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## 1.0 GENERAL REQUIREMENTS

- A. Refer to PG-18-3 topic 18 for the qualification requirements for the designers/consultants for this work. All studies and designs must be provided by independent, experienced and qualified Vertical Transport, Materials Transport and Logistics Consultant (MTLC).

## 2.0 CODE COMPLIANCE and DESIGN

- A. This document is not a specification but a guide that must be followed in the creation of a specification by the MTLC. Functions, features and devices that might be required in a specific installation must be included whether identified herein or not.
- B. AGV/AMR Designs and Specifications must be accomplished by a MTLC that has experience providing this work for a minimum of three similar Hospital facilities that are currently in operation.
- C. An AGV installation must meet all relevant local and national codes such as NFPA, A17.1, IBC, etc. as well as codes that are specific to an AGV: ANSI/ITSDF B56.5 (2012). Updates and later editions of this code will be evaluated and approved by the VA before being referenced.
- D. Currently there is no published code for what is being called an Autonomous Mobile Robot (AMR). The code is being written and is intended to be published as ANSI/RIA R15.08.
- E. ANSI/RIA R15.06 American National Standard for Industrial Robots and Robot Systems-Safety Requirements does not apply to or must be confused with the requirements of ANSI/RIA R15.08 Autonomous Mobile Robot.
- F. Until the complete AMR code, ANSI/RIA R15.08, is published and formally accepted by the VA all AMR installations must be designed to follow the rules that apply to AGV installations as identified in ANSI/ITSDF B56.5 (2012).
- G. The VA recognizes that most AGV/AMR installations are in non-Healthcare environments. New AGV or AMR codes may not recognize the issues involved with navigating through Health Care facilities and hospital rated corridors and areas populated by public and patients. The VA will not accept AGV/AMR designs and specifications where it deviates from the AGV 2012 code without a specific waiver being requested and granted for the activity in question. Areas of specific concern deal with fire codes and other life safety considerations.
  - 1. The VA requirements for AGV/AMR may be more restrictive than a new AGV/AMR code or the published AGV 2012 code to improve the safety of those installations and recognize conditions that may not be considered in the current code.
- H. The AGV 2012 code edition and many other robotic codes rely heavily on staff training to help ensure safety. This training would be impossible for most visitors, patients and many staff found in healthcare environments. AGV/AMR operations must be restricted to areas where patient, visitor and general staff traffic would normally not be found.



AGV/AMR designs in VA hospitals are to assume that patients have a general freedom of movement and could be found in most accessible areas of the building.

- I. The AGV (2012) code references the Owner working with the manufacturer to evaluate and/or create certain conditions. Since the design and specification are completed by the MTLC before a manufacturer has been selected the Architect and MTLC must replace the manufacturer/supplier as the responsible parties for design and specification activities.
- J. Certain activities that are assigned by standards to the successful manufacturer's/supplier's participation must be required in the AGV/AMR specifications and must remain under the oversight and acceptance of the A/E and MTLC.

### **3.0 STUDIES, OPERATION and PERFORMANCE**

- A. AGV/AMR installations in VA facilities must be of the highest standards of quality and performance and these must all be incorporated in the designs and specifications by the MTLC.
- B. The single most important element that drives the decisions for a hospital materials handling system and eventually forms the design is the relevant Cart/Transporter Traffic Matrix. The detailed and updated Traffic Matrix must be submitted with each TLA submittal together with a brief narrative tying the design decisions to the Traffic Matrix (i.e., discusses how designs respond to vertical and horizontal traffic and cart washing, etc.). Totals must be shown for each hour and for each major element to show the total number of moves to verify the element has the capacity to meet those demands.
  1. The traffic matrix for an AGV/AMR must be a detailed "from – to" chart showing: the beginning points for every cart movement, the hour of the move shown for each vertical and horizontal element (elevators, corridors, cart washers) through to the destination.
  2. An AGV/AMR system must be a turnkey installation consisting of all its necessary components including but not limited to as required for the individual projects. Items listed must all be included in the AGV/AMR specifications prepared by the MTLC and as required for the system in question.
    - AGV/AMR vehicles and system controls
    - all attendant interface devices
    - integrated elevators/VRC's
    - Carts and Trolleys
    - integrated automated cart washers
    - integrated batteries and battery charging
    - pathway system
    - integration with building fire and smoke alarms
    - fire doors integration
    - sprinklers integration
    - room and corridor doors interlocks



