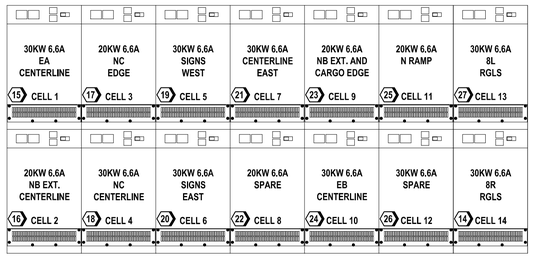
SHEET NO.

NV-EL7.01

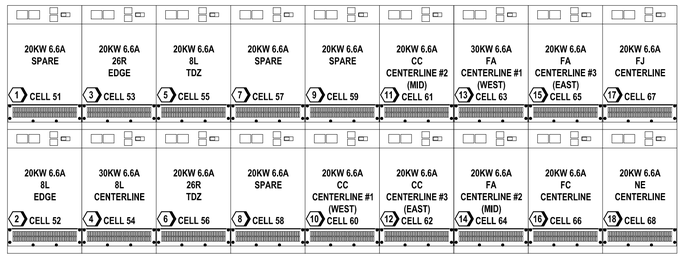
TYPE AC (BX) AND MC CABLE ARE PROHIBITED.



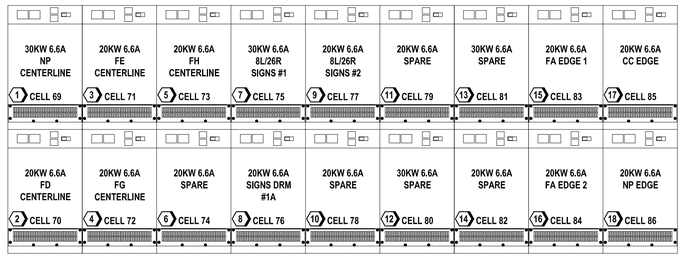
DETAIL A–A CCR LINEUP 1A



DETAIL B–B CCR LINEUP 1B



DETAIL C–C CCR LINEUP 2A



CCR LINEUP 2B

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HOUSTON AIRPORT SYSTEM
PROJECT 952 SOUTH LIGHTING VAULT RENOVATION
GEORGE BUSH INTERCONTINENTAL AIRPORT / HOUSTON
4104 WILL CLAYTON PARKWAY, HOUSTON, TX 77032

WEST VAULT RENOVATIONS
ELECTRICAL LIGHTING PLAN

PROJECT MGR: AEO
DESIGNER: AO
DRAWN BY: SH
CHECK BY: NM

DATE:

STATE OF TEXAS
ARTHUR E. OTTO
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C.I.P. NO. A–000687
B.S.G. NO. 2024–31–IAH
H.A.S. NO. PN952
T.I.P. NO. 24–28–IAH

SHEET NO.

NV-EL7.02

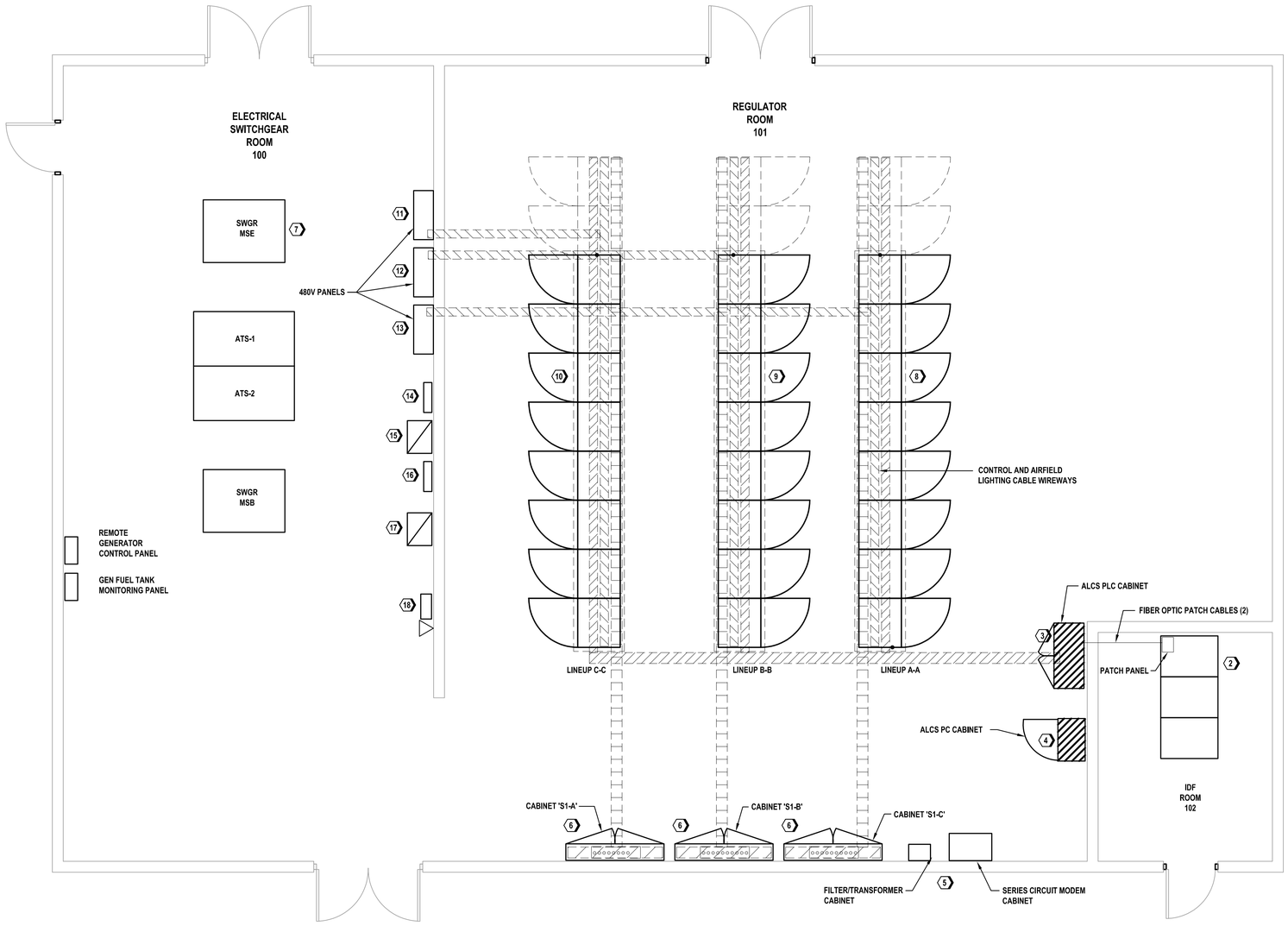
TYPE AC (BX) AND MC CABLE ARE PROHIBITED.

GENERAL NOTES

SEE SHEET WV EL7.02 FOR CCR LINEUP ELEVATIONS.

LIGHTING PLAN KEYED NOTES

1. AAB PROGRAMMING RGL CABINET.
2. FIBER TELECOMMUNICATION S RACK.
3. DEMOLISH ALCS PLC CABINET AND INSTALL NEW CABINET.
4. DEMOLISH ALCMS MONITOR STATION CABINET AND COMPUTER 28"W x 30"D x 70"H.
5. RGL MONITOR / SYNC PC / FILTER CABINETS 5A – 20"D x 21"W x 50"H (15" OFF FLOOR)
6. S–1 CUTOUT CABINET.
7. 420V SWITCHGEAR / ATS
8. CCR LINEUP 1
9. CCR LINEUP 2
10. CCR LINEUP 3
11. LIGHTING CONTROL HOA
12. PANEL LA 120 / 208
13. 120 / 208 TRANSFORMER TA
14. 120 / 208 TRANSFORMER TB
15. 480V PANEL HA
16. 480V TRANSFORMER TH
17. 480V PANEL DPA
18. 480V PANEL DPB
19. 480V PANEL DPC
20. FA PANEL
21. GEN DCMV



1 – WEST VAULT ELECTRICAL LIGHTING PLAN
SCALE: 1/4" = 1'–0"

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SHEET NO.

WV-EL7.01

TYPE AC (BX) AND MC CABLE ARE PROHIBITED.

