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SECTION 274224
MULTIMEDIA AV SPECIALTY SYSTEMS
(REV. 04-14-2023)

PART 1 - GENERAL

1.1   SUMMARY

A.   Provide the materials, systems, components, interfaces, and all related work required for a complete and working Oculus multimedia content management and delivery system to be implemented and utilized in the Houston Airport System (HAS) International Central Processor (ICP), part of the George Bush International Airport (IAH) Terminal Redevelopment Program (ITRP).

1.2   RELATED SECTIONS

A.   The publications listed below form a part of this specification. The publications are referred to in the text by basic designation only.

B.   Specific reference in specifications to codes, rules, regulations, standards, manufacturer's instructions, or requirements of regulatory agencies shall mean the latest printed edition of each in effect at the date of contract unless the document is shown dated.

C.   Contract Documents, including those portions prepared by or for the Contractor, consisting of Drawings, diagrams, illustrations, schedules, reports, charts, analysis, maps, models, Specifications, the original reproducible of all Drawings and other submittal documents or other data showing the scope, extent, and character of the Work, and general provisions of the Contract, including General and Supplementary Conditions, ITRP Specifications and Design Manual, HAS Design Standards, Houston Airport Technology Specifications, and stipulated Specification Sections shall apply to this Section.

D.   Related Specification Sections:

1.   Section 270526 – HAS Telecommunications Grounding and Bonding
2.   Section 270528 – Interior Communication Pathways
3.   Section 270553 – Identification and Labeling of Communication Infrastructure
4.   Section 271100 – Communication Cabinets and Equipment Rooms
5.   Section 271300 – Backbone and Riser Media Infrastructure
6.   Section 271500 – Horizontal Media Infrastructure
7.   Section 272100 – Data Communication Network Equipment

1.3   DEFINITIONS

A.   Reference Symbols:

1.   All device symbols are defined by the appropriate symbol schedule on the symbols and abbreviations sheet in the T-series Contract Drawings. Not all device symbols as indicated may be required for the project.
2.   Because of the scale of the drawings, symbols are shown on drawings as close as possible to the mounting location. Contractor shall coordinate exact

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location of all network systems and related components with all related Contract drawings, specifications and affected trades prior to submittal of shop drawings.

B.   Abbreviations:

1.   Refer to related Specification Sections for applicable abbreviations in addition to the following.

a.   CMS   Content Management System
b.   CPC   Content Production Company
c.   DP   Display Port
d.   dvLED   Direct View Light Emitting Diode
e.   EDID   Extended Display Identification Data
f.   FAS   Fire Alarm System
g.   FAT   Factory Acceptance Test
h.   HAS   Houston Airport System
i.   HDMI   High-Definition Multimedia Interface
j.   IAH   George Bush International Airport
k.   ICP   International Central Processor
l.   KVM   Keyboard Video Mouse
m.   LED   (See dvLED)
n.   LED DSP   LED Display System Provider
o.   OAR   Owner's Authorized Representative
p.   RAID   Redundant Array of Independent Disk
q.   SAN   Storage Area Network
r.   SFP   Small Form-factor Pluggable

C.   Definitions: Refer to related Specification Sections in addition to the following.

1.   The Oculus (Multimedia Installation): The display technology, content management and delivery system, and premium content that forms the unique, fully functioning, architecturally integrated digital art installation within the ICP.

2.   AV Design Team: The engineering consultants engaged to provide the initial design for the multimedia audio visual system and related display technology components, including content delivery and management connections to the HAS network, and any additional network, electrical, telecommunications, structural, and integration work not provided by ITRP for a fully functioning multimedia installation.

3.   CMS: The Content Management System, including video playback servers, generative content servers, video routing and processing equipment, audio processing equipment, signal distribution and control systems, user interfaces, data storage, and other equipment for the purpose of storing, accessing, processing, routing, distributing, and delivering media to the LED display technology.

4.   CMS Contractor: The contractor performing multimedia audio, video, control, IT, and all related equipment installation, programming, and related work for a complete and integrated CMS.

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5. CPC: The contractor engaged to produce the creative content to be displayed on the Oculus.

6. HAS IT: Houston Airport System Information Technology Department.

7. Houston Airport Technology Specifications: Standard HAS specifications that are considered a part of the Oculus Contract Documents and a responsibility of the Contractor.

   a. Reference documents can be obtained online: https://www.fly2houston.com/biz/resources/building-standards-and-permits#standars

8. Houston Airports Design Standards, including The Houston Airport System Design Criteria Manual (HAS Design Manual) and the Houston Airport System Designs Standards Manual (ITRP Design Manual): General building standards that are considered a part of the Oculus Contract Documents and a responsibility of the Contractor.

   a. Reference documents can be obtained online: https://www.fly2houston.com/biz/resources/building-standards-and-permits#standars

9. ITRP Contractor: The contractors engaged to build the International Central Processor as part of the terminal redevelopment project.

10. LED Display System Provider: The LED manufacturer contracted to deliver the Oculus display technology, from the LED tiles to the LED processors, including all cabling, conduit, power supplies, and image processors required for a fully functioning display.

11. LED Display Technology: The multimedia installation display, a uniquely shaped architecturally integrated media feature called the Oculus, including all direct view LED tiles, cabling, infrastructure, processing equipment, fiber optic patch panels, fiber optic converters, patch cords, and related appurtenances for a functioning display.

12. Owner's Authorized Representative (OAR): The person or group engaged to coordinate, manage, and act as executive producer of the Oculus project from design through operational system. HAS, as the owner and entity responsible for the operations of the Oculus, gives final approvals on any design and installation work reviewed and accepted by the OAR.

1.4 SCOPE OF WORK

A. Refer to Houston Airport Technology Specifications, Houston Airports Design Standards, and Contract Documents in addition to the following:

B. Refer to Appendix B – Responsibility Matrix for the work responsibility matrix for the scope of work required for the CMS work.

C. Where listed on the responsibility matrix and described herein, the following line components shall be provided by the CMS Contractor as described in this specification section unless otherwise noted, and be defined as:

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1. Headend and Software: CMS Contractor shall furnish and install the CMS equipment, software, licenses, cabinets, cabinet cabling, converters, and components as required by the Contract Documents, except for any equipment specifically noted as furnished by HAS. In such cases, HAS-furnished equipment included in the CMS design shall be installed and integrated by the CMS Contractor.
2. Integration to Existing Systems: HAS will be responsible for all integrations with existing systems. Unless specified in the agreement otherwise.
3. Interfaces: CMS Contractor shall furnish and install all system interfaces including, but not limited to, hardware, software, wiring, and interface devices, as required to communicate with other systems. These other systems include but are not limited to Fire Alarm Systems (FAS). Exact interface to be confirmed with HAS at the start of the Project.
4. Network: The HAS-specified CMS network equipment shall be furnished and installed by the CMS Contractor and configured by HAS. Coordinate all installation activities and details with the Houston Airport Systems' Information Technology (HAS IT) Representative. The HAS IT Representative shall be responsible for the final configuration of all network equipment supplied as part of this specification. CMS Contractor shall ensure that the proper documentation is provided to assist in the final system configuration.

    a. CMS Contractor is responsible for and shall coordinate with HAS IT, AV Design Team, and/or the OAR for all network requirements for data and communications prior to construction.
    b. Unless otherwise specified, furnish products manufactured by Cisco Systems. Substitutions for specified Cisco Systems components are NOT permitted.

5. Backbone Cable: CMS Contractor shall furnish and install all low voltage cable and wiring within the IDF rooms containing CMS components.
6. Horizontal Cable: HAS shall furnish and install low voltage pathways from designated IDFs to the vicinity of the Oculus display technology. The LED DSP shall furnish and install the remaining cabling and pathways required to connect the HAS provided horizontal pathway to the required field enclosures. CMS Contractor shall furnish and install all low voltage cable and wiring to any field mounted interaction or monitoring devices. CMS Contractor shall furnish and install all horizontal cable runs at the equipment and within the associate communications rooms.
7. Field Devices: The LED DSP shall furnish and install all field devices required for an operational display technology including, but not limited to, fiber converters, patch panels, patch cables, field enclosures, mounting brackets, and power supplies as required. CMS Contractor shall furnish and install any interaction or monitoring devices.
8. Cabinets: CMS Contractor shall furnish and install CMS equipment cabinets in the designated IDF.

D. CMS Contractor shall possess applicable experience and qualifications which show competency in engineering and installing large, complex video processing and

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delivery systems, and shall have proven successful performance of installations of similar size and sophistication.

E.   CMS Contractor shall provide the Work in compliance with all codes, standards, and regulations as required by HAS and ITRP, and be responsible for obtaining all permits for a complete and working installation.

F.   The CMS shall include all system components as required to meet all functional, operational, performance, and redundancy requirements necessary to deliver a fully integrated and operational system in accordance with Specifications and Contract Documents, including but not limited to the hardware, software, and other appurtenances specifically identified in the Contract Documents. Refer to the Contract Documents for further details.

G.   The Work also includes requirements for submittals, quality assurance, product handling and storage, project documents, project conditions, installation, system performance, demonstrations, testing, and certifications for work related to the CMS. Refer to additional requirements specified under related trades including the provisions of all related specification sections.

H.   CMS Contractor shall provide Project Management services to coordinate team members and communicate with HAS and their chosen contractors.

I.   CMS Contractor is responsible for providing Quality Assurance to ensure that the installed system meets or exceeds every standard set forth in these specifications and the Contract Documents.

J.   CMS Contractor shall be responsible for meeting the design intent through engineering, shop drawings, installation, programming, and commissioning of all elements of the CMS as described herein and in the related Contract Documents. It is the responsibility of the CMS Contractor to ensure that the installed system meets or exceeds the expected performance, specification, feature set, and functionality set forth in the design.

K.   The CMS and related work described in this section is integral to the ongoing parallel work procured for the successful implementation of the Oculus. The CMS Contractor shall coordinate work across all disciplines and trades to provide a seamless and complete integration as described in the Contract Documents.

1.5   REFERENCES

A.   Refer to Houston Airport Technology Specifications, Houston Airports Design Standards, and Contract Documents in addition to the following:

B.   If conflicts exist between referenced requirements, the CMS Contractor shall bring those to the immediate attention of HAS and the OAR prior to work. Where conflicts exist, comply with requirements in the following order: 1) Requirements contained within this section, 2) Specifications and 3) Contract Documents.

   1.   Where the Contract Documents mandate a greater requirement or performance than those specified by the referenced codes and standards, the greater requirement shall be the governing design application.

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C.   The Contract Documents include this Specification Section in addition to the following.

1.   Houston Airport Technology Specifications
2.   Houston Airport System Building Standards
3.   Oculus Content Management System Request for Proposal
4.   Oculus Content Management System Request for Proposal Attachment A – Content Management System Contractor Scope of Services
5.   Oculus Content Management System Request for Proposal Attachment E – Oculus Design Documents
6.   Oculus Content Management System Request for Proposal Attachment F – LED Display Technology Maintenance and Warranty

D.   Industry Practice standards are the minimum installation requirements for this system.

1.6   CONTRACTOR'S DUTIES

A.   Refer to Houston Airport Technology Specifications, Houston Airports Design Standards, and Contract Documents in addition to the following:

B.   Coordinate with the AV Design Team for a technical review of the design. The CMS has been designed as an initial plan with coordinated performance specifications, compatibility of equipment and content, and available technology. The CMS Contractor is expected to review the design and add, substitute, or eliminate any devices in the design as required for an optimal system after the selection of the LED DSP. Changes to the design shall be reviewed and approved by the AV Design Team and HAS prior to the creation of shop drawings.