- safety signage, active and passive
  - handheld or other mobile computers / communication devices
  - tracking and reporting system
- C. AGV/AMR systems must operate as a demand system with transports between areas being controlled by the individual Users based on the current Traffic Matrix and must not be preprogrammed to make pre-scheduled transports except for specific limited areas that are designed to operate as a storage/retrieval function. Traffic must be governed by the Users from a Traffic Matrix to be originated by the MTLC and then, after the date of beneficial use, updated continuously by the VA.
- D. AGV/AMR suppliers employ different software, hardware, battery capacities, etc. with the result of having varied system efficiencies in performing the same tasks and achieving functionally identical results. Since many of these differences are subtle and not obvious each supplier may require a transport vehicle that varies from their competitors to meet the needs of a specific project.
1. The MTLC must provide sufficient documentation and information in the bidding documents, such as the detailed Traffic Matrix, to allow the bidders to determine the number of transporters that will be needed to meet all the requirements of the project in question. The successful bidder must provide enough vehicles even if the number quoted in their bid is found to be incorrect.
- E. AGV/AMR system control must consist of a primary computer and a live/hot back-up system to prevent the failure of the main control system from shutting down the whole or any portion of the system. All computers and controls must be provided with adequate UPS systems to allow safe transitions to emergency power and/or safe shutdown activities.
- F. In the event of a shutdown the system must maintain the information required to allow the completion of activities upon the resumption of power.
- G. AGV/AMR flooring must be appropriate for the local conditions of the building area and must provide adequate skid resistance and proper anti-static properties for the AGV/AMR. The flooring materials must withstand the repetitive traffic of the system and not cause excess wear on the AGV/AMR wheels. The MTLC must approve the final selection of main pathway flooring.
- H. AGV/AMR's must always follow a prescribed and clearly marked pathway applied to the flooring. Markings to show the boundaries of the loaded AGV/AMR travel must clearly show the locations where people could safely move, stand and/or where equipment might be parked.
- I. AGV/AMR's must not be allowed to deviate by more than 0.5" from their pre-assigned and marked pathways. Vehicles must not deviate from this pathway to navigate past any obstruction including people, beds, IV Poles, equipment, etc. that might be found in the corridors. In navigating around these obstacles, vehicles would find themselves creating "face to face" or trailing encounters with people, equipment and patients and



this would be unacceptable. It must be the VA User's responsibility to keep the assigned pathways clear.

- J. All areas of general AGV/AMR Operation in a building must be considered non-restricted and the floor space boundary required for the vehicle and its intended load must be clearly marked, including the clearance necessary for turns and maneuvering.
- K. A minimum clearance of 0.5 m (19.7 inches) must be maintained between obstructions and vehicles (including loads) except at the areas such as elevator entrances and doorways where reduced speeds and detection zones are controlled for safe passage through the areas in question.
  - 1. All areas having reduced clearance (< 19.7") between a vehicle and a fixed object must be considered hazard zones and be clearly marked by signs, stripes, lights or other appropriate designations. These areas must be limited to the extent possible with maximum vehicle speeds through those areas of =<60 fpm or less if required to ensure safe braking distances are provided for fully loaded vehicles that sense objects in their path.
- L. AGV/AMR guide paths must not be routed through doorways frequented by personnel unless the opening is wide enough for personnel to remain outside the guide path clearance aisle or where vehicle speed is reduced to =<60 fpm in the door path area while clearly annunciating its presence. It is preferred that separate doors be provided for automated vehicles and people. Also, opening and closing of powered doors must be accomplished in a manner that alerts or restricts personnel near the doorway. Doors to be equipped with sensors to prevent them from opening when a person or object is within the opening zone for the doors.
  - 1. Automatic electrified "Vehicle Approaching Signs" and audible alarms must be provided at all intersections and doorways that might find both people and AGVS/AMR vehicles.
- M. To minimize the possibility of blocking the complete closing of a fire door or obstructing other traffic, the system controls will respond to a signal from the fire/smoke alarm system and stop vehicles prior to obstruction of a fire door. If the vehicle is already closer than 8'-0" from the door the door must remain open to allow passage or the vehicle must reverse direction until fully clear of the door.
  - 1. Fire doors may stay open for a maximum of 10 seconds to allow vehicles to reach safe positions.
  - 2. Controls must ensure that when an active fire/smoke condition exists the AGV/AMR vehicle will travel a minimum of 8'-0" clear from either side of a fire door with measurements taken to include the door swing clearances. Depending on the alarm the vehicles must then remain in those positions or move to a predetermined safe position, that must be shown in the MTLC design, within the corridors or travel to other locations or to AGV/AMR fire safe rooms provided in the design and system specification and as required by code.