30KW 6.6A 15L EDGE	30KW 6.6A 15L TD3 (FUTURE)	30KW 6.6A WW CENTER LINE	30KW 6.6A T/W CONNECTOR (FUTURE)	30KW 6.6A T/W CONNECTOR (FUTURE)	30KW 6.6A WHKM CENTER LINE	30KW 6.6A SCW5	30KW 6.6A RGL 15L NORTH
1 CELL 41	3 CELL 43	5 CELL 45	7 CELL 47	9 CELL 49	11 CELL 51	13 CELL 53	15 CELL 55
30KW 6.6A 15L CENTER LINE	30KW 6.6A 33R TD3 (FUTURE)	30KW 6.6A SPARE	30KW 6.6A T/W CONNECTOR (FUTURE)	30KW 6.6A T/W CONNECTOR (FUTURE)	30KW 6.6A WDGJ	30KW 6.6A SPARE	30KW 6.6A RGL 15L SOUTH
2 CELL 42	4 CELL 44	6 CELL 46	8 CELL 48	10 CELL 50	12 CELL 52	14 CELL 54	16 CELL 56

DETAIL A–A SWITCHGEAR REGULATOR LAYOUT 8

30KW 6.6A 15R EDGE	30KW 6.6A 15R TD3	30KW 6.6A WP CENTER LINE	30KW 6.6A WP EDGE SOUTH	30KW 6.6A WC EDGE NORTH	30KW 6.6A WST CENTER LINE	30KW 6.6A SPARE	30KW 6.6A RGL 15R NORTH
1 CELL 21	3 CELL 23	5 CELL 25	7 CELL 27	9 CELL 29	11 CELL 31	13 CELL 33	15 CELL 35
30KW 6.6A 15R CENTER LINE	30KW 6.6A 33L TD3	30KW 6.6A WP EDGE NORTH	30KW 6.6A SPARE	30KW 6.6A WC EDGE SOUTH	30KW 6.6A WQR CENTER LINE	30KW 6.6A SPARE	30KW 6.6A RGL 15R SOUTH
2 CELL 22	4 CELL 24	6 CELL 26	8 CELL 28	10 CELL 30	12 CELL 32	14 CELL 34	16 CELL 36

DETAIL B–B SWITCHGEAR REGULATOR LAYOUT 9

30KW 6.6A WA EDGE NORTH	30KW 6.6A WA CENTER LINE NORTH	30KW 6.6A SPARE	30KW 6.6A WB EDGE NORTH	30KW 6.6A WB CENTER LINE NORTH	30KW 6.6A RA CENTER LINE	30KW 6.6A SIGN SCW 1	30KW 6.6A SIGN SCW 3
1 CELL 15	3 CELL 13	5 CELL 11	7 CELL 9	9 CELL 7	11 CELL 5	13 CELL 3	15 CELL 1
30KW 6.6A WA EDGE SOUTH	30KW 6.6A WA CENTER LINE SOUTH	30KW 6.6A SPARE	30KW 6.6A WB EDGE SOUTH	30KW 6.6A WB CENTER LINE SOUTH	30KW 6.6A RB CENTER LINE	30KW 6.6A SIGN SCW 2	30KW 6.6A SIGN SCW 4
2 CELL 16	4 CELL 14	6 CELL 12	8 CELL 10	10 CELL 8	12 CELL 6	14 CELL 4	16 CELL 2

DETAIL C–C SWITCHGEAR REGULATOR LAYOUT 10

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HOUSTON AIRPORT SYSTEM
PROJECT 952 SOUTH LIGHTING VAULT RENOVATION
GEORGE BUSH INTERCONTINENTAL AIRPORT / HOUSTON
4104 WILL CLAYTON PARKWAY, HOUSTON, TX 77032

WEST VAULT RENOVATIONS
ELECTRICAL LIGHTING PLAN

PROJECT MGR: AEO
DESIGNER: AO
DRAWN BY: SH
CHECK BY: NM

DATE:

STATE OF TEXAS
ARTHUR E. OTTO
75035
REGISTERED PROFESSIONAL ENGINEER
4/19/24

APPROVED BY:

DIRECTOR
HOUSTON AIRPORT SYSTEM

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C.I.P. NO. A–000687
B.S.G. NO. 2024–31–IAH
H.A.S. NO. PN952
T.I.P. NO. 24–28–IAH

SHEET NO.

WV-EL7.02

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes grounding and bonding systems and equipment.

B. Section includes grounding and bonding systems and equipment, plus the following special applications:

1. Underground distribution grounding.
2. Ground bonding common with lightning protection system.
3. Foundation steel electrodes.

C. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans showing dimensioned as-built locations of grounding features specified in "Field Quality Control" Article.

B. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: In addition to items specified in Section 260010 "Supplemental Requirements for Electrical," include the following:

1. Plans showing as-built, dimensioned locations of system described in "Field Quality Control" Article, including the following:

a. Test wells.
b. Ground rods.
c. Ground rings.

d. Grounding arrangements and connections for separately derived systems.
e. Grounding for sensitive electrical equipment and electronic equipment.

2. Instructions for periodic testing and inspection of grounding features at test wells, ground rings, grounding connections for separately derived systems, and grounding connections for metallic systems based on NETA MTS and NFPA 70B.

a. Tests must determine if ground-resistance or impedance values remain within specified maximums, and instructions must recommend corrective action if values do not.
b. Include recommended testing intervals.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with UL 467 for grounding and bonding materials and equipment.

2.2 MANUFACTURERS

A. Acceptable Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:

1. Erico Inc; Cadweld Electrical Products group
2. Burndy Electrical
3. Harger Lightning and Grounding
4. ILSCO
5. Kearney/ Cooper Power Systems
6. Thomas & Betts
7. VFC ZPen Lyncole

2.3 CONDUCTORS

A. Insulated Conductors: Copper or tinned-copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:

1. Tinned Conductors: ASTM B33.
2. Bonding Cable: Minimum size required by greater of drawings or current National Electrical Code.

3. Bonding Conductor: Minimum size required by greater of drawings or current National Electrical Code. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; Minimum equivalent kcmil required by greater of drawings or current National Electrical Code.
4. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; Minimum equivalent kcmil required by greater of drawings or current National Electrical Code.

C. Grounding Bus: Predrilled rectangular bars of annealed copper, 3/8 by 4 inches in cross section, with holes spaced 1-1/8 inch apart for length of 4 ft ground bar in main switchboard room and electrical rooms with transformers. Stand-off insulators for mounting must comply with UL 891 for use in switchboards, 600 V and must be Lexan or PVC, impulse tested at 5000 V.

2.4 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

C. Compression-Type Bus-Bar Connectors: Cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar. Provide exothermic terminals for underground and elsewhere where required by the current National Electrical Code.

D. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.

E. Cable-to-Cable Connectors: Compression type, copper or copper alloy.

F. Cable Tray Ground Clamp: Mechanical type, zinc-plated malleable iron.

G. Conduit Hubs: Mechanical type, terminal with threaded hub.

H. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex-head bolt.

I. Straps: Solid copper, rated for 600 A or code minimum whichever is greater. Coordinate bolt material with clamp type and material.

J. U-Bolt Clamps: Mechanical type, copper or copper alloy, terminal listed for direct burial.

K. Water Pipe Clamps:

1. Mechanical type, two pieces with stainless-steel bolts.

a. Material: Tin-plated aluminum.

b. Listed for direct burial.

2. U-bolt type with malleable-iron clamp and copper ground connector rated for direct burial.

2.5 GROUNDING ELECTRODES

A. Ground Rods: Stainless steel; 3/4 inch by 10 ft.

B. Chemical Ground Rods: 2 to 4 inch diameter copper by 10 ft.

C. Ground Plates: 1/4 inch thick, stainless steel

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.

B. Underground Grounding Conductors: Install tinned-copper conductor, No. 2/0 AWG or as specified on drawings or code minimum whichever is greater.

1. Bury at least 30 inches below grade.

C. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, at cable tap boxes and elsewhere as indicated.

1. Install 4 ft length or greater bus horizontally, on insulated spacers 2 inch minimum from wall, 6 inch above finished floor unless otherwise indicated.

D. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING AT THE SERVICE

A. Equipment grounding conductors and grounding electrode conductors must be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses in main switchboards, main panelboards or cable tap boxes whichever is electrically closest to the transformer for the separately derived electrical system. Provide a new equipotential earth grounding system including ground rods and a ground ring around the building. Bond to all existing ground grounds and existing

ground systems. Test the existing system ohms to earth and document the current grounding systems prior to installing the new grounding system and bonding to the existing grounding system. Bond the new system to the building structure and all metal components in the building connect to the electrical systems and lightning protection systems.

3.3 GROUNDING SEPARATELY DERIVED SYSTEMS

A. Generator: Install grounding electrode(s) at the generator location. The electrode must be connected to the equipment grounding conductor and to the frame of the generator.

B. Transformer: Install grounding electrode(s) at the transformer location. The electrode must directly connect to the transformer Xo. The Transformer separately derived systems must be connected to the equipment grounding conductor and to the frame of the transformer as required by code.

C. Where an equipment grounding conductor is required by the NEC to supplement the grounding capacity of flexible conduit, the conductor must be installed outside the conduit and attached at each end of the flexible conduit with UL listed bonding fittings.