1.   During the design technical review period, the CMS Contractor will verify that the chosen equipment represents the best value and offers optimal functionality and will present alternatives where appropriate. The CMS Contractor will incorporate any changes or updates to the design for approval prior to preparing engineering shop drawings.

C.   Coordinate location of power and data requirements, including any monitoring equipment, audio equipment, and interactive sensors, where applicable, with the LED DSP.

D.   Coordinate with CPC, LED DSP, AV Design Team, and HAS for the positioning, installation, and commissioning of any additional multimedia technologies, including but not limited to cameras, sensors, speakers, and ancillary components.

E.   Coordinate with CPC, LED DSP, AV Design Team, and HAS for the programming of ambient light monitoring equipment.

F.   Coordinate with LED DSP and AV Design Team for Oculus multimedia mock-ups. Refer to the Contract Documents for details on support requirements for LED display technology mock-ups.

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G.   Coordinate with LED DSP and CPC for any required interfaces between the LED Display Technology and the systems architecture design to support seamless delivery of high-resolution content to the Oculus.

H.   Coordinate with LED DSP and AV Design Team for playback specifications, video processing parameters, and LED processor configuration. Involve the CPC as necessary to ensure synchronized playback of high-resolution content across multiple outputs.

I.   Coordinate and pull all required permits in line with the appropriate HAS and ITRP codes and standards.

J.   Coordinate with LED DSP for rack-mounting and cabling of LED processors in ICP IDFs.

K.   Coordinate with HAS, LED DSP, and AV Design Team for the positioning, installation, and commissioning of any interactive components and sensors.

L.   Coordinate schedule for startup of systems with HAS Marketing, LED DSP, AV Design Team, and CPC to ensure proper sequencing.

M.   Coordinate with HAS IT, LED DSP, and AV Design Team for the placement of performance monitoring CCTV cameras to be added by HAS to the existing CCTV system.

N.   Coordinate with AV Design Team, CPC, and LED DSP for Performance Verification Testing and Commissioning.

O.   Coordinate final documentation with CPC, AV Design Team, and LED DSP to ensure consistency and coherence.

1.7   SUBMITTALS

A.   Refer to Houston Airport Technology Specifications, Houston Airports Design Standards, and Contract Documents in addition to the following:

B.   Qualifications. Submit qualifications including but not limited to:

1.   Compliance with requirements of Paragraph 1.9.C.
2.   Evidence of technical experience and capabilities in the following areas:

   a.   Large scale, public facing, architecturally integrated media features utilizing direct view LED multimedia systems
   b.   Integration and configuration of video wall display technology for use with 4K or greater quality content
   c.   Frame accurate, synchronized, multi-channel display systems
   d.   Control system integration, including media playback systems, show control, and other custom applications
   e.   Capability to provide construction level designs for projects with complex systems integration components including:

      1)   Providing complete equipment specifications that include design criteria for power and heat loads, mounting details, and signal distribution

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> 2) Coordination with engineers of record
> 3) Coordination with Owner and Owner's Authorized Representative to bid for and procure equipment
> 4) Integration, testing, and commissioning of systems of similar complexity as described above

> 3. A technical resume of experience for the Project Manager and, if different, the On-Site Installation Foreman who will be assigned to this project.

C. All project submittal documents as outlined in the Contract Documents, coordinated with HAS, LED DSP, CPC, and AV Design Team as required, including but not limited to:

1. Shop Drawings.
2. Equipment Submittals.
3. Quality Assurance Plan.
4. Security Plan.
5. Installation Plan.
6. Commissioning Plan.
7. Integration Plan.
8. Testing Plan.
9. As-built documentation.
10. Training Plan.
11. Warranty Plan.
12. Maintenance Plan.

1.8 QUALITY ASSURANCE

A. Refer to Houston Airport Technology Specifications, Houston Airports Design Standards, and Contract Documents in addition to the following:

B. The Contract Documents reflect the design intent of a working system. CMS Contractor shall reflect final engineering in shop drawings indicating construction and fabrication details, signal diagrams indicating cable types and protocols, as well as coordination with Engineers of Record.

C. CMS Contractor shall deliver quality assurance for the overall system in alignment with the approved quality assurance plan submitted as part of this Project.

D. Equipment and materials: The Contractor shall provide standard products, when possible, where there is routine manufacture of each of the required equipment types and shall be the manufacturer's latest standard design.

E. Provided products shall meet the following requirements:

1. Electrically powered equipment shall be UL approved.
2. Items of the same classification shall be identical. This requirement includes equipment, modules, assemblies, parts, and components.

F. All hardware, software, firmware, and/or operating system requirements given are the minimum requirements. The Contractor's product shall meet or exceed these requirements. The product selected shall meet the operational, functional, and

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performance requirements specified herein. Additionally, due to the rapid advancement and antiquation of technology related products, the supplied product shall be the "contemporary technical equivalent" of that specified. "Contemporary technical equivalent" shall be based on a comparison of technology at the time of publication of specification to the technology at the time of the first product submittal. Final product approval is at the sole discretion of HAS.

G.   Any necessary structural work shall require final structural calculations to be validated by a structural engineer licensed in the State of Texas and will be based on shop drawing construction and fabrication details.

H.   Contractor Qualifications:

1.   CMS Contractor shall possess a minimum of seven (7) years of experience designing, integrating, and commissioning multimedia AV systems of similar size and scope.
2.   CMS Contractor shall be proficient in and have experience delivering extensive electronic project documentation including as-built drawings, standard operating procedures, troubleshooting strategies, training materials, and operation and technical equipment manuals.
3.   CMS Contractor shall possess experience performing project management and coordination duties on new construction projects with a multidisciplinary team for a minimum of five (5) years.
4.   Contractor shall provide three (3) references for projects of approved equivalent scope, type, and complexity of work completed within the last five (5) years.
5.   CMS Contractor shall demonstrate record of financial stability and business operation for ten (10) years and ability to meet the insurance and bonding requirements.
6.   CMS Contractor shall be capable of providing warranty and support services and provide preventive maintenance services at appropriate and regularly scheduled intervals and as noted in the Contract Documents.

1.9   DELIVERY, STORAGE AND HANDLING

A.   Refer to Houston Airport Technology Specifications, Houston Airports Design Standards, and Contract Documents in addition to the following:

1.   CMS Contractor shall store all equipment and materials in a climate-controlled environment. Storage environment shall, at a minimum, comply with the following:
2.   Temperature not to exceed: -20˚ C to +70˚ C (-4˚ F to + 158˚ F)
3.   Relative humidity of 5% to 95%, non-condensing.
4.   Where manufacturer's storage requirements are more restrictive than those listed above, store such equipment and/or materials in compliance with all manufacturer's requirements.
5.   Store products within the Contractor's staging area and with seals and labels intact and legible. Store sensitive products in weather-tight enclosures.
6.   Do not store equipment or materials in areas where fire or explosion hazards exist because of flammable gases or vapors, flammable liquids, combustible

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dust, or ignitable fibers. Do not store equipment or materials in areas subject to corrosive agents, liquids, or gasses.

7. Do not store equipment or materials in areas that contain potential water hazards (including, but not limited to, restrooms, kitchens, or mechanical spaces), or adjacent to liquid-carrying pipes.

B. CMS Contactor shall store materials only in areas designated by HAS.

C. CMS Contractor shall coordinate and carry out product delivery and relocation to final installation locations with HAS within both on- and off-hour periods as required to minimize impact to Airport operations.

D. CMS Contractor shall be responsible for product shipment, delivery, and storage/staging/testing locations onsite for the finalized list of CMS equipment based on approved shop drawings. The CMS Contractor shall coordinate with HAS regarding site readiness and refer to architectural drawings regarding placement.

E. CMS Contractor shall provide a security plan for approval by HAS describing the methods, areas, and access for equipment. The plan shall include how equipment will be securely stored and accessed by the CMS Contractor, HAS, and other contractors, if necessary, within IDFs and similar spaces throughout construction.

F. The Contractor shall be responsible for all loss or damage in the shipment and delivery of all material until sign off and transfer to HAS.

1.10 RECORD DOCUMENTS

A. In addition to all general provisions of the Contract, including but not limited to all General and Supplementary Conditions and ITRP Specifications, the following requirements apply:

B. Refer to Houston Airport Technology Specifications, Houston Airports Design Standards, and Contract Documents for requirements.

1.11 MAINTENANCE AND SUPPORT

A. Refer to Houston Airport Technology Specifications, Houston Airports Design Standards, and Contract Documents in addition to the following:

B. Provide a complete set of operating and maintenance manuals in accordance with all related specification sections and Contract Documents. The manuals shall include all operational programming and maintenance information for the system being provided. Edit all manuals specific to the installation of the provided system; manufacturer's documentation alone shall not be acceptable. Include all manufacturer's technical data sheets, programming matrixes, and graphic screen representations.

C. Operations and Maintenance (O&M) Manuals shall include:

1. Record of test data results for all copper, metallic, and fiber optic cables installed and tested, or existing cables tested.

   a. Test data shall be formatted according to HAS Standards.

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           b.   Test results shall be submitted in electronic format. Acceptable forms include thumb drives and cloud file transfers - to be coordinated with HAS at time of delivery.

2. Data sheets showing all field labeling used for termination blocks, and cable (outside plant, backbone, riser and horizontal) runs.
3. Cable Data for all backbone (riser) and horizontal fiber and copper indicating type and use of cable installed by Contractor and to include:

        a.   Manufacturer's specification sheet.
        b.   Manufacturers performance and warranty sheet.
        c.   Date manufactured.
        d.   Part number.
        e.   Serial number.
        f.   Reel number.
        g.   Description.
        h.   Attenuation specifications.
        i.   Bandwidth specifications.

4. Complete equipment rack/cabinet layouts showing locations of all rack mounted patch panels, and equipment items.
5. Test data results for all other tests performed as part of this project.

1.12 SOFTWARE AGREEMENT

A. Refer to Houston Airport Technology Specifications, Houston Airports Design Standards, and Contract Documents in addition to the following:

B. HAS shall retain the ownership and access rights of the source code for all custom system programs and software specifically developed and/or modified as part of this project. Additionally, HAS shall retain ownership of all software licenses for "off the shelf" software furnished and installed as part of this project.

C. CMS Contractor shall provide HAS complete copies of all current software programming and software licenses related to the operation of each system prior to final acceptance of the related Contract Scope of Work.

1. Required software licenses shall be identified and supplied by the Contractor. Licenses shall be "Site Licenses" which shall cover all equipment installed now or in the future.
2. All software licenses and warranties shall be registered in the name of Houston Airport System.
3. CMS Contractor shall provide all system programming as part of closeout documentation for review by HAS.