3. Where fire and life safety codes and/or facility policies require activities be accomplished by human attendants such as moving carts to clear egress zones or that may be carrying combustible materials out of corridors into rated rooms those activities must be incorporated into the AGV/AMR design.
- N. System design should not have a normal stop or queuing stop location where a vehicle or its load would block a fire door closure or stop in a way to restrict, in any way, traffic entering or exiting doors or corridors along the path of travel. Doorways opening into AGV/AMR's pathways must be provided with necessary "door closed/open" interlocks to prevent contact between open doors and vehicles and open doors triggering vehicle object detection systems.
- O. AGV/AMR movements must not be controlled by an attendant that is remote from the location and not within direct sight of the activity being controlled.
- P. AGV/AMR's that stop when they make physical contact with an obstruction must not automatically restart. Restart must be enabled after the nature of the physical contact has been determined by facility staff and any safety issues corrected.
- Q. It is recognized that many National and Local codes governing life safety, HVAC, Electrical, etc. such as NFPA 101, are not referenced in the AGV code and likely will not be in the AMR code. AMR's have been installed without being compliant with relevant codes putting the Owner at risk. To minimize this risk to the VA it is the responsibility of the Architect and the MTLC to ensure that the system design and specifications are compliant with all relevant codes and standards including Life Safety Codes that are particular to the project conditions.

#### **4.0 BATTERY CHARGING**

- A. Batteries for AGV/AMR vehicles must not require frequent (less than monthly) maintenance and must be non-gassing when powering the vehicles and when being charged except for conditioning charging in specified locations with adequate ventilation.
- B. Battery charging concepts for AGV/AMR systems must be on an Opportunity Charging basis. Centralized charging or charging systems requiring the regular exchange of batteries to keep vehicles in operation will not be permitted.
- C. The number and locations of Distributed Battery Chargers in the required Opportunity Charging System must be calculated in the MTLC's design based on probabilities using all relevant factors such as but not limited to vehicle battery capacity specified, length and conditions of travel from the dispatch locations, number of loaded and unloaded carts traversing the areas involved, pathway conditions (level, ramps, etc.), and power consumption rates.
- D. Batteries for the AGV/AMR vehicle must provide the power for the vehicle to meet the requirements of the project and must not be rated less than 120 amp/hours.