D. Bond together system neutrals, service equipment enclosures, and equipment grounding conductor at service entrance.

E. Provide a 36” x 4” x 3/8” Master Ground Bar (MGB) in each buildings main electrical room and interconnect the earth grounding reference to the building structural steel, metallic piping systems, conduit systems, electrical systems and other ground bars in the building.

F. Supplement existing main building grounding system to include grounding bonds to metal frame of the buildings, reinforcing steel in buildings foundations, metal cold water pipe at building entry, and all existing grounding electrodes.

G. Test grounding system for compliance and provide supplemental grounding electrodes to meet the specified grounding system requirements.

H. Provide grounding electrode conductors from each main switchgear to the buildings MGB.

I. Provide grounding electrode conductors from each separately derived sub-station transformers and secondary switchgear grounding electrode termination to the buildings MGB.

J. Provide grounding electrode conductors from generator alternator and secondary switchgear grounding electrode termination to the buildings MGB.

K. Provide a 24” x 4” x 1/4” Ground Bar (MDFGB) at the IT system MDF room / area and bond from the MDF ground bar to the main building ground bar. Provide 24” x 4” x 1/4” Ground Bar (IDFGB) in each IDF room or IDF area and bond from the IDFGB to the . MDFGB.

L. Connect separately derived low voltage transformers to building main ground bar or grounding electrode riser connected to building main ground bar.

M. Where feeder conductors are supplied between two buildings, (bond the grounding conductors to the grounding electrode system for both buildings as required by code.

N. Grounding electrode conductors for service entrance switchgear, substation transformers and generators shall be 4/0 or larger bare tinned copper grounding conductors. Grounding electrode conductors serving MDF and IDF rooms shall comply with current BICSI standards. Grounding electrode conductors for low voltage transformers shall be as required by NEC for corresponding phase conductors.

O. Provide grounding and bonding at the power company's metering equipment.

3.4 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

A. Comply with IEEE C2 grounding requirements.

B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inch will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, non-shrink grout.

C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors' level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.

D. Pad-Mounted Transformers and Switches: Install ground rods and ground ring and grounding conductors as required by the electrical utility for service entrance pad-mounted transformers and switches.

3.5 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:

1. Feeders and branch circuits.
2. Lighting circuits.
3. Receptacle circuits.
4. Single-phase motor and appliance branch circuits.
5. Three-phase motor and appliance branch circuits.

6. Flexible raceway runs.
7. Armored and metal-clad cable runs.
8. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.

C. Metal Structures: Ground metal sheathing and exposed metal vertical structural elements of buildings. Ground metal fences enclosing electrical equipment. Bond metal equipment platforms which support electrical equipment to the equipment ground. Provide electrical continuity between metal frames and railings supporting push-button stations, receptacles, instrument cabinets, etc., and raceways carrying circuits to these devices.

D. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V or higher, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

E. Mechanical Equipment, Plumbing Equipment, Water Heaters, Heat-Tracing, and Anti-frost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

F. Metallic Raceways: Metallic raceways shall be electrically continuous. Raceways shall be bonded to corresponding boxes or equipment enclosures, where they enter such equipment, using appropriate couplings, fittings, and locknuts as required by code or the local authority having jurisdiction.

G. Signal and Communication Equipment: For telephone, alarm, voice and data, and other communication equipment, provide insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location. Grounding conductors shall be compliant with TIA standards referenced by data telecommunication engineer.

H. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 36” x 4” x 3/8” grounding bus.

I. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal

3.6 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage. Provide insulated throat bushings for abrasion protection for the conductors as they exit the raceway.

B. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at

closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor and install in conduit.

C. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.

1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.

2. Provide test wells in the grounding rings for testing of the earth equipotential grounding systems.

3. Test wells will be traffic rated where located in traffic areas. Test wells will be rated for H-20 minimum or greater where required to meet the weight rating of the traffic area.

D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

E. Exothermic Welds:

1. When making exothermic welds, wire brush or file the point of contact to a bare metal surface.
2. Use exothermic welding cartridges and molds in accordance with the manufacturer's recommendations.
3. After welds have been made and cooled, brush slag from the weld area and thoroughly clean the joint.

F. Compression Connectors:

1. Use homogeneous copper, anticorrosion, surface treatment compound at connectors in accordance with connector manufacturer's recommendations.
2. Use connectors of proper size for conductors and ground rods specified.
3. Use connector manufacturer's compression tool.
4. Notify the A/E prior to backfilling ground connections

G. Bolted Connectors:

1. When making bolted connection to aluminum or galvanized structures, apply a corrosion inhibitor to contact surfaces between cable, connector, and surface of structure.

H. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

I. Grounding and Bonding for Metallic Raceways:

1. Metallic raceways shall be electrically continuous.
2. Raceways shall be bonded to corresponding boxes or equipment enclosures, where they enter such equipment, using appropriate couplings, fittings, and locknuts as required by code or the local authority having jurisdiction.
3. Grounding bushings with lay-in lugs shall only be provided where required for service entrance conductors.
4. Provide insulated throat bushings for abrasion protection for the conductors as they exit the raceway.

J. Exterior Air Handling Units and Metal Ducts:

1. Exterior air handling units shall be externally connected to the lightning protection system. Provide exposed down conductor in PVC conduit along the exterior to the lightning protection conductors.
2. Exterior metal ducts shall be externally connected to the lightning protection ground grid. Provide exposed down conductor in PVC conduit along the exterior wall to the lightning protection conductors.

3.7 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Prior to submission for equipotential earth reference ground field for grounding systems, test earth and submit calculations from ground system manufacturer confirming that ground system will meet required ground resistances to earth as indicated herein.

2. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
3. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
4. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells, and at individual ground rods. Make tests at ground rods before any conductors are connected.

a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
b. Perform tests by fall-of-potential method according to IEEE 81.

5. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

B. Grounding system will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

D. Report measured ground resistances to earth that exceed the following values:

1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: **5** ohms.
3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
4. Power Distribution Units or Panelboards Serving Electronic Equipment: 3 ohm(s).
5. Substations and Pad-Mounted Equipment: 3 ohms.
6. Manhole Grounds: 10 ohms.

E. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Engineer promptly and include recommendations with supporting calculations to reduce ground resistance to specified levels.

END OF SECTION 26056

SECTION 26 32 13

STANDBY ENGINE-GENERATOR SYSTEM

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS:

A. The General Provisions, Supplemental General Provisions, Special Provisions and Division 1 Specification Sections apply to Work covered by this Section.

B. Comply with other Division 26 Sections, as applicable. Refer to other Divisions for coordination of the Work.

1.2 SCOPE OF WORK:

A. Provide labor, materials, equipment, tools and services, and perform operations required for, and reasonably incidental to, the providing of the standby engine-generator system, including all related systems and accessories.

B. Standby generators include accessories as indicated on manufacturers as-shipped list for re-installation on project site. Each standby engine-generator shall include, but not necessarily be limited to, the following basic components:
1. Engine
2. Governor
3. Generator
4. Voltage regulator
5. Radiator cooling system
6. Radiator discharge scoop for vertical discharge
7. Fuel supply sub-base UL2085 storage system (24 hour fuel minimum), fuel controls
8. Critical grade silencer(s) and bellows to generator
9. Engine exhaust system
10. Air box turbo-cooler and cooling system for Tier 2 engine
11. Dual chargers and best battery system
12. Fuel filters and water separator
13. Fuel connection with containment reservoir and locking hose connections for fuel refueling system.
14. Fuel connections with containment reservoir and locking hose connections for connections to mobile fuel polishing system.
15. Fuel level monitoring system
16. Fuel containment interstitial space leak monitoring system
17. Fuel Cooler
18. Dual Starting Batteries
19. Ren 15 gallon crankcase oil make-up supply system
20. Miscellaneous engine-generator set accessories.
21. Miscellaneous engine-generator set accessories as required to complete installation for working system.

22. Integrated enclosure weatherproof sound attenuated enclosure for 75 dBA at 7 meters.
23. Enclosure lighting, exhaust fan, heater.

C. The contractor shall coordinate with the local engine generator manufacturer's representative to coordinate the integration of the equipment and the contractors installed equipment for a complete and working installed engine generator system.

1.3 SYSTEM DESCRIPTION:

A. Standby engine-generator system shall have a site capability of 1250 KW 1500 KVA at 0.80 power factor, 480/277 Volt 3-phase, 4-wire, 60 hertz.

B. System Function
1. The EG shall include the capability of being automatically controlled by the automatic transfer switch. After starting, the unit shall attain rated speed and voltage, and accept rated load. Generator set speed shall be controlled by the engine governor, while generator output voltage regulation shall be a function of the generator automatic voltage regulator. Manual adjustment of generator speed and voltage shall be provided.

