**Design Review**

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|---|---|
| **Date of Review:** | |
| **Tests Performed by:** | |

| Test | Description | Results & Supplementary Notes |
|---|---|---|
| 3.1 | **Pre-Inspection** (Exact location, Performance Specification, Narrative. Programming Report/Needs Analysis/AV Proposal has been approved by the client. Supporting architectural drawings are accurate and current. Special instructions from the client on system standards, performance standards, etc. have been included in the design. In short, all input documentation is present) | |
| 3.2 | **Display** | |
| 3.2.1 | Image size is the proper height for the application and viewing area. | |
| 3.2.2 | Image luminance has been considered, with 25% de-rating due to lamp fluctuations. | |
| 3.2.3 | The proper lens has been selected for image size and throw distance according to manufacturer specification/calculator. | |
| 3.2.4 | An EDID Plan has been prepared and included in the design package in some form. The plan must include intended resolutions at each display, and required image settings when there are aspect ratio mis-matches. The Plan indicates how each device in the video chain (especially sources) gets its EDID information and configuration information (including supported resolutions, refresh rates, HDCP support and audio format information) in an unambiguous way so that the AV specialists can easily configure the system as designed. The required resolutions at the displays take visual acuity into consideration in accordance with the intended use of the system and distance to the furthest viewer. | |
| 3.2.5 | Audience viewing sight lines have been considered. | |
| 3.2.6 | Consideration has been given to scale source resolutions to the native resolution of the display. | |
| 3.2.7 | System bandwidth is designed for, taking into account supported resolutions and cable lengths along the signal path. | |
| 3.2.8 | Attenuation due to cable loss has been calculated for analog video, and along with system bandwidth, allows the video signal to arrive at each destination with a tolerance of less than 1 dB (10%) | |
| 3.2.9 | Consideration is given to video formats (composite, s-video, component, RGBHV, DVI, Display Port, iOS, SDI, HD-SDI, 3G-HDI, etc.) and required converters have been accounted for. | |
| 3.2.10 | The input and output configurations for each device will work with the system. Some Display Port outputs use HDMI/DVI video signals, and some do not. Some laptop digital outputs embed the audio, some do not. Some DVI inputs support more resolutions than HDMI inputs. | |
| 3.2.11 | Video test points and/or test equipment was considered. | |
| 3.2.12 | Direct View display screen burn-in issues were addressed. | |
| 3.2.13 | VGA termination considerations (if they exist) were allowed for in terms adapters and physical space requirements. | |
| 3.2.14 | The system supports an HDCP-compliant video path for content protected sources, if required. | |
| 3.2.15 | Front projection contrast levels have been accounted for (7:1-Passive Viewing, 15:1-Basic Decision Making, 50:1-Analytical Decision Making, 80:1-Full Motion Video), and the architect/lighting team member been made aware of recommended ambient light levels on the screen, as well as task lighting levels. | |
| 3.2.16 | Recommendations for computer resolutions that will work best with the system have been made to the client. | |
| 3.2.17 | The system can be designed with only one color space, or with equipment that has the ability to adjust color space, to improve performance by reducing the time a display needs to adjust to differing sources. | |

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| 3.2.18 | The display specifics of any client laptops that will be used is confirmed, and arrangements have been made for their presence during Staging and Commissioning tests. | |
| **3.3** | **Audio** | |
| 3.3.1 | The sound system(s) will be "loud enough". | |
| | *Discussion: Conference Room applications are designed for a sound pressure level for speech to be 65 - 70 dB SPL. This is based on a Standard Talker producing 60 dB SPL at one meter from the mouth, and ambient noise 15 dB below that. As the ambient noise increases, the sound system must be able to easily produce 15 dB above it (for reverberant spaces, 24 dB). The system must also develop an additional 10-15 dB above this without distortion to allow for peaking. This is called the "headroom" level, and allows for the intermittent raising of a voice. Level calculations including loudspeaker sensitivity, distance to the ear from the loudspeaker, insertion loss of transformers, if any, and power amplifier rating must be considered in assuring these target levels. Indeed, the entire gain structure must assure it.* | |