D. Software and firmware upgrade provisions shall be included as part of this specification requirement and shall include the automatic upgrades as required to maintain all software and firmware to the manufacturers most current revision on all system components installed and or modified as part of this project for duration of the warranty period. This upgrade policy shall require the CMS Contractor to install, test, and certify all software and firmware upgrades that become available from the

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manufacturer for a period of three (3) years from date of final acceptance to the expiration of the warranty.

1. Upgrading of software shall include all revised/new software, labor, testing certification as well as all licenses, software and all programming copies as described in the Contract Documents associated with the installation of all revised software.

2. These updates shall be accomplished in a timely manner, fully coordinated with the system operators, and incorporated into the operations/maintenance and software documentation manuals.

   a. One (1) scheduled final update shall be provided near the end of the warranty period, at which time the CMS Contractor shall install and validate the latest released version of the manufacturer's software and firmware for all systems installed and/or modified for this project.

   b. All software changes shall be recorded in accordance with HAS requirements, to be coordinated with HAS IT.

   c. The system shall include anti-virus software in accordance with HAS requirements.

E. Coordinate with HAS for scheduling and access to the system and to allow HAS to upgrade computer equipment if necessary.

F. Operating System Updates and Security Patches

1. The Contractor shall perform operating system updates and security patches to all CMS related servers, workstations, and any networking devices maintained by CMS Contractor, as required for the system to function at peak performance. CMS Contractor shall follow ITIL best practices. Updates may be performed remotely.

2. Any changes to a live system require an official Change Request. Coordinate submission of Change Requests for updates to the Operating System with HAS and HAS IT.

1.13 SPARE MATERIAL

A. Refer to Houston Airport Technology Specifications, Houston Airports Design Standards, and Contract Documents in addition to the following:

B. All extra material to be appropriately labeled, packaged, and documented in compliance with HAS requirements.

C. The Contractor shall provide, at the outset of the onsite testing, a store of consumables and spare parts as required. Those consumables and spare parts shall be available to the Contractor for use during the equipment demonstration test, warranty periods, and extended support period in order to maintain system response time criteria.

D. The Contractor shall replenish the store as it is used, so that at the end of the test and warranty periods, the store shall be equal to that initially provided. Based upon the maintenance experience of the warranty period, the Contractor shall recommend, at the end of the warranty period, any changes in spare component

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and small part stores that may prove to be appropriate. The Contractor shall maintain the spare component store during any extended support period.

1.14 ENVIRONMENTAL CONDITIONS

A.   Refer to Houston Airport Technology Specifications, Houston Airports Design Standards, and Contract Documents in addition to the following:

B.   Systems, components, devices materials, and equipment shall be capable of withstanding the environmental conditions of the space without mechanical or electrical damage or degradation of operating capabilities or performance.

1.15 SYSTEMS WARRANTY

A.   Refer to Houston Airport Technology Specifications, Houston Airports Design Standards, and Contract Documents in addition to the following:

B.   Hardware warranty replacement and repair shall be considered inclusive of all labor, materials, shipping, rentals, and hardware necessary to service the defective equipment and return the system back to fully operational status. All hardware shall have a minimum warranty of three (3) years and shall allow for replacement or repair of failed items at the discretion of HAS.

1.16 EXTENDED WARRANTY

A.   Refer to Houston Airport Technology Specifications, Houston Airports Design Standards, and Contract Documents for requirements.

1.17 PROCUREMENT

A.   Refer to Houston Airport Technology Specifications, Houston Airports Design Standards, and Contract Documents in addition to the following:

B.   Procure equipment specified to ensure that the technology is acquired in a timely fashion, but not outdated, by the installation date.

C.   Submit a copy of Appendix A "Technology Implementation Schedule" as a part of the equipment submittals required. The Contractor shall complete the columns headed "Quantity", "Procurement Lead Time", "Start Date or Dependent", and "Installation Duration".

D.   The "Procurement Lead Time" shall be expressed in days or weeks and shall include time required for the contractor's personnel to order and receive the material. Substantiation may be required.

E.   "Start Date or Dependent" and "Installation Duration" should be an accurate estimate based upon known facts in the project. Substantiation may be required.

F.   The Contractor shall not purchase any materials requiring submittals until HAS approves the submittal and the Technology Implementation Schedule.

G.   The Contractor shall not purchase any materials requiring submittals until the date established by HAS as the Purchasing Authorized Date. The Purchasing Authorized Date will be reflected in the "Purch Auth" column of Appendix A to this Specification Section as a part of the Submittal Review process.

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PART 2 - PRODUCTS

2.1   MANUFACTURED PRODUCTS

   A.   Refer to Houston Airport Technology Specifications, the Houston Airports Design Standards, and Contract Documents in addition to the following:

   B.   Equipment and materials supplied shall be a standard product of manufacturers regularly engaged in the manufacture and installation of such items and shall be the manufacturer's latest standard design. Items of the same classification shall be identical. This requirement includes equipment, modules, assemblies, parts, and components. Electrically powered equipment shall be UL approved. Electronic equipment shall meet the requirements of CFR 47 Part 15.

   C.   Replacement parts shall be readily available to operations and HAS. The equipment specified is based on the acceptable manufacturers listed. Where "or equal" is stated, equipment shall be equivalent in every way to that of the equipment specified, and subject to approval.

      1.   Acceptable manufacturers for each system shall be as specified and shall be provided in full compliance with the requirements of this and all related Specification Sections and Contract Documents.

         a.   Manufacturers listed as acceptable shall not negate the contractors' responsibility for providing all equipment, devices, components, and/or systems, in accordance with all functions and performance requirements of the Contract Documents.
         b.   Where manufacturer and/or manufacturer model numbers reference specific system components, it is to establish the performance requirements and quality of the systems and components only.

            1)   It is in no way an inference that the referenced model numbers are the manufacturer's current product and are the only acceptable components for this project unless specifically referenced as "no substitutions."

      2.   Due to the rapid advancement and antiquation of hardware technology, the supplied hardware shall be the "contemporary technical and operational equivalent" of the specified hardware. The following requirements shall be met:

         a.   Contemporary technical and operational equivalent shall be based on a comparison of technology at the time of publication to the technology at the time of ordering the equipment.
         b.   Hardware shall be ordered as close to the actual installation date for a given phase as reasonable (i.e., latest responsible date). Final hardware approval and scheduled order date are at the sole discretion of HAS.
         c.   Hardware equivalence shall be based on both technical equivalence and operational equivalence.
         d.   Contemporary technical equivalence shall be based on device performance and class specifications.

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        e.   Contemporary operational equivalence shall be based on industry standards, maintainability, and functions.

   3.   The manufacturer's product or product line/series shall have been in satisfactory operation, on three (3) installations of similar size and type as the Oculus, for approximately three (3) years. HAS and the AV Design Team reserve the right to require the Contractor to submit a list of installations where the products have been in operation for the specified period prior to approval of shop drawings.

        a.   The manufacturers shall submit the appropriate documentation certifying that the installing personnel or subcontractor is a qualified service provider of all manufacturers' products being provided for this project.

        b.   The manufacturer shall certify that the submitted product will continue to be fully supported for a minimum of five (5) years after acceptance by HAS.

  D.   Equipment Manufacturers:

   1.   Content Management System (CMS)

        a.   ISAAC
        b.   Or Equal.

   2.   Media Servers

        a.   Pixera
        b.   7thSense
        c.   Disguise
        d.   Realmotion
        e.   Or Equal.

   3.   Support Equipment

        a.   Evertz
        b.   Rayloy
        c.   Raritan
        d.   Tektronix
        e.   Or Equal.

  E.   Equipment Assemblies and Components:

   1.   Components of an assembled unit need not be products of the same manufacturer.

        a.   Manufacturers of equipment assemblies, which include components made by others, shall assume complete responsibility for the final assembled unit.
        b.   Components shall be compatible with each other and with the total assembly for the intended service.
        c.   Constituent parts which are similar shall be the product of a single manufacturer.

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d.   Factory wiring shall be identified on the equipment being furnished and on all wiring diagrams.

F.   Compatibility and Interoperability of System Components and Devices

1.   Where multiple components, devices, and/or systems are intended to be interconnected and components of a complete system in accordance with any related specification sections, it shall be the Contractor's responsibility to verify interoperability and compatibility of said components, devices, and/or systems in full conformance to the specified performance criteria prior to the submission of shop drawings.

2.   Where specified devices are found to be incompatible or incapable of performing as specified in a seamless manner, the contractor shall notify HAS and the AV Design Team in writing prior to submission of shop drawings. Failure to properly identify such functional discrepancies shall not relieve the contractor from providing a complete and fully functional system in accordance with the requirements of all related specification sections.

G.   The CMS has been designed with attention to performance specifications, compatibility of equipment, and available technology. CMS Contractor shall review any additions, replacements, substitutions, alterations, or eliminations of any devices specified in the design with the LED DSP and AV Design Team.

2.2   GENERAL SYSTEM AND PERFORMANCE REQUIREMENTS

A.   Refer to Houston Airport Technology Specifications, Houston Airports Design Standards, and Contract Documents in addition to the following:

B.   The system shall provide high quality input, transport, processing, distribution, and output for all video applications. Signals shall be free of noise, distortion, pixilation, or other artifacts at all times during equipment operation. When the equipment is in standby mode with inputs off, the same requirements apply.

1.   Video signal distribution shall be seamless, reliable, and synchronized.

C.   The system shall support the seamless transport of native 4K video signals from source to output. The system transport and processing capabilities of 4K shall include a minimum resolution of 4096 x 2160 at 60Hz. Chroma subsampling capabilities should be 4:2:2 with 10-bit color depth.

1.   Support of full 4:4:4 chroma subsampling is preferred. Provide optional support for 4:4:4 chroma subsampling throughout the CMS and to the inputs of the LED display technology.

2.   The system shall have the capability to support high dynamic range (HDR) of HDR10 or similar.

3.   The system shall support a color gamut of 100% NTSC or better.

4.   The system shall display high resolution content without delay, flicker, or distortion.

D.   Display hardware for the project, furnished and installed by the LED DSP Contractor, shall include direct view LED (dvLED) technology, possibly of differing

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pixel pitches, including structural attachments designed and approved by a licensed structural engineer with the State of Texas.

E.   Control equipment shall be user-friendly so that a trained operator can program audio/video, select sources, select outputs, schedule playback, mute audio, and adjust audio signal levels.

F.   Coordinate component features to form an integrated system and ensure compatibility. Match components and interconnections for optimum performance of specified functions.

G.   Content:

1.   Oculus creative content will be produced by the Content Production Company (CPC) and delivered to the CMS Contractor for implementation on the content management and distribution system.

2.   The CMS Contractor shall be responsible for all necessary programming of the CMS to play the creative content.

3.   The CMS Contractor shall be responsible for programming modifications based on information received from ambient light sensors provided by the LED DSP.

4.   The CMS Contractor shall be responsible for coordinating with the Owner, OAR, and AV Design Team to develop all necessary components of the CMS programming and scheduling.

5.   All content shall be considered pre-rendered. Options for real-time interactive and/or generated content may be considered during initial creative content programming efforts being undertaken by the CPC.