## 5.0 TRANSPORT VEHICLES

- A. AGV/AMR vehicles must be equipped with non-contact object detection sensor protection on both the front, rear, and both sides of the vehicles. These detectors must slow a vehicle when it approaches an object and ensure a full stop is achieved a minimum of twelve inches (12”) from any stationary object in its path. Contact sensors must be provided to initiate an emergency stop sequence if any object contacts the front, rear or sides or appears suddenly within the non-contact sensor fields.
- B. Should a design require, through unavoidable conditions, that the FRONT object detection system be turned off to avoid detecting a fixed building feature this must only be permissible in areas that are fully dedicated to AGV/AMR use only and with the vehicle speed being reduced to 30 fpm from six feet (6’) before and two feet (2’) after the reduced clearance zone. The vehicle must annunciate that the safety object detection system has been turned off by annunciating this in English and any other language selected for the installation. With the slow down and the verbal announcements the four (4) vehicle-mounted turn indicator lights must cycle on and off at a rate of two (2) sequences per second. The contact sensors must always remain active.
- C. The vehicle must be capable of self-detecting the status of the object detection systems and immediately stop operations if a fault condition is detected. All these conditions must be transmitted to the central control system and tablet/computer where they create an alarm and are included in the individual vehicle status and operational logs.
- D. All vehicles must be equipped with easily accessible emergency stop buttons on each end of the transporter.
- E. All vehicles must be equipped with a secure manual operating system to allow the safe movement of transporters by trained attendants.
- F. AGV/AMR vehicles must carry materials on carts with four (4) wheels that are capable of being easily moved manually when not on the automated system. Vehicle designs must prevent, to the extent technology allows the system from moving materials placed directly on its load deck.
- G. AGV/AMR vehicles must remain in continuous communication with the system controller providing its status, alarms and other data as specified by the MTLC.
- H. AGV/AMR vehicles must be equipped with signal lights on each of its four (4) corners. These must be used to signal certain conditions and activities to provide information to the various user and maintenance staff. As a minimum provide the following signals:
  - 1. Initiate the lights on one side to indicate the vehicle will be turning in that direction like turn signals used in automobiles.
  - 2. Initiate a simultaneous on-off blinking signal for all four (4) corner lights every eight (8) feet of travel or every three (3) seconds, whichever is reached first, while the vehicle is moving normally in a substantially straight path.



3. Initiate a rapid simultaneous on-off blinking signal for all four (4) corner/turn signal lights to alert that the vehicle has intentionally stopped at that location and has not stopped due to a fault condition.
4. Initiate a sequential on-off blinking signal for all four (4) corner/turn signal lights to alert that the vehicle has stopped due to a fault condition.
5. Simultaneous with the activation of the signal light a verbal annunciation must be made to describe the condition. For example: when the lights indicate a right turn is being made the annunciation must say something equivalent to “vehicle turning.” Final wording to be determined with cooperation of the VA.
6. Provide other signals that are required for the project being designed.

## 6.0 CART WASHERS

- A. Fully automated cart washing/sanitization must be provided as an integrated process in the overall AGV/AMR system. With the robotic systems ability to move carts on an “as needed” basis there may not be a need to place cart washing functions in multiple departments when it is possible to achieve the function more efficiently in one consolidated location. The TLA functional and cost studies must include the space, labor and operational cost differences between both centralized and decentralized cart washing functions. The superior option must be used and must have the following characteristics. The minimum temperature requirements for the automated cart washers are listed below:
  1. Wash water temperature must be adjustable (Range: 150 185 degrees F. from service water temperature of 55 degrees F).
  2. Rinse water temperature must be adjustable (Range: 180 200 degrees F. from service water temperature of 55 degrees F.).
  3. Hot air temperature must be adjustable. (Range: 180 250 degrees F.).
  4. The drying cycle must operate during every machine cycle to maintain a preheated chamber.
- B. The HVAC Exhaust must prevent steam or water vapors from escaping the machine.
- C. The cart wash must tilt the carts when they are washing, rinsing, and drying to assist in the prevention of water accumulation and to expose the bottoms of shelves to the washing action.
- D. The automated cart wash must interface with the AGVS/AMR system without the need for human attention. All cart transfers to and from the automated cart wash must be fully automatic.
- E. All cart wash activities must be logged into system memory and any faults annunciated at the maintenance area and at assigned stations and/or tablet/computer.