| 3.3.2 | The sound system(s) will be "loud enough" for all listeners. | |
| | *Discussion: Loudspeakers were carefully chosen and deployed, so as to attain the same level to all listeners plus or minus 2 dB across the passband stated for speech. In the case of overhead distributed loudspeakers, a 50 % overlap pattern is adopted to allow for the high frequency "beaming" that takes place with cone transducers. This necessitates CH-EH (the distance between the ceiling height and the ear height) centers. Note that overlap percentage is based on the diameter of the coverage pattern at ear height.* | |
| 3.3.3 | The system will be stable. | |
| | *Discussion: PAG NAG equations are considered. Target for EAD required for the application.* | |
| 3.3.4 | Microphones are properly placed. | |
| | *Discussion: For speech reinforcement, microphones are no more than 2.5 feet from a talker's mouth. Ceiling microphones are almost never used for reinforcement, but when they must be used, keep them no further than 2.5 feet from the talker's mouth. Also, the "One to three" rule is used to assure that too many microphones are not used, causing phase cancellation effects when the microphones add, unless there is gating electronics to permit only one mic being on. Consider offsetting the microphones if all participants are facing the screen to position the microphones on-axis with the talker's mouth.* | |
| 3.3.5 | Microphone patterns are carefully chosen. | |
| 3.3.6 | The system will be intelligible. Possible room acoustic problems have been considered. | |
| 3.3.7 | The loudspeakers and the power amplifiers driving them are impedance compatible. | |
| 3.3.8 | There is a method of leveling source inputs, so that the audio level in the room does not change in level when a new program source is selected. | |
| 3.3.9 | Every piece of equipment is "matched" to the impedance and levels of the equipment it is connected to (constant voltage protocol). | |
| 3.3.10 | Unbalanced sources that are not located inside the main equipment rack, such as a DVD player mounted in a lectern, has an unbalanced to balanced device to make the audio run as a balanced signal. | |
| 3.3.11 | Digital hybrids and CODECs are able to receive the levels they need for proper operation. | |
| 3.3.12 | Compressors, volume controls, and feedback "exterminators" are removed from the echo canceller chain (note: this is manufacturer-specific, and does not apply in all cases). | |

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| 3.3.13 | Wireless microphone systems have their intended area of operation defined, and additional antennas and RF amps are added if required. Wireless microphone transmitters have a clear line of site to an antenna from the intended area of operation, and appropriate antennas have been included for the intended area of operation. | |
| 3.3.14 | Wireless antenna receivers have been selected for the given area, taking into account the RF spectrum of the specific location. An RF Sweep has been conducted, if required. | |
| 3.3.15 | Wireless microphone systems are digital and encrypted where required. | |
| 3.3.16 | A place to store the wireless transmitters has been accounted for in the design. | |
| 3.3.17 | Wireless microphone battery types have been determined, taking into account cost of ownership, user time requirement, and field replaceability. | |
| 3.3.18 | Wireless microphone chargers have been included if rechargeable batteries have been selected. Note that the difference in voltages between alkaline and rechargeable batteries may cause damage to the transmitters if alkaline batteries are substituted. | |
| 3.3.19 | Appropriate, low loss antenna cable has been accounted for in the design. | |
| 3.3.20 | Record function allows adjustments for acceptable levels at the recording input | |
| 3.3.21 | Audio test points and/or test equipment was considered. Pay special consideration to access to the amplifier-loudspeaker line access point. | |
| 3.3.22 | If digital sources have embedded audio, the audio will be properly distributed. If the source is the digital output from a laptop with no embedded audio, there is provision for the audio by analog means (i.e., a 3.5 mm stereo connector). If there is digitally embedded audio with an analog sound system, there is a way to de-embed the audio. | |