6.   Duration / Storage:

a.   Content shall be stored locally on the media servers for the current day of operation. Additional content not in active rotation can be stored on the CMS storage array.

b.   The CMS storage array shall be capable of storing backup copies of all active content. Inactive content not in a playlist rotation may be stored elsewhere and transferred to CMS storage when needed. The CMS storage shall be capable of pushing content to the media servers for scheduling or backup recovery reasons.

c.   Refer to following Sections 2.3 and 2.4 for the storage requirements for the CMS storage array and the individual media servers.

H.   Management

1.   All devices connected to the network shall have SNMP management capability.

2.   System failures shall be viewable at a central control point (i.e., the system administrator's workstation). A failure shall initiate an alarm and add a failure record to the failure database table. Additionally, the system administrator shall receive a warning message on the system administrator workstation, notifying them of the failure. The system shall also provide text and e-mail

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      notification to the designated HAS staff members. Server failure shall include any hardware or software-based failure.

    3.   Network devices shall be configured as required in Specification Section 272100.

I.   System Failure Definitions

    1.   Inoperative: A device shall be considered inoperative when the device does not perform its intended function(s) within defined performance criteria. Response services shall include inspections and necessary tests to determine the causes of equipment or software malfunction or failure. The failure services shall include the furnishing and installation of components, parts, or software changes required to replace malfunctioning system elements.

    2.   Operational Failure: Defined as a user interface end device that is inoperative. Operational failure may impact the ability of the end user to modify operations of the Oculus but does not cause any direct failure of the Oculus to display content.

    3.   Critical Failure: Defined as a redundant head end component that is inoperative or when a system failure results in a distorted or otherwise degraded image, including outputs being out of sync by less than two (2) frames causing image tear or perceptible noise. A Critical Failure does not impact the remainder of the Oculus to display content and operate normally. Additionally, the fourth and subsequent occurrence of an operational failure with the same root cause shall be deemed a critical failure.

    4.   Emergency Failure: Defined as a head end failure that results in the Oculus display being partially or fully inoperative or unresponsive, including when the outputs are out of sync by two (2) or more frames. Additionally, the fourth and subsequent occurrence of a critical failure with the same root cause shall be deemed an emergency failure. A formal report shall be submitted to HAS on the cause and resolution of the problem. Resolution shall not be considered formally complete until written approval is provided by HAS.

J.   Downtime

    1.   Acceptable downtime includes

        a.   Software updates
        b.   Routine maintenance
        c.   Operational programming
        d.   Conscious failover during an airport emergency
        e.   Media preparation transfer of media to alternate server

K.   Redundancy

    1.   Playback

        a.   The video/media servers are integral to the functioning of the Oculus CMS and therefore shall support active/active redundancy, defined as having a secondary active server for every primary server with duplicated configuration to act in place of the faulty component without

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affecting the scheduled media playback, except during acceptable downtime.

1) Baseline Media Server Redundancy: The CMS and related LED display technology shall be capable of supporting active/active redundant media servers but only utilize primary units on day one.

2) Optional Media Server Redundancy: The optional media server redundancy shall include the full implementation of primary and secondary active/active operational servers for all required units on day one.

2. Control Engine / Content Management System Software

a. The control engine shall provide operational resiliency for continued availability of CMS during planned and unplanned downtime.

b. Provide physical and virtual server redundancy operating in an active/active architecture.

1) Physical redundancy shall be considered two physical enterprise-grade servers operating in as active/active primary and secondary platforms.

2) Virtual redundancy shall be considered a virtual machine cluster across both physical servers with multiple virtual server instances running simultaneously. In the event of a failure of the primary virtual machine the secondary virtual machine shall immediately take over.

3. Data Storage

a. The CMS storage array shall have active/active redundant controllers and the disk array shall minimally support RAID 5 for all data storage.

b. Media server onboard storage shall utilize SSD drives for increased speed and fault tolerance. The media servers shall rely on the CMS storage array for maintaining backup copies of the content in the event of a drive failure or file corruption.

4. Network

a. All critical network-connected equipment, including media server(s), data storage, CMS servers, and video synchronization equipment, shall have dual/redundant network connections.

b. All network-connected equipment shall have 2x1Gb connections to the admin/control network.

c. Equipment connected to the 10G content media network equipment shall have 2x10Gb connections to the content network in addition to 2x1Gb connections to the admin/control network.

d. The CMS network shall implement redundancy as required by HAS for network design, as outlined in Specification Section 272100.

5. Power

(These Guidelines are basic minimum criteria to be met in preparing the final specification for this section, which is the responsibility of the Designer/Contractor/Installation team.)

        a.   All critical equipment, including media server(s), data storage, CMS servers, network switches, KVM, and video synchronization equipment shall have redundant dual power suppliers.

        b.   System servers, media servers, and network switches shall have hot swappable power supplies.

L.   System Availability

    1.   The CMS shall be available and operating as specified while passengers are in the terminal area during opening hours.

        a.   Opening Hours

            1)   24 hours a day
            2)   Approved downtime may be scheduled between the hours of 11pm and 4am with prior approval from HAS and coordinated with Airport operations.

    2.   Availability of the CMS shall be at least 99.97% (not more than 1577 minutes per year of downtime).

M.   Network:

    1.   The HAS-specified CMS network equipment shall be furnished and installed by the CMS Contractor and configured by HAS. Coordinate all installation activities and details with the Houston Airport Systems' Information Technology (HAS IT) Representative. The HAS IT Representative shall be responsible for the final configuration of all equipment supplied as part of this specification.

    2.   The CMS Contractor shall be responsible for providing an Admin/Control and Content Network sized properly to support the proposed CMS and LED display technology network requirements. The requirements noted below and in other Contract Documents are considered preliminary and shall be updated as needed based on the proposed network architecture and requirements.

    3.   1Gb Admin/Control Network

        a.   Provide a minimum of two (2) redundant Cisco C9300-24U-E with C9300-NM-4G network module per HAS specification 272100. Provide all required licensing and maintenance.

        b.   Include all necessary SFPs for downlinks and uplinks. Provide for a minimum of two (2) 1Gb uplinks per switch. Provide SFP for both sides of the uplink and downlinks. Coordinate uplink requirements with HAS IT.

        c.   Coordinate with LED Display System Provider regarding network connectivity to LED display technology networked equipment.

    4.   10Gb Content Network

        a.   Provide minimum of one (1) Cisco C9300X-12Y with C9300X-NM-8M network module. Provide all required licensing and maintenance per HAS specification 272100.

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        b.   Include all necessary SFPs for downlinks and uplinks. Provide for a minimum of two (2) 10Gb uplinks per switch. Provide SFP for both sides of the uplink and downlinks. Coordinate uplink requirements with HAS IT.

N.   Power:

    1.   All CMS equipment shall have universal power supplies with full range 120V-240V AC. Where required due to redundancy requirements, equipment shall have hot-swappable redundant power supplies.

    2.   The CMS Contractor shall be responsible for providing power to the Oculus equipment cabinets. This includes extending branch circuits from the local panel to the cabinets and providing dual power distribution units (PDU) per cabinet. Refer to the Contract Documents for further information.

O.   Interfaces:

    1.   Fire / Emergency System: Provide a system interface to the building Fire Alarm System (FAS). The interface shall include an input from the FAS to trigger changes to the Oculus display (blank display, display prearranged emergency messages, etc.)

        a.   FAS interface via addressable relay output will be provided by the ITRP Contractor. CMS Contractor shall be responsible for coordinating input requirements with the ITRP Contractor, wiring from the relay output to the CMS control system, and programming the CMS to respond to events.

P.   The Contractor shall provide all software, licenses, site keys, and other associated costs and/or services for a completely functional system for the duration of the warranty period based on the final installed solution.

Q.   SSAE 18 Compliance

    1.   For as long as Contractor has City data or on behalf of the City, Contractor will maintain an information security program that provides for the security and protection of the City data, including, but not limited to, processes and procedures to respond to security incidents. Contractor will operate in conformance with the physical, technical, operational and administrative measures and protocols regarding data security as set forth in its then current Standards for Attestation Engagements ("SSAE") No. 18 SOC1 Type II Report or SOC2 (or equivalent report), received from its third-party auditors. Contractor will, upon written request, provide City with copies of then-current SSAE No. 18 report issued by its third-party independent auditors in relation to the data security policies and procedures designed to meet the requirements set forth in this Agreement with regard to the services.

2.3   CONTENT MANAGEMENT SYSTEM

A.   General

(These Guidelines are basic minimum criteria to be met in preparing the final specification for this section, which is the responsibility of the Designer/Contractor/Installation team.)

1. The Content Management System (CMS) drives the Oculus Multimedia Installation including system monitoring and management, AV system control, scheduling, and playback of prerendered content, with future expansion for generative content. The CMS shall be an enterprise-level IT based management system capable of managing multiple AV and digital devices and applications.

2. The CMS shall be hosted on a high-availability and fault tolerant server-based platform connected to the HAS network. The location of the CMS server(s) and related storage array shall be coordinated with HAS IT. Space is being allocated for the equipment within the designated Oculus telecommunications equipment cabinets, but alternative locations may be acceptable.

3. The CMS shall provide an intuitive web-based graphical user interface allowing for centralized management and control of the Oculus including but not limited to, content management, scheduling, playback, system administration, logging and reporting, and system maintenance.

4. The CMS shall include a data storage array for storing backup copies of all creative content. The CMS shall be capable of automatically pushing content to the media servers based on schedule requirements or in the event of a corruption of a content file on the media server.

B. Scheduling

1. Include a scheduling sub-system that manages content and playback based on customizable schedules.
2. Manage custom content and assist in the creation and maintenance of schedules and playlists.
3. Allow multiple schedule modes (automatic, override, manual).
4. Include a user interface that allows for intuitive creation, editing, and publishing of schedules or playlists.

   a. User access shall be leveled allowing for individual control over user authorization to create, edit, and publish schedules.
   b. User control shall include an intuitive calendar-based approach to scheduling.

5. Include a default schedule in the event of a failure of the scheduling sub-system.
6. Allow for an emergency response based on external input or manual override.
7. Allow for dynamic / automatic sharing of content between online storage and media players based on upcoming schedule.

C. Storage / File Management

1. The CMS shall include a dedicated storage array for the storage of active content including out-of-rotation content and content backups.
2. The CMS storage array shall be an enterprise-level Storage Array Network (SAN) or Network Array Storage (NAS) device utilizing active/active storage array controllers.
3. CMS storage shall allow for dynamic sharing of content with media servers as needed based on upcoming scheduled playback.

(These Guidelines are basic minimum criteria to be met in preparing the final specification for this section, which is the responsibility of the Designer/Contractor/Installation team.)

4. The CMS storage array shall utilize RAID 5 for data integrity and redundancy.

5. Provide day one capacity for a minimum of 12TB usable storage of online content backup.

6. Storage shall be capable of being expanded to 24TB within the same chassis with the addition of hard drives.

7. Storage shall be capable of being expanded to 48TB with an additional storage array chassis.

8. CMS Contractor shall coordinate with the CPC and LED DSP prior to purchase of the CMS storage array to confirm storage is sufficient to support the planned creative media content and relevant support files.