## 7.0 CARTS / TROLLEYS

- A. The MTLC must provide the designs for the carts used by an AGV/AMR system for each specific function and operation. It is anticipated that these would include fully enclosed carts as well as flat bed and open carts with shelving. Specialty carts, such as Food Service Carts, must use standard designs with the MTLC designing the lower carriage structure and casters.
- B. Every cart must be provided with a fully unique digital identity that is recognized by the AGV/AMR system for tracking: activities, loads and maintenance. Controls must allow for automatic control of cart destinations based on their specific identity. For example: carts identified for soiled use would not be permitted to travel to clean areas. Patient Food Service Tray carts must be automatically returned to the Food and Nutrition Department.
  - 1. Provide a matching graphic and/or text identity plate that can be easily read by attendants at distance of ten feet (10’).
- C. AGV/AMR carts must be designed and constructed to be fully washable without being negatively impacted by the heat, moisture, and detergents in the cart washing process. Special attention must be paid to:
  - 1. Cart casters and bearings must be impervious to the heat, water and chemicals encountered in the cleaning process.
  - 2. Casters must be constructed of substantial stainless steel, including forks and body, wheels must be a minimum of six inches (6") in diameter. Casters must be non-marking.
  - 3. Casters must not extend beyond the front or rear of the cart. Extension beyond the side of cart must not interfere with any automated operation or any building feature when being transported, picked up or dropped off. Casters must be equipped with an automatic self-aligning feature that automatically maintains the casters in a “fore – aft” position when free of the floor.
  - 4. Caster swivel and axle bearings must be precision stainless-steel ball bearings rolling in a hardened raceway, lifetime lubricated, and sealed in a housing that will prevent the entry of dirt and moisture at 1" water column pressure. Bearings must have a smooth and quiet operation. Tipping or inverting of cart must not be required to lubricate bearings. The initial lubricant used must be of a non-petroleum base with a minimum drop point more than 250 degrees F.
  - 5. No surface of the cart interior or exterior must have accumulated pools of water when leaving the cart wash, with any water droplets remaining flash drying within 60 seconds after leaving the cart wash.
- D. AGV/AMR carts must meet all relevant standards including National Science Foundation (NSF) and codes and must have passed tip-tests.



- E. AGV/AMR carts must be constructed to safely carry the loads established for their intended use plus adequate safety factors when used manually or when being carried by an AGV/AMR transporter. The maximum gross weight for any load must be 1,000 pounds but operational and functional planning should limit gross weight loadings of  $\leq 650$  pounds when possible.
- F. Maximum push required to start movement of a cart with 650-pound gross weight (over smooth level floor) must not exceed 25 pounds of pressure. Effort to sustain movement of fully loaded cart, on straight course must not exceed 17 pounds over smooth level floor.
- G. All cart components except full size wire shelving which may be high quality chrome over a copper base must be stainless steel or similar corrosion resisting material for all new carts and for modified parts of rebuilt existing carts. Fasteners, handles, bumper backing, door latches and other hardware must be stainless steel. No aluminum must be used for any part of the transfer carriage, caster, cart body, or hardware.
- H. Where stainless steel or corrosion-resistant steel is specified, it must be corrosion resistant steel complying with Federal Specification QQ-S-766, class 302 or 304, condition A, with number 3 finish on all outside surfaces except transfer carriage.

## **8.0 CONTROLS, SIGNALS, and REPORTING**

- A. AGV/AMR control systems must track all activities and provide on-screen and printed reports of these activities. Digitized information screens must be controlled through well-organized intuitive pulldown menus as specified by the MTLC.
- B. Alerts and alarms must be shown automatically on appropriate screens as identified in the system specifications.
- C. AGV/AMR system controls must prevent the sending of any soiled cart whether loaded or empty into any clean area.
- D. The AGV/AMR System must not emit or broadcast any signals, radio waves or energy of any kind that might interfere with any equipment, signals, communications, etc. within the facility or adjacent construction.
- E. Tablets/computers must be integrated into the system to provide information and control functions to local Users, maintenance staff, etc. Cart tracking, ETA arrival information, system faults and alarms and similar functions must be provided.