| 3.3.23 | If this is a public space, assistive listening has been added with the appropriate number of receiver in accordance with the Authority Having Jurisdiction (AHJ) requirements, and in accordance with the manufacturer's instructions for installation. | |
| 3.3.24 | If latency is an issue, there is a means for synchronizing the audio and the video signals for lip sync. | |
| 3.3.25 | Patch panels include "mults" or “DAs” where applicable. | |
| 3.3.26 | Patch panel assignments are logically laid out, and "normal-throughs" have "source" on top and "destination" directly below it. | |
| 3.3.27 | Patch cords have a “home” | |
| **3.4** | **Control** | |
| 3.4.1 | There are enough user interfaces included in the design for ease of use. They are accessible and located appropriately in the space. | |
| 3.4.2 | An appropriate number (less than 3 or 4) of keystrokes are required to access any system function control. Buttons/knobs are intuitively grouped. | |
| 3.4.3 | All required controls are available to a user. This includes any hidden/protected Engineering/Operator Modes where additional system or equipment controls may be located. | |
| 3.4.4 | The level of control is appropriate for the intended users. Operators need access and flexibility. Users need contained simplicity. If both are required, the Operators Pages are hidden or protected. | |
| 3.4.5 | The hardware protocol is compatible between the controller and controlled device. | |
| 3.4.6 | If sync or power sensors are required for true control system feedback, they have been included. | |
| 3.4.7 | There enough ports on the control system, or expansion devices have been included. | |

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| 3.4.8 | The block diagram has port assignments, pin-outs, communications protocol listed, sufficient power blocks. The rack fabricator will be able to integrate the system without looking for additional information, or trying to squeeze multiple terminations into the same phoenix connector. | |
| 3.4.9 | Power requirements, cable length, and RS 485 anomalies been considered and verified on the manufacturer's website. | |
| 3.4.10 | RS 232 runs are less than 50 feet, or there are converters to compensate included in the design. | |
| 3.4.11 | Any Ethernet switch used in the design has enough ports and has room for expansion. | |
| 3.4.12 | The control system can span the required number of networks if there are two (or more), if required: client LAN and AV LAN. | |
| 3.4.13 | Additional memory for html/iOS files has been included for the processor. | |
| 3.4.14 | Enough PoE ports have been accounted for in the design. Note that on some PoE switches, not all ports actually have PoE. Also, PoE power calculations have been performed to confirm the ports have adequate power available. | |
| 3.4.15 | All control system ports are integrating with other low voltage controllers, unless high voltage interfaces have been accounted for. | |
| 3.4.16 | Third party controllers are able to accept the protocol available on the control system port. | |
| 3.4.17 | The port and processor are of an adequate size and buffer given their intended function. Some functions pass an incredible amount of data and may flood a given port and/or stall a processor. | |
| 3.4.18 | All peripherals for user devices have been included in the design (power supplies, table top kits, wall installation kits, extra batteries, chargers, PoE injectors, etc.). | |
| 3.5 | **Videoconferencing** | |
| 3.5.1 | All required codec options have been included in the bill of materials, including local bridging modes, additional resolutions, sharing content, etc. | |
| 3.5.2 | The codec supports the users' required computer presentation resolutions. If not, scaler(s) been included, Discussion: Some presentation inputs on codec are severely limited in the resolutions that they support. | |
| 3.5.3 | Videoconferencing lighting has been addressed. (55 fc, measure 45 degrees up and pointing to camera) | |
| 3.5.4 | (a) Camera placement has good site lines, can capture all intended participants, and accounts for perceived eye contact at the far end. (b) The camera and/or lens has been considered to capture the participants at the appropriate "shots". Wide angle lenses have been considered for shorter conference rooms to capture all participants in one shot. Zoom lens have been considered to capture presenters in an adequate "close shot". | |