D. Content Management

1. Content ingestion, storage, and management
2. Upload and manage media content within the CMS
3. Deploy media content to media servers
4. Media composition / Content customization

   a. In addition to management of pre-rendered creative content provided by the CPC, the CMS shall include the user interface and editing modules that provide the ability to compose simple media or customize existing media on an ad hoc basis.

E. System Control

1. The CMS shall include a control sub-system that acts as the centralized control system for the CMS and the entire Oculus display system. The CMS control system shall be capable of directly controlling and monitoring all relevant system devices through various protocols and offer a user interface for consolidated operation of the system.

2. Protocols: Natively support typical control protocols (TCP/IP, Serial, etc.)

   a. Where existing integrations with Oculus system equipment do not exist, the CMS Contractor will be responsible for developing custom integrations. Coordinate with the LED Display System Provider to confirm equipment types and model numbers as well as control and monitoring needs.

3. The CMS control system shall be interfaced with external systems. The CMS Contractor will be responsible for programming/developing these interfaces in coordination with the owner/maintainer of the external system. Refer to Section 2.2 for information on requirements for interfacing with systems external to the Oculus.

4. As per Section 1.12, the owner shall retain ownership of source code or custom programming. All such programming shall be accessible to the owner in an uncompiled manner capable of being edited by the owner or any owner authorized representative.

F. Playback and Routing

(These Guidelines are basic minimum criteria to be met in preparing the final specification for this section, which is the responsibility of the Designer/Contractor/Installation team.)

        1.   Control the playback and routing of pre-generated or real-time content via remote control of the media servers.

        2.   Scheduled playback based on schedule / playlist.

G.   Graphical User Interface (GUI)

        1.   The CMS shall include a web-based GUI capable of performing all key system task, including, but not limited to, the following:

            a.   Web-based Operation: real-time actions to control ongoing operations of the system.

            b.   Scheduling: schedule authoring and management of timeline and playlist.

            c.   Monitoring/Maintenance: status reports on system operation, general status, and user activity. View detailed information on system status and manage system setup.

            d.   Admin: management of user access.

H.   System Administration

        1.   The CMS shall utilize customizable user accounts and access levels to manage individual user authentication and access rights.

        2.   Utilize groups accounts to allow for common access rights.

I.   Logging / Reporting

        1.   The CMS shall monitor and log all Oculus system operations and user activities.

            a.   The CMS shall monitor all CMS system operations in addition to all Oculus equipment interfaced to the CMS.

        2.   System status reporting

            a.   Live and historic reporting of all relevant system conditions

            b.   Alarm Conditions

                 1)   Include external alerts and notifications for critical issues using a rules-based approach.

            c.   Scheduling / Playback reports

            d.   Content Management: playback, deletion, modification of content

            e.   System Access: user access and activity.

J.   Server / Hardware

        1.   The CMS platform shall be deployed on an enterprise-level high-availability platform. The platform shall include both physical and virtual redundancy to provide for operational redundancy and system maintenance without downtime.

            a.   Redundant physical server cluster providing physical hardware redundancy.

(These Guidelines are basic minimum criteria to be met in preparing the final specification for this section, which is the responsibility of the Designer/Contractor/Installation team.)

    b. Virtual cluster platform deployed across the hardware platform providing virtual redundancy with active/active instances of the CMS in constant operation.

    c. In addition to the CMS server cluster, the CMS shall include a separate storage array for content storage. Refer to Section 2.3.C for further information.

    d. Remote access via Microsoft Remote Desktop or similar

  K. Network

    1. The CMS server cluster shall minimally include dual redundant 1Gb links to the Admin/Control network. In addition, provide 10Gb connectivity to the Content network if required per the proposed CMS and storage architecture.

    2. Provide 10Gb connectivity between the CMS storage array and the Content network.

    3. Primary active equipment (network switches, SFP, etc.) to be provided and programmed by HAS IT. CMS Contractor responsible for coordinating system needs with HAS IT and programming network components on any Contractor provided equipment.

2.4 MEDIA SERVERS

  A. Provide dedicated content media servers capable of supporting near-term content storage and seamless playback of media.

  B. Quantity of media players as indicated in the drawings and Contract Documents is preliminary. CMS Contractor, in coordination with the LED Display System Provider and Content Production Company, shall be responsible for providing sufficient media servers as required per the proposed LED display technology and resulting resolution.

  C. Media servers shall be capable of supporting the storage and playback of media meeting the minimum specifications as noted in Section 2.2 and the Contract Documents.

    1. The media servers shall be capable of synchronizing video input, playback, and output at a frame-to-frame level to allow for playback of multiple content video files in a seamless and synchronized manner to the LED display technology.

    2. The media servers shall be capable of supporting custom display canvases including unique resolutions. If necessary to accurately display the creative content, the media servers shall be capable of warping or dewarping content around the unique shape of the Oculus.

  D. Media servers shall support the playback of pre-rendered lossless or uncompressed video content at a minimum of 4K/UHD resolution, 60Hz, 4:2:2 chroma subsampling, 10-bit color, and HDR (HDR10 or similar). Refer to Section 2.2 and the Contract Documents for further information.

(These Guidelines are basic minimum criteria to be met in preparing the final specification for this section, which is the responsibility of the Designer/Contractor/Installation team.)

1. Support of full 4:4:4 chroma subsampling is preferred. Provide optional support for 4:4:4 chroma subsampling throughout the CMS and to the inputs of the LED display technology.
2. Media servers shall include the option for video input capture. At this time, the Oculus media is expected to be video-only, prerendered media.

    a. Options for including audio or motion capture sensors may be considered during coordination efforts between HAS and the CPC.
    b. Options for real-time interactive and/or generated content may be considered during initial creative content programming efforts being undertaken by the CPC. CMS Contractor shall propose media servers that are capable of being upgraded or expanded to support real-time and/or generated content.

E. Additional Requirements:

1. System Requirements:

    a. EDID Management
    b. Multi-layer / multi-timeline playback
    c. Capability of creating a large video canvas by linking several units.
    d. Video timing reference signal (Genlock) input accepting Tri-level Sync or similar.
    e. Server-grade components
    f. Redundant hot-swappable power supplies

2. Network:

    a. Redundant 1Gb network interfaces – RJ45
    b. Redundant 10Gb network interfaces – SFP or RJ45
    c. TCP/IP-based remote control of all functions via CMS control engine.

3. Onboard Storage

    a. Onboard OS and content storage shall utilize solid state drives (SSD) in a RAID 0 configuration capable of supporting the read/write rates required based on the minimum video content specifications.
    b. Provide minimum 8TB onboard storage

        1) Design intent is to support locally on the media servers a minimum of one full operational day of video based on a maximum of 2 hours of unique content plus transitions.
        2) Additional content requirements can be pushed from online CMS storage as needed.
        3) CMS Contractor shall coordinate with the CPC and LED DSP prior to purchase of the media servers to confirm onboard storage is sufficient to support the planned creative media content and relevant support files.

4. Video Output: Minimum of 4K 60Hz (4:2:2) 10bit output via HDMI (2.0) or DP (1.4)

(These Guidelines are basic minimum criteria to be met in preparing the final specification for this section, which is the responsibility of the Designer/Contractor/Installation team.)

  a. Provide option for supporting 4:4:4 chroma subsampling.
  b. Native support for uncompressed or lossless video file format support (NotchLC, HAP Q, etc.)
  c. Alpha channel support

 5. Video Input – Video input capture via optional cards.

  a. HDMI 2.0 or DP 1.4
  b. Minimum 4K capture

2.5 SUPPORT EQUIPMENT

 A. Keyboard-Video-Mouse (KVM) Switch

  1. Provide KVM switch in telecommunication equipment cabinets supporting all workstation and server-based equipment.
  2. CATx or TCP/IP based KVM.
  3. Minimum 2 remote users via Ethernet/IP connection.
  4. Minimum 16 CATx / IP ports for KVM connectivity to local equipment.
  5. Dual / redundant power supplies.
  6. Local video (DVI-D or HDMI) and USB ports to support local pull-out rack mounted KVM drawer.
  7. DVI/HDMI/DisplayPort/USB Computer Interface Modules.

   a. Provide interface modules for all relevant equipment indicated in the equipment racks. CMS Contractor is responsible for connecting all equipment, including equipment being provided by the LED Display System Provider.

 B. Rack mounted KVM drawer

   a. Provide rack mounted KVM drawer in the telecommunication equipment cabinet connected to the KVM switch.
   b. KVM drawer and KVM switch can be a single integrated unit or separate units.
   c. Pull-out drawer fitting within 1 rack unit of cabinet space.
   d. Minimum 17" diagonal 16:9 LED-backlit LCD display.
   e. Minimum resolution 1920x1080.
   f. Keyboard and touchpad.

 C. Master Sync Generator

  1. Provide master sync generator supporting all critical video equipment. Refer to the drawings for further information.

   a. CMS Contractor shall be responsible for providing master video synchronization signals to all equipment necessary to obtain frame to frame synchronization at the dvLED display.

  2. Tri-level analogue video synchronization or similar timing signal coordinated with the sync requirements of the media servers and video processing equipment.
  3. Minimum 3 timetable reference outputs providing independent timed sync.

(These Guidelines are basic minimum criteria to be met in preparing the final specification for this section, which is the responsibility of the Designer/Contractor/Installation team.)

4. Internal crystal oscillator reference with output frequency stability better than 1.0×10^{-8} (or 0.01ppm).
5. Dual / Redundant power supplies.
6. SNTP option to synchronize with NTP server once daily.

PART 3 - EXECUTION

3.1 COORDINATION

A. Refer to Houston Airport Technology Specifications, Houston Airports Design Standards, and Contract Documents in addition to the following:

B. Coordinate with HAS, OAR, CPC, and LED DSP for project schedule.

C. CMS Contractor will examine areas and conditions of components comprising the work and notify HAS, in writing, of those conditions which are, in the CMS Contractor's opinion, potentially detrimental to proper completion of the Work. CMS Contractor shall not proceed with the Work until unsatisfactory conditions have been corrected.

D. The CMS includes configuration provided by HAS in addition to items provided under this Contract. CMS Contractor shall be responsible for overall coordination of the installation of all system components, equipment, and all appurtenances to ensure all activities adhere to the Project Schedule.

1. The CMS shall require extensive software programming and configuration. CMS Contractor shall coordinate with HAS, LED DSP, and CPC to provide sufficient time for such programming to be completed prior to project completion in accordance with the Project Schedule.

3.2 EQUIPMENT PROTECTION

A. Refer to Houston Airport Technology Specifications and Houston Airport System Building Standards.

3.3 WORK PERFORMANCE

A. Refer to Houston Airport Technology Specifications, Houston Airports Design Standards, and Contract Documents in addition to the following:

1. The CMS Contractor shall supply all software and hardware necessary for the system to function and perform as specified.

3.4 EQUIPMENT INSTALLATION

A. System installation shall conform to the requirements of HAS and ITRP Specifications, standards, and local codes. Refer to Houston Airport Technology Specifications, Houston Airports Design Standards, and Contract Documents in addition to the following:

B. General

(These Guidelines are basic minimum criteria to be met in preparing the final specification for this section, which is the responsibility of the Designer/Contractor/Installation team.)