## **9.0 GUIDANCE / PATHWAYS**

- A. Where “Guide path” aka “Pathways” are referenced, it is intended to indicate the general path of travel. The requirements must apply equally to any device, control, or feature that provides AGV/AMR guidance including active or non-active systems such as Laser Guided, Embedded Magnet, Grid System, Visual, and Mapped Memory, etc. Routing and distance references must assume that the centerline of the planned path is the location of the “guide path” for all types and variations of systems. All Guide path and Pathway references must apply functionally to all systems.



- B. AGV guide path must be passive type. AGV guide path must not require nor utilize continuous conductors embedded in or on the floor. Passive guide path systems must use integrated devices to provide the control, communications, and other system features specified or required.
- C. Passive guide path must be of substantial design and must provide a unique interface with the Auto Transporter System - Transporter (ATS-TX) ensuring that the ATS-TX will not be "fooled" by other devices, potential markings or irregularities. Passive guide path systems must utilize ATS-TX designs that provide mapped memory capabilities to compensate for damaged, worn and/or missing sections of any guide path element. Laser guidance systems and other passive systems must ensure that guidance information is substantial and located such as to be safe from accidental removal, covering or distortion from reasonably foreseeable activities and events.
- D. If "dead reckoning" is used it must not exceed 12 feet of substantially straight travel and a means of verifying the transporter has been properly re-associated with the system is to be provided. If verification fails, the vehicle must stop and transmit an alarm.
- E. If any turns are to be negotiated by "dead reckoning" the transporter speed is to be reduced to ensure wheel slippage does not occur and a means of properly locating and aligning the transporter must be provided before the transporter travels to pick-up or drop off a cart or negotiates through any doorways or otherwise areas where proximity requires positive control of the vehicle.
- F. Transporter control systems must communicate with the central control system via local control elements that provide essentially full time/real time interfaces. Systems allowing substantial lapses in communication between ATS-TXs, and the central control will not be considered acceptable.

## **10.0 VERTICAL TRANSPORTATION SYSTEM - ELEVATORS**

- A. AGV/AMR VTS must not carry visitors, patients or non-materials handling staff.
- B. AGV/AMR VTS must be designed and specified by the MTLC as an integrated part of the AGV/AMR system and must include the requirements noted and referenced herein and in applicable codes and VA Standards. The plans and specifications must be based on the sizes, controls, devices, and features required for the project.
- C. It is preferred that the elevators used for the AGV/AMR installations be included in the total "AGV/AMR System Bid" package along with the carts, cart washers, vehicles, etc. to ensure proper physical control interface and coordination is maintained. Where this is not possible the AGV/AMR Contractor will be responsible for providing the interface devices for the VTS company's installation be paid by the AGV/AMR supplier. The VTS Contractor must review and provide reports on all the information/submittals and make monthly on-site evaluation of the installations to ensure the VTS provides a fully satisfactory and integrated installation for AGV/AMR use.
- D. Elevators that carry AGV/AMR vehicles must have their door openings within dedicated materials handling service lobbies with limited entry only by keyed or ID Card access.