| 3.5.5 | Additional cameras if required (presenter view, audience view, etc.) have been included in the design. | |
| 3.5.6 | The client's network is prepared to have a video conferencing codec reside on it, and the requested bandwidth and permissions can be supported. | |
| 3.5.7 | The client's video conferencing preferences (call speed, global directory, gatekeeper information, etc.) has been accounted for in the design package. | |
| 3.5.8 | The VC Camera control path is maintained, even if codec uses CEC controls to send commands and an HDMI path is required. | |
| 3.5.9 | Codec maintenance agreements are included in the bill of materials, if required. | |
| 3.5.10 | The codec has adequate inputs and outputs for all functions required in the system (dual display, presentation input, multiple cameras, etc.). | |

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| 3.5.11 | The system has enough sources and destinations to support the codec functions (presentation feed to the codec, multiple inputs for dual display). | |
| 3.5.12 | Audio inputs and outputs levels are appropriate for the system, and that any required adapters (line to mic, mic to line) have been accounted for. | |
| 3.5.13 | If there is an audio conference system, audio calls can be added to video calls. | |
| **3.6** | **Audio conferencing** | |
| 3.6.1 | The type of audio conferencing system can be provided by the client (analog line, VoIP, etc.). | |
| 3.6.2 | Echo cancellation has been accounted for in the hybrid being provided, or elsewhere in the system. | |
| 3.6.3 | All mixer inputs can accept the levels being provided (mic inputs vs. line inputs) | |
| 3.6.4 | The client's VOIP or Phone network provider is prepared to have an audio conferencing unit reside on it (not just another phone end point). | |
| 3.6.5 | If multiple references are required (speech reinforcement mics vs. conference only mics), it is called for in the narrative, and the mixer can support it. | |
| 3.6.6 | If there is a video conference system, video call can be added to audio calls. | |
| 3.6.7 | If the system supports both audio conferencing (AC) and video conferencing (VC), the preferred, single echo canceller has been recommended in the design. For example, if there is echo cancellation available in a video conferencing codec and DSP/hybrid mixer, the design states that the echo canceller in the mixer will be used for both AC and VC, and the echo canceller in the codec will be disabled. | |
| **3.7** | **Architectural and General AV** | |
| 3.7.1 | Every feature, source, destination is accounted for as described in the functional narrative. | |
| 3.7.2 | Every effort has been made to assure no dangerous obstructions or jagged edges exist that may injure a user, operator, or presenter. | |
| 3.7.3 | Environmental sustainability credits included in the needs analysis/programming phase have been accounted for. | |
| 3.7.4 | "Entanglement" issues included in the needs analysis/programming phase have been accounted for, and failover processes have been documented in the narrative. Immediate actions during a failure have been considered, along with their possible solutions (e.g. redundant power supplies, system switchers, control systems, patch bays, etc.). | |
| 3.7.5 | Every effort has been made to assure single phase feed for the A V system, and that it is properly grounded. | |
| 3.7.6 | Electrical requirement calculations are reasonable. Section of the system can be shut down when not in use to conserve power. The calculations have been communicated to the client and the Design Team. | |
| 3.7.7 | Power distribution hardware is sufficient for the equipment and in accordance with AHJ requirements. | |
| 3.7.8 | The conduit capacity has been accounted for in the schematic drawings for all cable runs, include Jam Ratio calculations on 3-cable pulls. | |
| 3.7.9 | Thermal gradients have been accounted for in the equipment racks, projectors, lecterns, auxiliary cabinets, etc. Fans, vents, and other HVAC requirements are accounted for in the design. The heat loading calculations have been communicated to the client and the Design Team so that adequate HVAC can be designed for the room, equipment closet, credenza, etc. | |
| 3.7.10 | Rack elevations are laid out to afford easy, safe, and ergonometric operation. | |

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| 3.7.11 | Whenever possible, the equipment racks have extra space for ventilation and system upgrades. | |