1. Where undefined by codes and standards, the Contractor shall apply a safety factor of at least 2 times the rated load to all fastenings and supports of system components.

2. Grounding shall be installed as necessary to preclude ground loops, noise, and surges from adversely affecting system operation.

3. For equipment mounted in drawers or on slides, provide the interconnecting cables with a service loop of not less than two feet and ensure that the cable is long enough to allow full extension of drawer or slide.

4. CMS Contractor is responsible for conducting Quality Assurance and shall conduct a visual inspection of all installations to verify that the installations are in accordance with HAS's and manufacturer's specifications. Records of the inspections signed and dated by the designated Quality Assurance Inspector shall be provided to HAS. The Director and/or designee shall be notified at least 5 days prior to the inspection by the Contractor of any inspection(s) and the Director and/or designee may elect to participate in any inspection(s).

5. CMS Contractor shall be responsible for the patching of the horizontal cable runs at the equipment and within the associated communications room.

6. All products shall be new, undamaged, and covered by the original manufacturer's warranty and licensed as applicable to meet project intent.

7. CMS Contractor shall furnish and install products in accordance with the manufacturer's recommendations and as illustrated in the approved shop drawings.

8. Should discrepancies be noted regarding quantities in schedules, specifications and/or on Project drawings, the Contractor shall provide the greater number of units.

9. For installations occurring at sites with active operations, all installation work shall be performed in a manner that will minimize disruption to the airlines, HAS, and the travelling public. CMS Contractor shall coordinate with HAS and/or the OAR to schedule any work in public areas during times that minimize impact to operations.

10. Systems, components, devices materials, and equipment shall be capable of withstanding the environmental conditions of the space without mechanical or electrical damage or degradation of operating capabilities or performance.

C. Special Equipment

1. The Contractor shall supply a list of special tools, test equipment, and outside inventory required for this project as part of the maintenance plan. The Contractor may recommend specific items to facilitate long-term support of the system.

D. Hardware Installation

1. The Contractor shall install and inspect all hardware required in this Specification in accordance with the manufacturer's installation instructions. Final placement of hardware is subject to Director and/or designee's approval.

2. End user devices shall be labeled with IP address and device name.

3. The Contractor shall be responsible for any and all loss or damage in the shipment and delivery of all material.

(These Guidelines are basic minimum criteria to be met in preparing the final specification for this section, which is the responsibility of the Designer/Contractor/Installation team.)

    4.   The Contractor shall coordinate installation with HAS, to minimize disruption of existing business functions at HAS.

    5.   The Contractor shall place materials only in those locations that have been previously approved. Any other locations shall be approved, in writing, by HAS.

    6.   The Contractor shall provide all tools and test equipment required to install, verify, and test the installation and to determine that it meets the specifications. The Contractor shall furnish all necessary materials required to implement and to achieve the required work performance.

E.   Software Installation

    1.   Each shall be identified by the generic, off-the-shelf name. The software provided by the Contractor to operate the system shall be delivered in a ready-to-run form, including all necessary utility programs and documentation.

    2.   The system shall use industry standard components. The systems shall not contain any proprietary interfaces or components. The system shall use industry standard application development software.

F.   System Start-up

    1.   The Contractor shall not apply electrical power to the system until after:

        a.   System and components have been installed and inspected in accordance with the manufacturer's installation instructions.

        b.   A visual inspection of the system components has been conducted to ensure that defective equipment items have not been installed and that there are no loose connections.

        c.   All system grounding and transient protection systems have been verified as properly installed and connected, as indicated.

        d.   Power supplies to be connected to the system and equipment have been verified as the correct voltage, phasing, and frequency as indicated.

        e.   Satisfaction of the above requirements shall not relieve the Contractor of responsibility for incorrect installations, defective equipment items, or collateral damage as a result of the Contractor's work/equipment.

3.5   COMMUNICATIONS CABLING REQUIREMENTS

A.   Refer to Houston Airport Technology Specifications, Houston Airports Design Standards, and Contract Documents for requirements.

B.   As part of design development, installation, and coordination, CMS Contractor is expected to:

    1.   Provide suggested CMS communications cabling requirements (cable type, quantity, termination location, etc.).

    2.   Provide typical details of suggested wiring, of the communication equipment room or local active video distribution and control equipment.

    3.   Provide communication cabling requirements for any field-mounted equipment (i.e., audio equipment, sensors, etc.).

(These Guidelines are basic minimum criteria to be met in preparing the final specification for this section, which is the responsibility of the Designer/Contractor/Installation team.)

    4.   Provide communication requirements for equipment located within cabinets in the communications equipment room(s).

    5.   Coordinate all IAH/HAS common network connection requirements with HAS IT.

    6.   Provide communication and low voltage distribution including conduits, cabling, and other components required for a fully functional Oculus in compliance with the approved design and any regulations/codes.

    7.   Provide communication and low voltage distribution, including conduit, cables, cable pulling, cable termination, and other communication distribution components required to ensure connection from any active field-mounted equipment not provided by the LED DSP (i.e., sensors and audio equipment) to head end equipment located in communication equipment room. The distribution shall result in a fully functional Oculus as indicated on an approved design and in compliance with HAS regulations, codes, and standards.

C.   CMS Contractor shall be responsible for all equipment, cabling, and pathways connecting any field-mounted equipment not provided by the LED DSP (i.e., sensors and audio equipment) to head end equipment in the designated communications equipment room IDF B.06. This includes fiber and/or copper data cabling as well as extending IAH/HAS common network out to field devices as needed.

    1.   LED DSP shall be responsible for all equipment, cabling, and pathways connecting the display technology equipment, including the LED tiles, to head end equipment in the designated communications equipment room IDF B.06. This includes fiber and/or copper data cabling as well as extending IAH/HAS common network out to field devices as needed.

D.   CMS Contractor shall be responsible for providing a means of mounting any field-mounted equipment not provided by the LED DSP (i.e., sensors and audio equipment). Equipment supporting the Oculus shall be hidden from view and blend in with surrounding architecture as much as possible. Coordinate any additional mounting locations and requirements with HAS and ITRP.

    1.   LED DSP shall provide communication and low voltage distribution, including conduit, cables, cable pulling, cable termination and other communication distribution components from IAH/HAS network equipment in IDF B.06 to any networked equipment located in three (3) dedicated equipment cabinets in IDF B.06. Equipment cabinets to be provided and installed by the CMS Contractor.

E.   Provide required spare parts for any data distribution

F.   The following are descriptions of the planned communication infrastructure available to support the Oculus and related equipment.

    1.   One (1) 4" empty conduit routed from the vicinity of the Oculus opening to IDF B.06 on the lower level.

    2.   Three dedicated equipment cabinets in IDF B.06.

    3.   Existing IAH/HAS network connectivity available in IDF B.06.

(These Guidelines are basic minimum criteria to be met in preparing the final specification for this section, which is the responsibility of the Designer/Contractor/Installation team.)

G.   LED DSP shall be responsible for the management of the communication infrastructure installation from the LED tiles to the LED processors.

3.6   ELECTRICAL POWER DISTRIBUTION

A.   Refer to Houston Airport Technology Specifications, Houston Airports Design Standards, and Contract Documents in addition to the following:

B.   As part of design development and coordination, the Contractor is expected to:

1.   Provide suggested CMS equipment electrical characteristics (volts, amps, phase, watts).
2.   Provide typical details of suggested wiring between devices.
3.   Provide power requirements for any field-mounted equipment beyond the CMS equipment (i.e., audio equipment, sensors, etc.).
4.   Provide power requirements for equipment cabinets/components located remote from display area.
5.   Provide electrical power distribution including conduits, cabling, and other electrical components required for a fully functional Oculus in compliance with the approved design and any regulations/codes.
6.   Provide electrical distribution, including conduit, cables, cable pulling, cable termination, and other power distribution components required to ensure connection from any new active field-mounted equipment to designated power distribution panels. The electrical distribution shall result in a fully functional Oculus as indicated on an approved design and in compliance with HAS regulations, codes, and standards.
7.   Provide all interface wiring / components between CMS equipment and back to power source.
8.   Provide the required spare parts for any electrical power.

C.   The following are descriptions of the planned electrical power infrastructure available to support the Oculus and related equipment.

1.   Dedicated 225A, 3 phase 208/120V electrical distribution panel (L1B1-V) in Electrical Room F.C101.4. Includes one (1) 3" empty conduit routed up the wall in the electrical room.
2.   Space for three dedicated equipment cabinets in IDF B.06. Cabinets to be provided by CMS Contractor.
3.   Existing UPS 2 phase 208/120V electrical distribution panel (UBE2) supporting IDF B.06 with 19 open single pole breaker positions.

D.   All IDF/MDF power to be fed from Uninterruptible Power Supply (UPS) supported panels and circuits in the event of a power failure. UPS and related distribution panels provided by others and considered existing. Coordinate load on UPS with ITRP. Unless noted otherwise, all power distribution outside of the telecommunication spaces shall be considered normal power not supported by emergency generator or UPS.

E.   The proposed design and resulting system architecture shall consider the lack of UPS-supported power distribution supporting field mounted equipment. Any field-mounted equipment must be invulnerable to sudden power loss and return to

(These Guidelines are basic minimum criteria to be met in preparing the final specification for this section, which is the responsibility of the Designer/Contractor/Installation team.)

normal operation under 30 seconds and without human intervention upon resumption of power.

F.   If a soft shutdown is required for specific equipment, the Contractor shall provide adequate uninterruptible power supplies (UPS) to support the orderly shutdown of this equipment in addition to the base building UPS that will be provided in the IDF. This shall be coordinated with ITRP and HAS.

G.   All decisions regarding UPS loads must be coordinated with and reported to the OAR, HAS and ITRP.

H.   Electrically powered equipment shall be UL or other Nationally Recognized Testing Laboratory (NRTL) approved.

I.   The LED DSP shall be responsible for the management of the electrical installation from the LED tiles to the LED processors.

3.7   TRANSIENT VOLTAGE SUPPRESSION

A.   Refer to Houston Airport Technology Specifications, Houston Airports Design Standards, and Contract Documents for requirements.

3.8   GROUNDING AND BONDING

A.   Refer to Houston Airport Technology Specifications, Houston Airports Design Standards, and Contract Documents for requirements.

3.9   EQUIPMENT IDENTIFICATION

A.   Refer to Houston Airport Technology Specifications, Houston Airports Design Standards, and Contract Documents for requirements.

3.10   MAINTENANCE & SERVICE

A.   Refer to Houston Airport Technology Specifications, Houston Airports Design Standards, and Contract Documents for requirements.

3.11   WARRANTY

A.   Refer to Houston Airport Technology Specifications, Houston Airports Design Standards, and Contract Documents for requirements.