- E. Elevators that carry AGV/AMR vehicles must, with a loaded vehicle on-board, provide adequate space to the side and to the end opposite the vehicle entry door to prevent trapping a person in the car and to allow maintenance staff to ride to observe activities or clear faults.
- F. Traffic study reports for AGV/AMR Elevators must show all the input information and must be based on all projected loaded and empty vehicle and deadhead movements. Unlike traffic studies for people elevators the AGV/AMR elevators must carry 100% of the moves estimated over a peak 60-minute period in <75% (<45 minutes) of the time studied to accommodate the randomness of that traffic.
- G. The AGV/AMR queuing at the service and user levels and the number of pickup and drop-off positions at user levels must be calculated based on the estimated vehicle arrival rates and system and staff response times achieving a minimum of 95% success rates during the peak transport periods.
- H. The AGV/AMR must be provided with “look ahead” and other control features that prevent dispatches from being sent to locations that will not have room to receive those deliveries. Reporting of those conditions must be automatic.
- I. When determining elevator usage requirements for AGV/AMR systems the elevator must be dedicated for exclusive use of the AGV/AMR system except as noted herein.
- J. If the AGV/AMR system requires greater than 40% of any single elevator traffic capacity, including empty transporter moves, over a one-hour period, then that elevator must be dedicated to sole use by the AGV/AMR system during that time. If the AGV/AMR system usage is less than 40% then the AGV/AMR elevator interface must allow for a manual mode of operation to accommodate other non-routine material transports. The manual mode must allow one trip at a time with the elevator automatically resetting back to automated mode when that trip is completed.
- K. For shared (automatic and manual) use elevators, the AGV/AMR system must allow an authorized attendant to release the elevator for manual movements using a key or ID Card control when all automatic transports have been completed. When a manual move is requested, all automated activities will stop for an adjustable period of 60 to 180 seconds to allow the AGV/AMR system to go into a safe mode, clearing elevator door areas, etc. The specific AGV/AMR actions during that period must be studied and specified by the MTLC for the project in question to ensure safety and operational efficiency of the automated system.
  - 1. The AGV/AMR system normal and default operating condition is “automatic” except during the one at a time manual use mode and under specified and code required fire/smoke and seismic conditions.
- L. The specific signals and sequencing of the AGV/AMR elevator interface must follow the system specifications written by the MTLC and then coordinated by the AGV/AMR system vendor after selection and with the elevator supplier. An override to allow



continuous manual use must only be available through proper control settings at the elevator and at the AGV Master Console/Control Unit.

- M. Where AGV/AMR systems are used, provide the elevator capacity and rating required to meet codes, standards and the needs of the areas being served.
- N. The MTLC must provide detailed and updated horizontal and vertical traffic studies in each TLA submittal: Concept, SD1/2, DD, and CD. These studies must verify the traffic adequacy of the elevators and the horizontal pathways including intersections, battery charging and other features and elements of the system.
- O. The MTLC must be responsible for ensuring the system capabilities and capacities are adequate for the operations required for the project and by the VA. If the physical design conditions (i.e., number of elevators, cart washers, etc.) are inadequate due to later (post SD-1) changes in requested operations/traffic by the VA the MTLC must immediately notify the VA and work with the VA staff to adjust the operations to stay within the capabilities of the transport system. Shifting of any transports to a manual mode to reduce AGV/AMR system traffic must not be considered an acceptable option.
- P. Where distances between AGV/AMR elevator cores exceed 400 feet of corridor distance provide additional AGV/AMR risers that are distributed to reduce horizontal travel on patient floors to a maximum of  $\leq$  200 feet.
- Q. On the service levels, open AGV/AMR elevators on both sides to allow drive-through capability. On the patient floors, there must be two openings (front and rear) into secure access AGV/AMR lobbies/vestibules used for the primary purpose of temporary staging, picking up, and delivering carts.
- R. Adequate space and clearances inside these lobbies for circulation, pickup and drop off stations and queuing must be included in the basic system design beginning with Concepts and must allow for competitive bidding by no fewer than three (3) Hospital AGV/AMR vendors.
- S. AGV/AMR elevators must be designed to carry one or two AGV/AMR transporters at a time as required to meet the traffic needs of the areas being served.
  - 1. Where both clean and soiled carts exist the AGV/AMR system must maintain separation between clean and soiled transports.
- T. The use of elevators opening on one side must be considered only where the elevator traffic study shows the one-sided configuration is adequate (which is  $<50\%$  of a double-sided elevator) including all loaded and empty vehicle and “deadhead” moves plus a 20% allowance for schedule flexibility and schedule changes. The rooms serving a single opening must allow the extra queuing required for the delays in receiving and returning carts and transporters. AGV/AMR traffic studies must include the loss of service of vehicles that may be “trapped” on user levels. This condition and the analysis must clearly show the inadequacy of a single opening design.
- U. Provide a detailed traffic analysis as a part of the TLA and facility studies and reports for the horizontal and vertical elements of an AGV/AMR system to determine the location,



number, size and speeds of AGV/AMR elevators and the location and number of all associated AGV/AMR elements such as pick-up/drop-off positions, battery chargers, cart washers, etc. This information must be used in coordination with the building designs, provided in a report and shown in the SD-1, SD-2, DD and CD drawings submittal to ensure the foundation for adequate and appropriate spaces, utilities and related building elements are available to properly support the installation.