| 3.7.12 | The racks are serviceable, with ample space to maneuver, remove equipment, etc. | |
| 3.7.13 | The rack elevations are ADA (or as applicable) compliant. | |
| 3.7.14 | Equipment cabinets sometimes require work surfaces, work lights, storage drawers, sequential power distribution, drawer shelves, preview monitors, etc. They have been included in the design. | |
| 3.7.15 | Critical areas for coordination such as millwork, supporting structures, metal work, etc. have been identified, and "over communicated". | |
| 3.7.16 | Everything has been labeled on the drawings. There is consistency between the naming of inputs on the switchers, panels, control system flows, AV flows, etc. | |
| 3.7.17 | Any licensing, permits, and/or affiliations with labor organizations required have been communicated in the narrative, along with applicable approvals from structural or seismic agents and authorities. | |
| 3.7.18 | Specialized/custom plates and panels have been accounted for and accommodated in the drawing set and bill of materials. | |
| 3.7.19 | Any latching (i.e., Twist lock) connectors required for power and other terminations in the system have been communicated on the drawings and the narrative. | |
| 3.7.20 | There is sufficient detailed information provided regarding table and Floor Boxes locations, types, sizes, and any plates. | |
| 3.7.21 | The display(s) is centered on room or the table, or logically located in the room. | |
| 3.7.22 | Projector throw distance and/or range is shown on the plan drawing, with references to projector, lens, throw distance, image size, vertical alignment, and horizontal alignment details. | |
| 3.7.23 | When mounting a projector from the ceiling, the appropriate extension tube has been selected, or a VIF ("verify in field") note has been added to the bill of materials. | |
| 3.7.24 | Power receptacles are available for all equipment, at the appropriate voltage and receptacle type. | |
| 3.7.25 | If equipment is to be mounted from the ceiling or wall, the proper blocking/support is specified to the Design Team. This includes projectors, displays, loudspeakers, cameras, etc. When required, approval of a structural engineer has been received. | |
| 3.7.26 | The proper hardware used for mounting equipment to the building been specified (SAE-5 or ISO 8.8 or higher fasteners, hardware with a working load limit of 5x total force from mounted equipment (including any torsion moments), etc) where applicable. | |
| **3.8** | **Design Package** | |
| 3.8.1 | The Design Package complete? It includes a: | |
| | Function Narrative, Customer Performance Specifications, | |
| | Equipment list, System Drawings, Architectural Drawings, | |
| | Control System Specification, | |
| | Client Installation Manual, etc.(if available) | |
| | The design package includes enough information for an installer to install the system. | |
| 3.8.2 | The required infrastructure drawings (reflected ceiling plan (RCP), plan, elevations, details, etc.) are clear and unambiguous. | |
| 3.8.3 | All terminations on the drawings match the physical connections on the equipment. | |
| 3.8.4 | The design designates specific cable types when required (i.e., plenum rated cable, shielded Category cable when a manufacturer requires it, job cable color compliance, building code requirements, etc.) | |
| 3.8.5 | There is consistency between equipment lists, system drawings, narrative, and plans/elevations. | |

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| 3.8.6 | All mounts reference their displays in the equipment list to avoid confusion. | |
| 3.8.7 | All devices on the equipment list are shown on the drawings. | |
| 3.8.8 | All devices are shown only once on the drawings (and otherwise referenced with drawing flags), or as per client instructions. | |
| 3.8.9 | All room devices are shown on architectural drawings with enough accuracy, so an installer can place it in the space. | |
| 3.8.10 | All the equipment to be located in the rack appears on the rack elevations. | |
| 3.8.11 | The drawings have been marked for "For Fabrication" or "For Review" | |
| 3.8.12 | The drawings have the most recent release date/revision date shown. | |
| 3.8.13 | Sanity Check: The current design package satisfies ALL of the requirements laid out in the client-approved needs analysis/programming report/signed proposal. | |
| 3.8.14 | *Prepare document report, certifying the product, performance, and practices are in compliance, and noting any exceptions below. Distribute accordingly.* | |