3.12   FIELD SERVICES

A.   Refer to Houston Airport Technology Specifications, Houston Airports Design Standards, and Contract Documents in addition to the following:

B.   Testing and Acceptance Requirements

1.   CMS Contractor shall prepare, submit for review, and execute test plans to demonstrate system completion and performance. Except as otherwise specified, CMS Contractor shall test all components, connections, and subsystems comprising the total CMS system as a complete operational system. The phases of testing and acceptance will include the following:

a.   Factory Acceptance Testing

(These Guidelines are basic minimum criteria to be met in preparing the final specification for this section, which is the responsibility of the Designer/Contractor/Installation team.)

        b.   Functionality and Performance Testing (preceded by system installation)

        c.   Endurance Testing (preceded by successful functionality and performance testing)

  2.   CMS Contractor shall coordinate all testing activities with HAS and their designated OAR.

C.   Test Plan/Procedure

  1.   CMS Contractor shall provide electronic copies of the test plan/procedures for each testing phase for the review and approval of HAS. The test plan for each phase of testing shall detail the objectives of all tests. The tests shall clearly demonstrate that the system and its components fully comply with the requirements specified in the Contract Drawings and Specifications.

  2.   Test plans shall contain at a minimum:

        a.   Functional procedures including use of any test equipment

        b.   Test equipment, identified by manufacturer and model

            1)   Test records shall include test equipment serial number, calibration date and calibration certification of test equipment. All calibrations shall be current.

        c.   Interconnection of test equipment and defined steps of operation

        d.   Expected results required to comply with specifications

        e.   Record of test results with witness initials or signature and date performed

        f.   Pass or fail evaluation with comments

        g.   Where operating tests are required, test the work as it progresses.

  3.   The test procedures shall provide conformity to all system requirements. Satisfactory completion of the test procedure is necessary as a condition of system acceptance.

  4.   CMS Contractor shall review all formal test procedures and deliverables under the contract to assure the tests cover all requirements and that there is a conformity between the conducted test, the test results, and Specification requirement.

  5.   Preliminary tests shall be satisfied before applying to HAS for official tests.

  6.   The Contractor shall provide HAS the opportunity(s) to participate observe in any or all of tests.

  7.   Tests shall be in the manner specified for the different branches of the work. Each test shall be made on the entire system for which such test is required, wherever practical. In case it is necessary to test portions of the work independently do so without extra compensation.

  8.   Should defects appear, such defects will be corrected and the test repeated until the installation is acceptable to HAS. Work shall not be covered or enclosed before it has been tested and approved.

D.   Test Reports

(These Guidelines are basic minimum criteria to be met in preparing the final specification for this section, which is the responsibility of the Designer/Contractor/Installation team.)

1. The Contractor shall prepare, for each test, a test report document that shall certify successful completion of that test. An electronic copy of the test report shall be submitted to HAS for review and acceptance. The test report shall be submitted to HAS within five (5) days after the test has been completed. The test report shall contain, at a minimum:

    a. Commentary on test results
    b. A listing and discussion of all discrepancies between expected and actual results and of all failures encountered during the test and their resolution
    c. Complete copy of test procedures and test data sheets with annotations showing dates, times, initials, and any other annotations entered during execution of the test
    d. Signatures of persons who performed and witnessed the test

E. Any discrepancies or problems discovered during these tests shall be corrected by the Contractor at no cost to HAS. The problems identified in each phase shall be corrected and the percentage of the entire system and re-tested determined by HAS and/or OAR before any subsequent testing phase is performed.

F. Factory Acceptance Testing

    1. Factory Acceptance Testing (FAT) shall be performed in order to validate the selected CMS components shown on the shop drawings and demonstrate that all specified features, design, and performance criteria are met.

    2. Coordination

        a. Coordinate location and procedure with HAS, subject to conditions in Paragraph 2.1.
        b. Coordinate end devices with LED DSP.
        c. Coordinate any CMS pre-programming or preparatory work for Factory Acceptance Testing with LED DSP, CPC, and AV Design Team.
        d. Tests shall be conducted prior to deployment of any equipment to the field. Conduct FAT on weekdays during standard business working hours, unless otherwise approved by HAS.
        e. Testing shall take place at CMS Contractor's local offices or other location approved by HAS.

            1) Refer to HAS Design Standards Manual (ITRP Design Manual) for offsite testing requirements.

    3. Preparation

        a. Items to be tested shall be set up and performance verified prior to arrival of HAS and/or OAR at the test site.
        b. Ensure that development of system components is complete, required approvals of submittals have been obtained, and sufficient equipment procured to completely demonstrate and test the system components.
        c. Test equipment shall be actual products or identical models of products to those designated to be delivered and installed at the site. The

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following equipment shall be setup and used for conducting pre-delivery test:

1) Operator equipment associated with system.
2) End devices and displays associated with system.
3) Software associated with system.
4) Administrative console equipment.
5) Sufficient signal transmission media (STM) and associated equipment and accessories to provide a fully integrated system model. Include at least one of each type of STM circuit.
6) Enough load and data simulators to provide simulation of full load operational conditions as required by design. Loads shall be manually or software generated.

4. Acceptance

   a. All requirements of the specification shall be tested including, but not limited to:

   1) Functionality.
   2) System capacity.
   3) Hardware interaction.
   4) Hardware and software interaction.
   5) Demonstrate report generation.

   b. Acceptance of system components to perform sufficiently and provide specified functions shall be determined by HAS and/or OAR witnessing the factory acceptance test. Up to three (3) representatives from HAS and/or the OAR shall witness all testing and validate the acceptance criteria.

   c. Acceptance criteria of the system components based on performance shall equal or exceed criteria stated in individual specification sections and Contract Documents.

      a) When equipment, product, or assembly fails to meet any factory or off-premises tests, retesting of equipment, product, or assembly shall be mandated, and the manufacturer/contractor shall be liable for all additional expenses, including all expenses incurred by HAS and the OAR for witnessing the retesting of any equipment, product, or assembly.

      b) If system components do not perform satisfactorily, CMS Contractor shall make corrections and/or modifications and schedule a new test with HAS and/or OAR at no cost to HAS.

      c) Compliance with criteria outlined in the Specifications, Contract Documents and approved test plans is at the sole discretion of HAS. If compliance cannot be met, or is insufficient, HAS shall have the right to terminate the contract.

5. Completion and Reporting

(These Guidelines are basic minimum criteria to be met in preparing the final specification for this section, which is the responsibility of the Designer/Contractor/Installation team.)

      a.   Once the test is completed successfully, equipment shall be disassembled so as to prevent damage. Any defective or worn items shall be replaced before installation on site.

           1)   Re-pack equipment in original containers to be delivered to site for installation. Mark containers with identification as items used in factory test.

      b.   Record all test procedures and results.

           1)   Submit report in accordance with reporting requirements described herein.

G.   Functionality and Performance Site Acceptance Testing

    1.   Performance Site Acceptance Testing (PSAT) shall be performed to validate operational performance of the installed and commissioned Oculus CMS.

    2.   Coordination

      a.   Coordinate procedures and test requirements with HAS according to approved test plan.

      b.   Coordinate end devices with LED DSP.

      c.   Coordinate any preparatory work with LED DSP, CPC, and AV Design Team.

      d.   Coordinate with other contractors for performance testing of the entire system, including the display technology (by LED DSP), CMS, and Oculus-specific content (by CPC) following installation and commissioning of the Oculus.

    3.   Preparation

      a.   Testing shall not begin until:

           1)   All systems have been installed and individually and jointly tested to ensure they are operating properly prior to arrival of HAS and/or OAR at the test site.

           2)   Written authority from has been received from HAS.

    4.   Acceptance

      a.   All components of the system will be tested, along with their interactions and performance.

      b.   The tests shall demonstrate system features and verify correct operation of the required system functionality as defined in the Specifications and Contract Documents.

      c.   Acceptance of CMS to perform sufficiently and provide specified functions shall be determined by HAS.

      d.   If the CMS does not perform satisfactorily, the test will be terminated and CMS Contractor shall make corrections and/or modifications and schedule a new test with HAS.

      e.   Tests will be terminated by HAS if

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1) Individual systems, system components, subsystems, or cabling infrastructure fail to perform as specified.
2) It is determined that a system or sub-system is missing any components or installation is not complete.
3) Upon termination, corrective work shall be performed, and performance verification test rescheduled with HAS and/or OAR.
4) Retesting shall be performed by CMS Contractor at no additional expense to HAS.

f. Contractor shall continue to perform corrective actions and retest until system passes all tests to the satisfaction of HAS.

5. Completion and Reporting

a. Test is complete when testing or retesting of each component has produced a positive result and has been approved in writing by HAS.
b. Reporting shall include a description of the operational tests performed, equipment used, test procedures, results, and personnel performing tests.

1) Record in a table all test results, deficiencies, and corrective measures
2) Submit report in accordance with reporting requirements described herein.

H. Substantial Completion

1. Once CMS is fully installed, operational, in use, and end user training is complete, the system will be considered Substantially Complete. Written notice of Substantial Completion will be provided to HAS.
2. Endurance Testing shall not commence until written notice of Substantial Completion is received.

I. Endurance Testing

1. Endurance testing shall verify that all technology hardware can withstand the typical processing load it is expected to endure for a given period. The test shall measure the response of the overall system under conditions that simulate typical-to-heavy daily use for the specific (14) fourteen-day window with all observations recorded during the full period of the test.
2. CMS Contractor shall develop, document, and submit specific testing procedures for approval prior to initiating the test. The test procedure documentation shall clearly indicate how typical usage load will be simulated and applied to the system and define the performance metrics to be measured and recorded.
3. Coordination with LED DSP and CPC will be required.

J. During commissioning and testing of the Oculus system components performed by others (LED DSP, CPC), CMS Contractor shall ensure correct operation of CMS and correct any deficiencies as required.

(These Guidelines are basic minimum criteria to be met in preparing the final specification for this section, which is the responsibility of the Designer/Contractor/Installation team.)

    K.   Institute protective measures and other precautions required to ensure that CMS will be without damage or deterioration at time of Substantial Completion.

3.13 TRAINING

    A.   Refer to Houston Airport Technology Specifications, Houston Airports Design Standards, and Contract Documents for requirements.

    B.   CMS Contractor shall ensure that all required personnel and substitute personnel are fully trained and certified on the complete system that is currently in service at that time.

    C.   CMS Contractor shall be solely responsible for all costs associated with the training of personnel and substitute personnel, including training-related travel expenses.

    D.   A Training Plan shall be submitted for approval from HAS and shall include, but not be limited to, training personnel on the installation, operation, renovation, alteration, inspection, maintenance, and service on each system and subsystem provided, so as to enable troubleshooting and repair to the component level. Maintenance training shall be conducted at a location that is coordinated with HAS.

3.14 PROJECT CLOSEOUT REQUIREMENTS

    A.   In addition to all final close out requirements as specified by related ITRP and HAS Specification Sections and Contractor Documents, CMS Contractor shall comply with all requirements of this Section.

    B.   Final System Acceptance

        1.   CMS Contractor shall prepare and issue a Certificate of Project Completion, containing:

            a.   The date of project completion.
            b.   A list of items that have been corrected by the Contractor.
            c.   The time and date the Authority will assume possession of the system (transfer of ownership).
            d.   The date that warranty begins.

        2.   HAS and/or OAR will perform an inspection after receiving the written Certificate of Project Completion. The project completion inspection shall include, but not be limited to:

            a.   The project's contracted work and any additional change orders.
            b.   Submission of all project documentation, including as-builts.
            c.   Successful completion of Endurance Testing in the presence of HAS and/or OAR.