- V. Horizontal traffic studies must verify that the corridor pathways are adequate for the peak traffic conditions. Where necessary provide wide corridors that allow multiple traffic lanes.

## 11.0 SPECIAL CONSIDERATIONS

- A. An AGV/AMR may offer space and functional advantages over other transport systems that must be considered in the project designs such as those noted below. Most of these benefits and functions are not standard AGV/AMR features but they can be added and usually at a reasonably low cost, but they must be considered in the designs and specified by the MTLC when they would be required. The MTLC is encouraged to investigate where these and other functions would be advantageous to the project.
  1. Centralized cart washing (reduce the total number of cart washers in individual departments and perhaps locate the function in less expensive space).
  2. AGV/AMR operations should guaranty cart washing sanitizing between uses (better aseptic control).
  3. Provide 24/7/365 high-capacity service allowing more reliable transport with much greater schedule flexibility so lower priority moves can be scheduled off hours and provides the ability to reduce an/or eliminate issues with “out of stock” items during off hours.
  4. Consider remote consolidated holding and/or storage retrieval of loaded and/or empty carts in less expensive space.
  5. Provide the ability to assign high numbers of AGV/AMR transporters to any department/location on an as needed basis allowing very quick response to accumulating loads such as from arriving trucks. This, for example, can reduce the number of docks and can reduce the size of dock holding areas.
  6. Consider the ability to weigh the loads being carried and automatically log that data which could provide benefits managing linen, trash and other commodities.
  7. Consider the ability to track carts being carried on the system.
  8. Consider the ability to provide last seen at (location) reports for carts that are/were on the system.
  9. Consider the ability to track cart contents while on the system.
  10. Consider the ability to track the chain of custody for carts.



B. Where an AMR/AGVS is to be included, the MTLC's initial TLA Report must document the specific space, adjacency and equipment variations that are required and/or beneficial to the VA Design standards for:

- Truck/Receiving Docks
- Materials Breakout and Receiving
- Bulk Storage
- Unit of Issue Storage
- Order Fulfillment
- Distribution
- Waste management and all similar and related spaces and functions.
- SPS: Decontamination, Prep & Pack, Sterile Stores
- Food and Nutrition Services
- FNS Receiving
- FNS Storage
- FNS Tray Makeup
- Linen Services

## 12.0 DRAWINGS

A. Unlike manual systems AGVS/AMR system designs will be unfamiliar to most A/E's and VA staff. Therefore, it is important that the planning and drawings for AGV/AMR systems be completed by the MTLC in advance of the general architectural drawings through the end of the project to provide guidance to the A/E of the AGV/AMR requirements to avoid time consuming architectural redesigns or serious compromises to the automated systems. Initial background drawings in electronic format and coordination to be provided by the A/E. Related studies and narratives such as those for the elevators, cart washers, primary live storage and storage/retrieval areas must accompany the drawings to demonstrate adequacy of the proposed designs to be provided by the MTLC.

1. AGV activities are very configuration sensitive and the addition of one inch more than is required wastes space while being one inch under the required areas may cause the system to fail to meet its goals.

B. MTLC must ensure the accuracy and generic qualities and dimensioning of the AGV/AMR drawings and sign the final system drawings for each phase (Concepts, SD, DD, and CD).

C. The drawings for an AGV/AMR system are created to define and memorialize the results of the many calculations accomplished to establish the operational characteristics required of the system. This includes items such as the number, type, location and speed of system:

- elevators
- automated cart washers
- battery charger's pickup and drop-off positions
- door controls
- maintenance
- storage/retrieval operation