D. Site Conditions
1. The operating environment of the standby engine-generator system shall be:

Altitude ..... 600 ft
Outdoor temperature, max .....105ºF (122F at radiator)
Outdoor temperature, min 10ºF
Engine jacket water, glycol 50%
Installation type. ..... Indoors EPA Tier 2
Fuel type .....standard No. 2 diesel
Cooling system type ..... On board radiator with blower fan and shroud

E. System Performance
1. The standby engine-generator system shall conform to the following general performance criteria:
   a. Rating - Engine brake horsepower shall be sufficient to deliver full rated engine-generator set KW/KVA when operated at rated rpm and equipped with all engine-mounted parasitic and external loads.
   b. Conditions - The rating shall be based on ISO 3046/1 conditions of 29.53 in Hg and 27ºC (81□F).
   c. Fuel - Diesel engines shall be able to deliver rated power when operating on No. 2 diesel fuel having 35 degree API (16ºC or 60ºF) specific gravity.
   d. Fuel Consumption - Diesel fuel rates shall be based on fuel having a low heating value (LHV) of 18,390 Btu/lb when used at 29ºC (85ºF) and weighing 7.001 lbs/U.S. gal.
   e. Start Time and Load Acceptance - Engines shall start, achieve

rated voltage and frequency, and be capable of accepting load within 10 seconds when properly equipped and maintained.

f. Block Load Acceptance - Transient response shall conform to ISO 8528 requirements.

1.4 REFERENCE STANDARDS:

A. The standby engine-generator set shall be designed, manufactured, and tested in accordance with the latest edition of the specific component manufacturers governing standards. This specification includes applicable considerations of:
   1. American Society of Mechanical Engineers (ASME)
   2. Diesel Engine Manufacturers Association (DEMA)
   3. Electrical Generating Systems Association (EGSA)
   4. International Electrotechnical Commission (IEC)
   5. International Standards Organization (ISO)
   6. Institute of Electrical and Electronics Engineers (IEEE)
   7. National Electrical Code (NEC)
   8. National Electric Manufacturers Association (NEMA)
   9. National Fire Protection Association (NFPA)
   10. Occupational Safety and Health Act (OSHA)
   11. Society of Automotive Engineers (SAE)
   12. Underwriters Laboratories (UL)
   13. United States Military Standards for Generators and Controls (MIL-STD)

B. The automatic transfer switch shall be designed, tested, and assembled in strict accordance with all applicable standards of ANSI, UL, IEEE and NEMA.

1.5 QUALITY ASSURANCE:

A. All required engine generator related systems and accessories, shall be provided by local manufacturer’s representative vendor. Thus the responsibility for integration of the completed system shall not be divided among individual vendors, but shall be assumed solely by one primary vendor. This shall include having a local organization responsible for service, parts, and warranty for the total system.

B. All system components shall have been designed to achieve optimum physical and performance compatibility and prototype tested to prove integrated design capability.

1.6 SUBMITTALS:

A. Submit eight (8) bound copies of product data and shop drawings for products specified under PART

B. Engine-Generator Set Accessories
   1. Component List - A breakdown of all components and options including switchgear.
   2. Technical Data - Manufacturer's specifications and data sheets identifying make and model of engine and generator and including relevant component design and performance data.
      a. Radiator
         1) Model
         2) Type

3) Fan drive ratio
4) Coolant capacity, radiator
5) Coolant capacity, radiator and engine
6) Weight
   a) dry
   b) wet

b. Major System Equipment:
1) Dimensions
   a) length
   b) width
   c) height
2) Weight
   a) dry
   b) wet

5. Auxiliary Equipment - Specifications and data sheets, including, but not necessarily limited to, vibration isolators, governor, voltage regulator, battery charger, jacket water heaters, muffler, weatherproof enclosure, etc.
6. Drawings - Dimensional drawings showing overall engine-generator set measurements, mounting location and interconnect points for load leads, fuel, exhaust, cooling and drain lines.
7. Wiring Diagrams - Wiring diagrams, schematic diagrams and control panel outline drawings published by the manufacturer in Joint Industrial Council (JIC) format for engine-generator set controls and the associated automatic transfer switch showing interconnected points and logic diagrams for use by the installing contractor and the Owner.
8. Warranty Statements - Warranty verification published by the respective manufacturer's of the component equipment.
9. Service - Location and description of EG vendor's parts and service facility including parts inventory and number of qualified generator set service personnel.
10. Maintenance and Repair Contract Options - Outline of the various maintenance and repair contracts available and the associated costs.
11. Oil Sampling Service - Description of service provided, recommended frequency of service, and associated costs.
12. Itemized deviations from these specifications.

1.7 SERVICE AND WARRANTY

A. The EG vendor shall be capable of providing factory trained servicemen, the required stock of replacement parts, technical assistance, and warranty administration.

B. Warranty Administration
1. The EG vendor shall be capable of administering the engine, generator, and all other components manufacturer's warranties.

C. Warranty Terms
1. The existing standby engine-generator set warranty shall be based on the warranty furnished with the engine purchase. All new accessories added under this project shall be based on a limitation of 1500 hours or two (2) years from date of initial start-up of the system, whichever occurs first, and shall include repair parts, labor, reasonable travel expense necessary for repairs at the jobsite, and expendables (lubricating oil, filters, antifreeze, and other service items made unusable by the defect) used during the course of repair. Applicable deductible costs shall be specified in the manufacturer's warranty.

D. Warranty Nameplate
1. A warranty nameplate shall affixed to the generator set with the following data:
   a. Warranty Period:
   b. Start-up Date:
   c. Termination Date:
   d. Supplier Name:
   e. Supplier Address:
   f. 24-Hour Emergency Number:
   g. Preventive maintenance to be performed by:

E. Maintenance and Repair Contract
1. The engine-generator set supplier shall be capable of offering a maintenance and repair contract which guarantees all support costs of the specified system. It shall include routine and 24 hour emergency access to an account manager to expedite emergency repairs.
2. The contract shall protect the user from parts and labor price increases, and shall provide a refund of residual funds at any time of user dissatisfaction. Optional payment schedules shall include:
   a. Fixed rate throughout the life of the contract.
   b. Graduated rate which increases the low initial cost throughout the life of the contract.
   c. Deferred rate which delays contract payment until expiration of the standard warranty.
   d. Lump sum discounted payment.

F. Mechanics and Equipment
1. The EG vendor shall have factory trained service representatives and tooling necessary to install, test, maintain, and repair all provided equipment.

G. Parts Availability
1. The EG vendor shall have sufficient parts inventory to maintain over the counter availability of at least 90% of any required parts.
2. The EG vendor shall guarantee 100% parts availability within 48 hours from the time an order is entered with the dealer.

H. Oil Sampling Service
1. The EG vendor shall be capable of providing a scheduled oil sampling service to monitor engine condition on an ongoing basis. The sampling method shall be of the atomic absorption spectrophometry method and be accurate to within a fraction of one part per million for the following elements.
   a. Iron
   b. Chromium
   c. Copper
   d. Aluminum
   e. Silicon
   f. Lead
   g. Water
   h. Fuel
   i. Antifreeze
2. The oil samples shall be analyzed at the EG vendor's facility by factory trained personnel. Immediate notification of critical results shall be provided to the Owner's Representative.

PART 2 - PRODUCTS

2.1 ENGINE-GENERATOR SET

A. Engine
1. The engine shall be equipped with air filters, fuel filters and pressure gauge, lubricating oil cooler, filters, and pressure gauge, water pump and temperature gauge, service hour meter, flywheel, and flywheel housing.
2. The design of the basic engine shall provide for maximum structural integrity to extend service life. Materials used in the engine shall incorporate the highest level of proven metallurgical and manufacturing technology.
3. The use of an electronic engine control system to provide overall engine management is acceptable. This system may perform self-diagnostic checks and monitor engine-generator system components. The system may control the basic engine functions, such as rated speed and power, timing of fuel injection, engine governing, torque shaping, cold start logic, transient fuel delivery, diagnostics, and engine protection.
4. The engine and generator shall be dynamically balanced from 0 rpm to 25% overspeed.

B. Lubrication System
1. The lubrication system shall include an engine driven oil pump, full flow filtration with replaceable elements and a bypass valve to continue lubrication in the event of filter clogging, flexible oil lines and an oil cooler.
2. The bypass valve shall be integral with the engine filter base or receptacle.

3. The filter shall incorporate a self-lubricating, free rotating seal and have a non-metallic core sufficiently rigid to minimize movement or shifting of the filtration media.
4. A skid-base mounted REN-RA Series oil makeup system (15 gallon reservoir) or approved equal shall be provided.