        3.   If issues or incomplete items are found during inspection, HAS and/or OAR will prepare and provide CMS Contractor with a list of actions to be completed and corrected, along with a timeframe for completion.

            a.   If the nature or complexity of the work required to comply with the written notice is such that it cannot be completed within the required timeframe, CMS Contractor shall immediately notify HAS and OAR in writing. The

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notification from CMS Contractor shall include a detailed, resource-loaded schedule indicating when and how the work will be completed, subject to approval by HAS. Until such a schedule is approved by HAS, the original timeframe specified will stand.

4.   Final System Acceptance will mark the beginning of the system Warranty and Maintenance period.

C.   Inspection Closeout

1.   Provide evidence of final inspections and approvals to HAS in accordance with all requirements of the Contract Documents.

2.   HAS approval is required prior to final system acceptance and payment.

3.15 ATTACHMENTS

A.   Appendix A – Technology Implementation Schedule

B.   Appendix B – Responsibility Matrix

 (These Guidelines are basic minimum criteria to be met in preparing the final specification for this
 section, which is the responsibility of the Designer/Contractor/Installation team.)

APPENDIX A

TECHNOLOGY IMPLEMENTATION SCHEDULE (EXAMPLE)

	(from Designer)		(Contractor Submittal)				(Submittal Response)		
	Product Description	Spec. Ref	Qty.	Procurement Lead Time	Start Date or Dependent	Installation Duration	Submittal Approval	Purch. Auth.	Remarks
1	[Model name and number]	2.3.C	2	6 weeks					[Example]
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									

(These Guidelines are basic minimum criteria to be met in preparing the final specification for this section, which is the responsibility of the Designer/Contractor/Installation team.)

APPENDIX B

RESPONSIBILITY MATRIX

ITEM	DESCRIPTION	LED DSP		CPC		CMS CONTRACTOR		HAS	ITRP	NOTES
		FURNISH	INSTALL	FURNISH	INSTALL	FURNISH	INSTALL			
1	**OCULUS DISPLAY + RELATED FIELD DEVIES**									
1.01	LED TILES	X	X	-	-	-	-	-	-	
1.02	LED TILE MOUNTS	X	X	-	-	-	-	-	-	
1.03	LED TILE POWER SUPPLIES	X	X	-	-	-	-	-	-	
1.04	POWER AND DATA/VIDEO CABLING BETWEEN LED TILES	X	X	-	-	-	-	-		
1.05	FIELD DEVICES POWER DISTRIBUTION	X	X	-	-	-	-	-	-	REFER TO ITEM 3 FOR FURTHER INFORMATION
1.06	CEILING ENCLOSURE BOXES	X	X	-	-	-	-	-	-	
1.07	ACTIVE FIELD-MOUNTED VIDEO DISTRIBUTION EQUIPMENT	X	X	-	-	-	-	-	-	INCLUDING FIBER CONVERTERS
1.08	CABLING: LED PROCESSOR TO LED TILES	X	X	-	-	-	-	-	-	REFER TO ITEM 4 FOR FURTHER INFORMATION
1.09	LED TERTIARY SUPPORT STRUCTURE	X	X	-	-	-	-	-	-	
1.10	BASE BUILDING SUBSTRUCTURE	X	X	-	-	-	-	-	X	
1.11	INSTALLATION COORDINATION	X	X	-	-	-	-	X	X	

(These Guidelines are basic minimum criteria to be met in preparing the final specification for this section, which is the responsibility of the Designer/Contractor/Installation team.)

ITEM	DESCRIPTION	LED DSP		CPC		CMS CONTRACTOR		HAS	ITRP	NOTES
		FURNISH	INSTALL	FURNISH	INSTALL	FURNISH	INSTALL			
2	**HEAD END EQUIPMENT (IDF/MDF)**									
2.01	CONTENT MANAGEMENT SYSTEM (CMS)	-	-	-	-	X	X	-	-	INCLUSIVE OF SERVER PLATFORM
2.02	CMS STORAGE ARRAY	-	-	-	-	X	X	-	-	
2.03	MASTER VIDEO SYNC GENERATOR	-	-	-	-	X	X	-	-	
2.04	MEDIA SERVERS	-	-	-	-	X	X	-	-	
2.05	LED PROCESSORS	X	X	-	-	-	-	-	-	
2.06	CABLING: VIDEO SYNC DISTRIBUTION	-	-	-	-	X	X	-	-	
2.07	CABLING: MEDIA SERVER >> LED PROCESSOR	-	-	-	-	X	X	-	-	
2.08	CABLING: LED PROCESSOR >> FIELD INFRASTRUCTURE	X	X	-	-	-	-	-	-	
2.09	CABLING: EQUIPMENT AND CABINET GROUNDING			-	-	X	X	-	-	BOND DEDICATED OCULUS EQUIPMENT AND HARDWARE TO PROVIDED TELECOM GROUNDING SYSTEM.
2.10	NETWORK SWITCHES (ADMIN/CONTROL AND CONTENT LANS)	-	-	-	-	X	X	-	-	
2.11	NETWORK SWITCH UPLINK SFP MODULES (BOTH SIDES)	-	-	-	-	X	X	-	-	
2.12	NETWORK SWITCH PROGRAMMING	-	-	-	-	-	-	X	-	
2.13	NETWORK PATCH CORDS (COPPER + FIBER)	X	X	-	-	X	X	-	-	INDIVIDUAL CONTRACTORS RESPONSIBLE FOR PROVIDING NETWORK PATCH CABLES IN SUPPORT OF PROVIDED EQUIP.
2.14	CONTENT LAN FIBER DOWNLINK SFPs (ON NETWORK SWITCH)	-	-	-	-	X	X	-	-	
2.15	CONTENT LAN FIBER SFPs (ON EQUIPMENT)	X	X	-	-	X	X	-	-	INDIVIDUAL CONTRACTORS RESPONSIBLE FOR PROVIDING SFPs IN SUPPORT OF PROVIDED EQUIP.
2.16	IDF EQUIPMENT CABINETS	-	-	-	-	X	X	-	-	INCLUSIVE OF ALL RELATED HARDWARE AND ACCESSORIES PER HAS STANDARD SPECIFICATIONS.
2.17	CABINET POWER DISTRIBUTION UNITS	-	-	-	-	X	X	-	-	
2.18	IDF GENERAL FIT-OUT	-	-	-	-	-	-	-	X	INCLUDING BUT NOT LIMITED TO IDF POWER AND HVAC, PYWOOD PANELING, LADDER TRAY, AND ??
2.19	IDF TELECOMMUNICATIONS GROUNDING SYSTEM	-	-	-	-	-	-	-	X	ITRP TO PROVIDE BASE TELECOM GROUNDING SYSTEM INCLUDING GROUNDING BUS BAR IN IDF B.06
2.20	CABINET POWER DISTRIBUTION FROM IDF POWER DISTRIBUTION PANELS	-	-	-	-	X	X	-	-	REFER TO ITEM 3 FOR FURTHER INFORMATION

(These Guidelines are basic minimum criteria to be met in preparing the final specification for this section, which is the responsibility of the Designer/Contractor/Installation team.)

ITEM	DESCRIPTION	LED DSP		CPC		CMS CONTRACTOR		HAS	ITRP	NOTES
		FURNISH	INSTALL	FURNISH	INSTALL	FURNISH	INSTALL			
3	**ELECTRICAL INFRASTRUCTURE**									
3.01	POWER DISTRIBUTION TO ALL FIELD-MOUNTED DEVICES	X	X	-	-	-	-	-	-	INCLUSIVE OF POWER CABLING, PATHWAYS, OUTLETS, AND GROUNDING FROM ITRP-PROVIDED PANEL
3.02	POWER DISTRIBUTION PANEL AND RELATED TRANFORMER FEEDING OCULUS FIED DEVICES	-	-	-	-	-	-	-	X	
3.03	BRANCH CIRCUIT BREAKERS IN OCULUS POWER DISTRIBUTION POWER PANEL	X	X	-	-	-	-	-	-	PANEL AND ASSOCIATED XFMR BY ITRP. LED DSP RESPONSIBLE FOR BRANCH CIRCUIT BREAKERS.
3.04	UPS POWER DISTRIBUTION PANEL IN IDF B.06	-	-	-	-	-	-	-	X	UPS-FED PANEL PROVIDED BY ITRP.
3.05	POWER DISTRIBUTION TO ALL OCULUS EQUIPMENT CABINETS IN IDF B.06	-	-	-	-	X	X	-	-	
3.06	BRANCH CIRCUIT BREAKERS IN IDF B.06 DISTRIBUTION POWER PANEL	-	-	-	-	-	-	-	X	PANEL BY ITRP. CMS CONTRACTOR RESPONSIBLE FOR BRANCH CIRCUIT BREAKERS.
4	**LOW VOLTAGE INFRASTRUCTURE**									
4.01	BACKBONE FIBER FROM IDF B.06 TO IAH CORE NETWORK	-	-	-	-	-	-	X	X	
4.02	FIBER INFRASTRUCTURE FROM IDF B.06 TO OCULUS / CEILING ENCLOSURES	X	X	-	-	-	-	-	-	INCLUSIVE OF FIBER OPTIC CABLING, PATHWAYS, TERMINATIONS, ENCLOSURES, HARDWARE, AND TESTING.
4.03	COPPER INFRASTRUCTURE FROM CEILING ENCLOSURES TO LED TILES	X	X	-	-	-	-	-	-	INCLUSIVE OF COPPER CABLING, PATHWAYS, TERMINATIONS, PATCH PANELS, OUTLETS, HARDWARE, AND TESTING.
4.04	INFRASTRUCTURE SUPPORTING LED DISPLAY CONTROL OR AMBIENT ENVIROMENTAL MONITORING	X	X	-	-	-	-	-	-	EXAMPLE; AMBIENT LIGHT SENSORS FOR AUTOMATED CONTROL OF DISPLAY BRIGHTNESS
4.05	ALTERNATIVE PROCESSOR TO TILE VIDEO DISTRIBUTION AND SUPPORTING INFRASTRUCTURE	X	X	-	-	-	-	-	-	LED DSP RESPONSIBLE TO FURNISH AND INSTALL ANY PROPOSED ALTERNATIVE DISTRIBUTION INFRASTRUCTURE.
4.06	GROUNDING	X	X	-	-	-	-	-	-	LED CONTRACTOR RESPONSIBLE FOR GROUNDING RELATIVE TO DEDICATED FIELD PATHWAYS / CABLING / ENCLOSURES

GENERAL NOTES

1. UNLESS OTHERWISE NOTED, RESPONSIBILITY TO FURNISH AND INSTALL AN ITEM IS CONSIDERED INCLUSIVE OF PROVIDING ALL RELATED LICENSING AND SOFTWARE.

2. RESPONSIBILITY TO FURNISH AND INSTALL A GIVEN BY ONE CONTRACTOR ITEM DOES NOT ALLEVIATE THE RESPONSIBILITY OF THE OTHER CONTRACTORS TO COORDINATE RELATED REQUIREMENTS

END OF SECTION 27 42 24