C. Fuel System
1. The fuel system shall be integral with the engine. It shall consist of a fuel filtration system, transfer pump, injection pumps, supply and return fuel lines, and nozzles. The transfer pump shall be engine driven and shall deliver fuel under low pressure to individual injection pumps. The system shall be capable of delivering fuel flow from the sub-base fuel tank to the engine fuel inlets, or nozzles, sufficient for full rated operation of the engine under all ambient temperature conditions.
2. The injection pumps shall be driven from the camshaft. The pumps shall be of a variable displacement type to alter the volume of fuel delivered to the spray nozzles according to load demand. The nozzles shall inject fuel directly into the cylinder in the optimum spray pattern for efficient combustion.
3. A unit fuel injector shall be mounted in each cylinder head, with external feeder lines requiring less than 75 psi fuel pressure. Individual control racks for each cylinder shall permit precise injection timing.
4. The fuel filtration system shall include a primary fuel filter between the fuel tank and transfer pump to screen large contaminants.
5. Provide a fuel/water separator system with isolation valves to protect the fuel system from water damage.
6. Fuel shall be piped from the filter/water separator system to the intake of the engine fuel pump, and then to the engine. A fuel pre-cooler shall be provided only as required for the engine to deliver its maximum horsepower to achieve its rated KW. The fuel cooler, if required, shall be capable of exchanging heat rejected at full load with the cooling medium, including 10% reserve to accommodate fouling.
7. Fuel lines between the engine and the fuel supply shall be flexible. Flexible connections shall be stainless steel braided hose. Fixed piping shall be Schedule 40 black steel.
8. The fuel transfer pump, injection pumps, rack and pinion assembly, and timing mechanism shall be maintenance and adjustment free for the life of the equipment.
9. The sub-base fuel tank shall be double-walled UL 2085 tank provided with float switches and solenoids for automatic re-fueling control sequences.
10. A fan-cooled fuel cooling system shall be provided to limit fuel temperature to normal operating temperature as required by the manufacturer and in no case higher than 140ºF.

D. Governor
1. The engine governor shall be an electronic speed controller. Speed droop shall be externally adjustable from 0 (isochronous) to 10% from no load to full rated load. Speed shall be sensed by a magnetic pickup off

the engine flywheel ring gear. A provision for remote speed adjustment shall be included. The governor shall incorporate provisions for limiting fuel during start-up and included capability for actuator compensation adjustment. Protection from voltage spikes and reverse polarity shall be included. In the event of a DC power loss, the forward acting actuator shall move to the minimum fuel position.

2. The use of an electronic engine control system to perform the governor functions of controlling fuel and speed is acceptable.

E. Cooling System

1. The engine jacket water cooling system shall be a closed circuit design with provision for filling, expansion, and de-aeration. The blower fan and cooling pump shall be driven by the engine. Auxiliary coolant pumps required for separate circuit after-cooling shall also be engine driven. The radiator shall be of sufficient capacity to allow full rated operation at core temperature at the sum of the engine room temperature rise and the ambient outdoor condition of 105 degrees F.
2. Heat rejected to the engine jacket water shall be discharged to the atmosphere through a remote radiator. The radiator shall cool the jacket water while the engine is operating at full load capacity at maximum site temperature.
3. The fan, fan drive, and fan belts shall be covered with 14 gauge punched steel mesh guarding for personnel protection.
4. Provide isolation valves and drain valves on top and bottom of the engine radiator piping connections to facilitate radiator and water pump maintenance.
5. Coolant lines shall be high temperature, strength reinforced with flexible connections.
6. Provide a water/ethylene glycol coolant mixture for the engine cooling system per the engine manufacturer's recommendations.

F. Combustion Air System
1. The engine intake air system shall include engine mounted, dry element, intake air filters.
2. Intake air shall be natural air aspirated or turbo charged. Turbochargers shall be of the axial turbine type driven by engine exhaust gases and direct-connected to a compressor supplying engine combustion air.
3. Intake air shall be after cooled. Aftercooler core air surfaces shall be coated with a corrosion inhibitor to minimize oxidation. Provide air box assembly, pumps, base and piping for assembly per manufacturer's instructions for compliance with EPA Tier 2 certification requirements. Engine manufacturer is representative to inspect installation and provide EPA Tier 2 certification documentation.
4. Air Box for each engine shall be mounted adjacent to the engine for piping connections to the existing engine. The Vendor shall provide submittals indicating exact details for radiator piping and structural steel supports to be coordinated with engine support skid. Vendor shall review proposed generator and radiator piping and provide pump selection for air box heat rejection piping system pump and site specific piping requirements. Submittal shall include isometric piping drawing and calculations of pumping heads and documentation that radiator, heat exchanger and piping system is compatible with the pump documentation. Vendor shall confirm expansion capacity in remote radiator is sufficient for liquid volume expansion. Vendor shall provide radiator fill ports and recommend radiator drain ports and liquid filling process

G. Exhaust System
1. The engine exhaust system shall be installed to discharge combustion gases quickly and silently with minimum restriction. The exhaust system including silencer shall be designed for minimum restriction, and in no case shall backpressure exceed 27 inches H20.
2. Schedule 40 heavy walled piping shall be utilized, with radii of 90□ bends at least 1 1/2 times the pipe diameter. Piping shall be installed with 9 inches minimum clearance from combustible material. The exhaust piping and muffler shall be insulated with 2 layers of 2" rock wool. Joints shall be staggered. Insulation shall be banded and shall be covered with mastic vapor barrier. Exterior piping shall be provided with stainless steel (316L) jacket and stainless steel bands.
3. Piping shall be supported and braced to prevent weight or thermal growth being transferred to the engine. Flexible expansion fittings shall be provided to accommodate thermal growth. Support dampers and springs shall be included where necessary to isolate vibration.
4. The exhaust silencer (muffler) shall be owner furnished contractor installed silencer.
5. Exhaust piping from the muffler shall be extended horizontally and vertically to discharge engine exhaust into the radiator discharge air stream. Provide a rain cap at the exhaust pipe outlet. Provide an exhaust condensation trap and drain valve at the low point of the piping.

H. Starting System
1. The engine shall be equipped with an electric starting system which shall include 24 volt DC starting motor(s), starter relay, batteries, battery charger and automatic reset circuit breaker to protect against butt engagement. The system shall be capable of starting a properly equipped engine within 10 seconds at maximum site ambient temperatures.
2. Batteries for starting and control shall be a heavy duty, low-maintenance, lead acid type with thru-partition connectors, and housed in a hard rubber or polypropylene case with provision for venting.
3. Starting batteries shall be rated 24 volt DC size based on specific application requirements of engine oil viscosity, ambient starting temperature, control voltage, overcharging and vibration. Battery capacity shall be sufficient for cranking the engine for a minimum of 15 seconds per cranking cycle at firing speed with ambient temperature of 0 degrees F. Batteries shall additionally have the capacity for a minimum of six (6) engine start cranking cycles.
4. Batteries shall be located as close to the starting motor as practical, away from spark sources, in a relatively cool and ambient and permit easy inspection and maintenance. A corrosion resistant or coated steel battery rack shall be provided for mounting. Required cables shall be provided and sized to satisfy circuit requirements.
5. Battery warranty shall be the responsibility of the Generator Integrity vendor.
6. Battery heaters shall be provided to maintain battery temperature above 50º F (10ºC) and automatically shut off when battery temperature attains 75ºF (24ºC).
7. OFCI dual battery chargers with best battery selector shall be provided.

J. Wiring and Conduit
1. Reusable bulkhead fittings will attach the conduit to generator set mounted junction boxes.

K. Generator
1. General Description:
2. Generator to meet applicable requirements of the latest approved edition of NEMA in design, performance and factory test procedures. The generator and voltage regulator to be UL listed. The voltage regulator to be factory wired and tested with the generator. The manufacturer to have a minimum of three (3) years documented experience in manufacturing the specified generator.
3. The generator to be synchronous-type, suitable for standby service as previously specified.
4. Sub transient direct axis (X”D) to be 12 to 16 percent at the anticipated load power factor of 0.95 lagging and selected voltage.
5. The generator windings pitch to be 2/3.
6. Construction and Bearings:

7. The generator to be drip proof, one or two bearing, close coupled construction. Cast iron end brackets and fabricated steel frames to be used. The unit to be fully guarded per NEMA MG1-22.
8. Bearings to be pre-lubricated, shielded, cartridge ball bearings with provisions for adding and/or changing grease through grease pipes extended to the generator exterior. Minimum B-10 bearing life to be 40,000 hours.
9. Permanent Magnet Excitation System:
10. The generator to be rotating field brushless construction using a permanent magnet pilot excited generator to supply the voltage regulator. Volt regulator power supply at each generator to be from a voltage transformer at the generator or the two 24-volt batteries via a best battery selector.
11. The voltage regulator to be digital type, microprocessor based, using non-aging silicon controlled rectifiers. The voltage regulator to be designed to work with the permanent magnet exciter to support a fault current of at least 300 percent of rated value for up to 10 seconds and prevent SCR induced interference to the voltage regulation system. The voltage regulator to be true RMS three phase sensing, and to have volts-per-hertz operation, loss of sensing, over and under excitation protection, short circuit current limit and zero droop regulation. Adjustments for voltage droop and voltage gain to be provided. The voltage regulator to be mounted in the generator panel. The voltage adjustment controls to be furnished with the generator.
12. The voltage regulator to be equipped to shut down excitation upon opening of a customer's remote contact.
13. The voltage regulator to maintain the specified steady-state operational band with a non-linear load having a THD of not more than 15 percent.
14. Regulation: plus 0.25 percent no load to full load.
15. Regulator temperature drift: Less than 0.5 percent for any 40 degrees C change over the operating temperature range.
16. Programmable Volts/Hz characteristic: Two slope ranges adjustable form 1 to 10 V/Hz.
17. Regulator sensing: True RMS 3-phase sensing.
18. Regulator stability: Regulator responds to the fundamental component of the sensed voltage and remains stable for total harmonic distortion of the generator output voltage waveform up to 20 percent.
19. Regulator filtering: Telephone Influence Factor (TIF) less than 50 Complies with MIL STD 461B Part 9, EN 50081-2, and EN 50082-2.
20. Fine voltage adjustment range: Minus 10 to plus 10 percent of regular sensing voltage.
21. Regulator voltage gain (IR compensation): Adjustable 0 to 10 percent.
22. Fault detection and identification: Diagnostics identify operation outside of programmed limits and specific fault information is available even after the unit has been powered down.
23. Regulator start-up voltage: Meets ISO8325-3 class G3 specifications.
24. Harmonic tolerance: To maintain precise control of the generator output with up to 20% harmonic distortion in the generator output voltage.
25. Reactive droop adjustment: Adjustable 0 to 10 percent.

26. Over excitation protection: Shuts off generator output when excitation current exceeds normal operating currents for 15 seconds or instantaneous shutoff if output is shorted.
27. Ambient operating temperature: minus40 degrees C to plus 70 degrees C.
28. Salt spray: Meets MIL-STD-810C, method 509.1.
29. Sealing: Withstands up to 35 kPA (5.08 psi).
30. Adjustable over/under voltage protection.
31. 24V DC, 0.5A power supply required.
32. Insulation System:
33. The insulation system of both the rotor and stator windings to be of NEMA Class H materials and to be synthetic and non-hygroscopic. The stator winding to be vacuum pressure impregnated with polyester resin, a dip and bake epoxy overcoat, and a final sealer coat. The rotor to be wet layer wound with thermosetting epoxy between each layer and epoxy paint on the bare rotor. The rotor insulation to be sealed and then oven cured.
34. Main Rotor:
35. The main rotating field core to be constructed of one piece four pole laminations. Dovetails, cross bolts and other core-to-shaft connection means are not acceptable. In addition, the amortisseur winding and field pole coil supports to be integrally die-cast with the rotor laminations to form a single piece rotor core. Fabricated and welded or brazed amortisseur windings and coil supports are not acceptable. The rotor core to be press fit and keyed to the shaft.
36. The rotor to be directly coupled to the engine flywheel through a semi-flexible shear type coupling containing replaceable shear pins or approved equal.
37. The rotor windings to be braced to withstand the forces resulting from operation at 125 percent over speed and dynamically balanced.
38. Stator Windings:
39. The stator windings to be random or form wound design as required to meet the 12 percent X”d requirement. at 0.95 lagging power factor. The output terminals to be properly designated to identify the proper sequence. The stator to be heavy-duty construction with solid bars, heavy bands, rings and welded foot assembly. Provide six leads for differential protection on MV alternators and twelve lead for LV alternators.
40. Winding Temperature:
41. The temperature rise of both the rotor and the stator windings, as measured by the resistance method. Temperature rise not to exceed 125 degrees C over 40 degrees C ambient.
42. Provide option for continuous rated 80 degrees C alternator. Higher temperature rise Standby rated alternator is not acceptable as an alternative.
43. Ventilation: The generator to be self-ventilated and to have a one piece, cast aluminum alloy, single directional internal fan for high volume, low noise air delivery.

44. Space Heaters: At each generator, provide space heaters rated 240V AC and de-rated by being connected to remote 208V AC circuit. Heaters to only be energized when the generator is de-energized by a generator auxiliary contact. Wire to terminal housing and size to prevent condensation from forming.

M. Generator Circuit Breaker

1. Provide a main line circuit breaker mounted and connected in a guarded drip- proof enclosure within the weatherproof enclosure meeting NEMA 1, IP 22 and IECC 144 requirements. Generator output circuit breakers will be furnished by the generator manufacturer. Circuit breakers shall be a molded case thermal magnetic breaker, Square D type SE or approved equal, 100% rated (40□C ambient), suitable for use on a system with 50,000 amperes RMS symmetrical short circuit interrupting capacity at 480 volts and shall be sized as shown on the Drawings. These devices shall be designed to carry 100% of their nameplate values in the maximum design enclosure temperature. Tripping mechanisms shall be solid state type, RMS current reading type.

2.3 ENGINE-GENERATOR BASE AND FUEL STORAGE

A. General

1. The engine and generator shall be mounted on a single structural base including vibration isolation means. The engine-generator set shall then be mounted on a single structural sub-base which shall house the fuel tank.

B. Engine-Generator Base

1. The engine and generator shall be assembled to a common base. The base shall be constructed of heavy duty structural steel designed and built to resist deflection and maintain alignment during skidding, lifting and operation and minimize resonant linear vibration during operation.
2. Steel spring isolators shall be installed between the engine-generator set base and the mounting surface within the enclosure. The isolators shall bolt to the base, and have a waffled or ribbed pad on their bottom surface. The pads shall be resistant to heat and age, and impervious to oil, coolant, diesel fuel and cleaning compounds.

C. Enclosure Base (Sub-base)

1. The sub-base shall be constructed of structural steel. The sub-base shall be designed to rigidly support the engine-generator set, enclosure, fuel tank, ensure permanent alignment of all rotating parts, be arranged to provide easy access to allow changing of lube-oil, and ensure that alignment is maintained during shipping and normal operation. The sub-base shall be provided with suitable lifting holes for use by a crane operated hoist to permit skidding in any direction during installation. The sub-base shall also withstand and mitigate the affects of synchronous vibration of the engine and generator. The sub-base shall be provided with suitable holes for foundation anchor bolts.

D. Fuel Storage

1. The engine-generator set shall be provided with a UL 2085 double-walled fuel tank located in the structural sub-base of the set. The tank arrangement shall comply with all local codes and ordinances. The tank shall incorporate threaded pipe connections, suction pump, and float switches. A manual shutoff valve on the engine supply line and a drain valve shall be included. The tank shall be provided with a check valve in the supply line to the engine. The tank shall be new and unused with clean steel finish on the inside and a primed and painted finish on the outside. The tank shall not be galvanized. The tank shall include a vent line, flexible fuel lines connections and fuel gauge.
2. A fail-safe safety circuit shall be included to ensure fuel flow through the fuel vent openings is prohibited.

E. Camlock boxes for generator connection.

1. Generator manufacturer shall provide two camlock boxes with one camlock box for connection to load bank for testing and one camlock box for connection to portable generator for temporary generator power when the generator is serviced for maintenance. Camlock boxes shall be weather resistant stainless steel enclosures with bussing and connections provided for the full ampere rating of the feeder breaker. Provide camlock connections for and wire tails for connection to wire cables compatible with manufacturer representative stock of rental cables.

F. FAA compliance.

1. Generator shall comply with all FAA requirements and shall include interface controls and monitoring as required by FAA for airfield lighting vaults.

2.4 REMOTE ANNUNCIATOR

A. Provide remote alarm annunciator with horn, located as indicated on the Drawings. The remote annunciator shall provide the following audible and visual alarms:

Lamp Legend	Generator Set Condition Indicated	Light	Audible Alarm
High Battery Voltage	Battery charger too high	Red	No
Low Battery Voltage	Battery voltage too low	Red	No
Normal Battery Voltage	Battery voltage normal	Green	No
Generator Running	Generator set has output voltage	Green	No
Normal Utility Power	Utility power supplying the load	Green	No
Generator Supplying Load	Generator set supplying the load	Green	No
Pre-Low Oil Pressure	Oil pressure approaching low limit	Yellow	Yes
Low Oil Pressure	Engine has shut down due to low oil pressure	Red	Yes
Pre-High Coolant Temp	Temperature of coolant approaching high limit	Yellow	Yes
High Coolant Temp	Engine set has shut down due to high coolant temperature	Red	Yes
Low Engine Temp	Engine heater has malfunctioned	Red	Yes
Overspeed	Engine has shut down due to overspeed	Red	Yes
Overcrank	Engine failed to start	Red	Yes
Not in Auto	Engine control switch not in AUTO position	Flashing Red	Yes

Battery Charger Malfunction	Charger is signaling a failure	Red	Yes

Lamp Legend	Generator Set Condition Indicated	Light	Audible Alarm
Low Fuel	Fuel level below preset minimum	Red	Yes
Fuel Leak	Fuel leak detected with dual wall containment of fuel tank	Red	Yes
High Fuel	Fuel above normal level	Amber	Yes
Highest Fuel	Fuel above high fuel alarm	Red	Yes

B. Provisions for labeling of the annunciator in a fashion consistent with the specified functions shall be provided. Alarm silence and lamp test switch shall be provided. Lamps shall be replaceable, and indicating lamp color shall be capable of changes needed for specific application requirements. Alarm horn shall be switchable for all annunciation points. Alarm horn (when switched on) shall sound for first fault, and all subsequent faults, regardless of whether first fault has been cleared. The remote annunciator shall comply with NFPA 110 for Level 1 emergency power supply systems.

C. Provide a remote start/stop key switch cabinet with ATS position lights for utility and emergency and an ATS transfer key switch.

2.5 GENERATOR 24V DC POWER TO GENERATOR OUTPUT SWITCHGEAR

A. Generator vendor shall provide 24VDC power source for auxiliary wiring from generator control panel to generator output switchgear for control power of generator output breaker relays. Generator output breaker springs will be normally charged and will be powered by 120V AC power source from generator output electrical distribution system similar to generator 120V and 208V accessories.

2.6 EXTRA MATERIALS

A. Provide a cabinet located inside the weatherproof housing to contain the following for each generator:
   1. Generator Instruction Manual contains:
      a. A detailed explanation of the operation of the system.
      b. Instructions for routine maintenance.
      c. Detailed instructions for repair of the EPS and other major components of the EPS.
      d. Pictorial parts list and part numbers.
      e. Pictorial and schematic electrical drawings of wiring systems, including operating and safety devices, control panels, instrumentation, and annunciators.
   2. Three of each type of fuse used in the generator.
   3. Three of each type of lamp used in the generator.
   4. Two air cleaners.
   5. Two primary fuel filters.
   6. Two secondary fuel filters.
   7. Four oil filters.

PART 3 - EXECUTION

3.2 INSPECTION

A. Examine the area to receive the EG equipment to assure adequate clearance for installation.

B. Check that concrete pads are level and free of irregularities.

C. Start work only after unsatisfactory conditions are corrected.

3.3 INSTALLATION

A. The EG shall be installed as indicated on the Drawings and per the manufacturer's recommended procedures.

B. The EG manufacturer will be responsible for providing a field service technician to oversee the installing contractor's installation of the system, including setting, alignment, assembly and connections.

C. The engine-generator set vendor shall be responsible for providing the coordinating wiring diagrams showing the electrical connections between the automatic transfer equipment and the engine-generator for use by the Installing Contractor during installation and checkout of the equipment.

D. After installation by others, the engine-generator set vendor shall provide the services of competent factory based service engineers to instruct the Installing Contractor, and to coordinate the installation of the equipment. They shall assist in placing the equipment into operation and provide instruction, as required, to the person or persons who are delegated to operate the equipment. This service shall include a minimum of four (4) visits by the factory service engineers as follows:
   1. Pre-installation coordination meeting to coordinate the installation and interconnection of the automatic transfer equipment with the engine-generator equipment.
   2. Initial checkout of the installation of the equipment prior to start up and testing.
   3. Post-installation start-up and testing prior to system turnover and for the initial instruction period for operating personnel. This trip shall include all service required to checkout the emergency power system and demonstrate its complete operation, for final acceptance by the Owner.
   4. Within six months after system turnover, a one (1) day instructional period for operating personnel on complete operation and maintenance of the equipment.

E. The engine-generator set manufacturer shall maintain a competent factory service organization that is available for service on a 24-hour call basis.

F. The EPS equipment shall be adequately protected from damage due to lightning.

G. Wiring from emergency source or emergency source distribution overcurrent protection to emergency loads shall be kept entirely independent of all other wiring and equipment and shall not enter the same raceway, cable, box, or cabinet with other wiring.

H. Stranded wire of adequate size shall be used to minimize breakage due to vibration. Bushings shall be installed to protect wiring from abrasion with conduit terminations.

I. Emergency Sources: A sign shall be placed at the service entrance equipment indicating type and location of on-site emergency power sources.

J. Identification: All boxes and enclosures (including transfer switches, generators, and power panels) for emergency circuits shall be permanently marked so they will be readily identified as a component of an emergency circuit or system.

3.4 FIELD QUALITY CONTROL

A. The complete installation shall be checked for procedural and operational compliance by technical representatives of the engine-generator set vendor. Any deficiencies shall be noted for correction by the Installing Contractor.

B. The EG vendor shall be available to assist the Installing Contractor during installation.

C. The EG vendor shall perform start-up procedure, systems check, adjusting, and site testing required after the installation is complete.

D. The engine lubricating oil and antifreeze, as recommended by the engine manufacturer, shall be provided by the EG vendor.

3.5 SYSTEM START-UP AND OPERATIONAL TESTING

A. The EG manufacturer’s field service technician shall be responsible for field start-up and testing. The manufacturer shall furnish the Owner with written certification assuring that each item of equipment is complete, in good condition, free from damage and properly installed, connected and adjusted.

B. The installing contractor shall provide the required assistance to the EG manufacturer’s field service technician during start-up and testing. This assistance shall be limited to tasks directly associated with the installation of the EG, not with the internal components or inherent function of the EG equipment.

C. The EG vendor shall coordinate the operation of the engine-generator with the operation of the automatic transfer switch so that automatic operation of the complete emergency power system functions as described and required by these and other related specifications.

D. System start-up and operational testing procedures shall not be limited to those specified herein. Others shall be performed as required to prove that the system functions as described and required by these specifications.

E. EG operational testing shall be performed by the EG vendor in conjunction with technical representatives of the automatic transfer switch manufacturer in the presence of the Owner's Representative(s). System start-up shall be performed by the same aforementioned personnel but it is not necessary to perform start-up functions and procedures in the presence of the Owner's Representative(s) unless specifically noted or required otherwise. Two (2) weeks written notice shall be given for all start-up and testing procedures requiring Owner witnessing.

F. EG Operational Testing
1. The EG vendor shall provide dry type, resistive load banks and fuel for the testing. Building load shall not be used. Upon completion of the testing and final acceptance by the Owner all fuel tank shall be filled to 90% full.
2. Cycle Crank Test - Utilize any method recommended by the manufacturer to prevent the prime mover from running. Put the control switch into "run" to cause the prime mover to crank. Observe the complete crank/rest cycle specified. After generator locks out due to overcranking reset and repeat.
3. Functionally test engine shutdown for low oil pressure, overtemperature, overspeed.
4. Verify lamps on EPS control panel and remote status panel with lamp test switch.
5. Verify all alarm on EPS control panel and remote status panel by simulating an alarm condition.
6. With prime mover in a "cold start" condition and emergency load at worst case operating level, initiate a normal power failure by opening all switches or breakers supplying the normal power to the building or facility. Test load shall be that load that is served by the EPS.
7. Observe and record the time delay on start.
8. Observe and record the cranking time until the prime mover starts and runs.
9. Observe and record the time required to come up to operating speed.
10. Record voltage and frequency overshoot.
11. Observe and record time required to achieve steady-state condition with all switches transferred to the emergency position.
12. Record voltage, frequency, and amperes.
13. Record prime mover oil pressure, water temperature where applicable, and battery charge rate at 6-minute intervals for the first 15 minutes, and at 15-minute intervals thereafter.
14. Continue load test with building load for one hour observing and recording load changes and the resultant effect on voltage and frequency.
15. Return normal power to the building or facility, record the time delay on retransfer to normal for each switch and the time delay on prime mover cooldown period and shutdown.

16. After completion of the test performed above the prime mover shall be allowed to cool for 5 minutes.
17. Load - 30-minutes of operation at 50% of full load rating. 30-minutes of operation at 75% of full load rating. Four (4) hours operation at 100% of full load rating. After the first half-hour stabilization period at full load, the following shall be recorded at fifteen minute intervals:
    a. Voltage and amperage (3 phase), frequency
    b. Fuel pressure, oil pressure and water temperature
    c. Exhaust gas temperature at engine exhaust outlet
    d. Ambient temperature
    e. If equipped with appropriate instrumentation:
        1) Kilowatts
        2) Power Factor
        3) KVARS
        4) Generator Temperature
18. Proper operation of system controls, engine shutdown, and safety devices shall be demonstrated.
19. Should these tests fail or indicate that the equipment does not meet the specified performance requirements, National Electrical Code and local codes, the cost of all corrective measures shall be borne by the EG vendor if equipment related and by the Installing Contractor if installation related. Once corrective measures are implemented, the operational testing shall be repeated at the cost of the responsible party, whether EG vendor or Installing Contractor.
20. After all the existing loads on the existing generator have been transferred to the new generator system has been, demonstrate operation of the generator under load for 4 hours under simulated power outage and for 1 hour under simulated generator run signal from air traffic control tower.
21. Contractor shall perform all tests for witness by the owners representative and engineer. Generator manufacturer representative, automatic transfer switch manufacturer representative shall be present for all tests to assist the contractor and shall prepare written testing procedure submittal eight weeks prior to testing. Generator manufacturer shall provide portable resistive and reactive load bank for load bank testing.

G. Engine-Generator Prestart Checks
1. Oil level
2. Water level
3. Subbase fuel tank fuel level
4. Battery connection and charge condition
5. Engine to control interconnects
6. Engine-generator intake air/exhaust obstructions
7. Engine-generator enclosure ventilation obstructions
8. Removal of all packing materials.

3.6 INSTALLATION, OPERATION AND MAINTENANCE MATERIALS

A. Installation Instructions
1. Provide three (3) copies of the installation, operation and maintenance instructions for all equipment and devices provided under this Contract for use during the installation and commissioning into service of the emergency power system. One (1) copy shall be for the Installing Contractor and shall be delivered to the installing contractor at the time of delivery. The other two (2) copies shall be issued to the Owner's Representative for their reference during installation, start-up and testing.

B. Operation Instructions and Maintenance Manuals
1. After completion of work and start-up of the equipment at the project site, deliver to the Owner's Representative, copies of operation instructions, maintenance manuals and drawings presenting full details for care and maintenance of each item of equipment provided under this Contract.
2. Each manual shall contain the operating and maintenance information and parts lists for all equipment provided under this Contract. When necessary, provide supplemental drawings to show system operation and servicing and maintenance points. For all electrical components, provide wiring and connection diagrams. Manuals shall include instructions required to accomplish specified operation and functions. Data shall be neat, clean, legible copies. Drawings shall be accordion folded. Non-applicable information shall not be included.
3. In general, the manual shall include, but not necessarily be limited to, the following:
   a. Operating Instructions - with description and illustration of the engine-generator set, engine and generator controls and any other controls and indicators.
   b. Parts Books - that illustrate and list all assemblies, subassemblies and components, except standard fastening hardware (nuts, bolts, washers, etc.).
   c. Preventative Maintenance Instructions - on the complete system that cover daily, weekly, monthly, bi-annual , and annual maintenance requirements and include a complete lubrication chart.
   d. Routine Test Procedures - for all electronic and electrical circuits and for the main AC generator.
   e. Troubleshooting Chart - covering the complete engine-generator set showing description of trouble, probable cause, and suggested remedy.
   f. Recommended Spare Parts List - showing all consumables anticipated to be required during routine maintenance and testing, including pricing.
   g. Wiring Diagrams and Schematics - showing function of all electrical components.
4. Manuals shall be in the form of three-ring binders adequately labeled with the project name and location and the contents indexed. Three (3) sets of manuals shall be provided to the Owner's Representative.

3.7 ORIENTATION

A. The EG vendor shall provide a complete orientation for the Owner's engineering and maintenance personnel. Orientation shall include both classroom and hands-on instruction. Topics covered shall include control operation, schematics, wiring diagrams, meters, indicators, warning lights, shutdown system and routine maintenance. Allow one (1) day for orientation.

END OF SECTION

SECTION 26 36 23

AUTOMATIC TRANSFER SWITCHES

PART 1 - GENERAL

1.1 REFERENCES

A. UL 1008 - Automatic Transfer Switches.

1.2 SUBMITTALS

A. Submit product data.

B. Provide operation and maintenance manual.

1.3 QUALITY ASSURANCE

A. Regulatory Requirements:
1. Conform to applicable code for standby electrical systems.
2. Conform to UL 1008.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Russelectric.
B. ASCO. (If approved by HAS)

2.2 AUTOMATIC TRANSFER SWITCH

A. Configuration: Electrically-operated, mechanically-held transfer switch; dual-motor operated with isolation bypass.

B. Double-throw with simple over-center type linkage so that both sets of contacts move simultaneously.

C. Positively interlock, mechanically and electrically, the normal and emergency contacts to prevent simultaneous closing. Mechanically lock the switches without the use of hooks, latches, springs or semi-permanent magnets.

D. Provide separate arcing contacts for all poles. Molded case circuit breakers or contactors will not be acceptable. Provide brush type main contacts of silver alloy protected by arc barriers and arc quenchers.

E. Equip transfer switch with permanently attached, safe, isolation bypass features and dead-front manual operator with same transfer speed as electrical operator to prevent flashovers.

F. Provide sturdily built operating mechanism of industrial type components which does not depend on critical electrical or mechanical adjustments. Use of miniature type limit switches and nonindustrial type components will not be acceptable.

G. Provide silver alloy contacts with a minimum rating of 10 amperes on all relays. Provide industrial type control that meet or exceed NEMA and IEEE standards and are field adjustable and have replaceable contacts.

H. Ratings:
1. Voltage: 277/480 volt, 3 phase, 4 wire, 60 hertz.
2. Switched Poles: Four.
3. Load Inrush Rating: Capable of transferring 600 percent rated current at 0.5 power factor between the 277/480 volt sources when sources are 120 degrees out of phase. Capable of closing on in-rush current equal to 20 times rating without excessive burning or welding of the contacts.
4. Continuous Rating: As scheduled.
5. Withstand Current Rating: 65,000 rms symmetrical amperes, when used with circuit breakers.

I. Automatic Sequence of Operation:
1. Initiate Transfer of Load to Alternate Source: Upon initiation by normal source monitor and permission by alternate source monitor.
2. Monitor Before Transfer to Alternate Power Source: Frequency and voltage to be within acceptable limits.
3. Monitor normal source of power by use of voltage sensitive relays in each switch. Adjust relays to detect failure when any phase or leg drops below 70 percent of normal voltage and sense restoration when all phases or legs have returned to at least 90 percent of normal voltage.
4. Provide close differential (90 percent dropout and 95 percent pickup) relays on connected load which will prevent transfer of load to emergency source upon a voltage frequency drop until it has reached at least 90 percent of rated voltage and frequency.
5. Provide a solid state timer to signal the generator to start after an adjustable time delay of 0.5 to 6 seconds. Provide lockout relay to prevent transfer until the generating set has reached 90 percent of voltage rating and frequency.
6. Time Delay Before Transfer to Emergency Power: Provide adjustable time delay of 0 to 60 seconds on transfer to emergency.

7. Initiate Retransfer Load to Normal Source: Upon permission by normal source monitor.
8. Time Delay Before Transfer to Normal Power: Provide an adjustable time delay on retransfer (0 to 25 minutes); factory set at 5 minutes, to assure a stable normal source before returning the load to the normal source. Include a bypass circuit switch to override time delay in the event of simultaneous failure of the emergency source and availability of a suitable normal source.
9. Time Delay on Retransfer: Provide an adjustable time delay between opening of emergency contacts and closing of normal contacts to allow motor loads to decay.
10. In-Phase Monitor on Re-transfer: Provide an in-phase monitor to allow retransfer only when both sources are within an acceptable range.
11. Time Delay on Engine Shutdown: Provide an adjustable time delay on retransfer to normal (0 to 5 minutes); factory set at 5 minutes.

J. Enclosure: Type 1.

2.3 ACCESSORIES

A. Indicating Lights: Mount in cover of enclosure to indicate normal source available, alternate source available, switch position.

B. Test Switch: Mount in cover of enclosure to simulate failure of normal source.

C. Return to Normal Switch: Mount in cover of enclosure to initiate manual transfer from alternate to normal source.

D. Transfer Switch Auxiliary Contacts: One normally open; one normally closed.

E. Normal Source Monitor: Monitor each line of normal source voltage and frequency; initiate transfer when voltage drops below 85 percent or frequency varies more than 5 hertz from rated nominal value.

F. Alternate Source Monitor: Monitor alternate source voltage and frequency; inhibit transfer when voltage is below 85 percent or frequency varies more than 5 hertz from rated nominal voltage.

G. In-Phase Monitor on Re-transfer: Provide an in-phase monitor to allow retransfer only when both sources are within an acceptable range.

H. Provide preferred source controls with automatic control by contact closure and by external input form c relay. Also provide over-ride control button with two-level authentication keyed control.

I. Provide infrared scanning ports to facilitate scanning terminations.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that surfaces are ready to receive work.

B. Verify field measurements are as shown on Drawings.

C. Verify that required utilities are available, in proper location, and ready for use.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide 4-inch concrete housekeeping pad with anchor bolts for floor mounted units. Bolt enclosure to pad plumb and square.

C. In conjunction with standby generator testing, all ATS shall be individually tested with simulation of normal source outage, automatic start signal to generator, generator start, ATS measurement of generator source voltage, and ATS transfer to generator source and subsequent restoration of normal source, signals to generator and return of generator and ATS to normal condition.

END OF SECTION