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# Extending the Life of Elderly Automation

Track 4 Session 9



Supply Chain  **Forward.**

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**Manager-Tulsa Warehouse Operations**

**American Airlines**

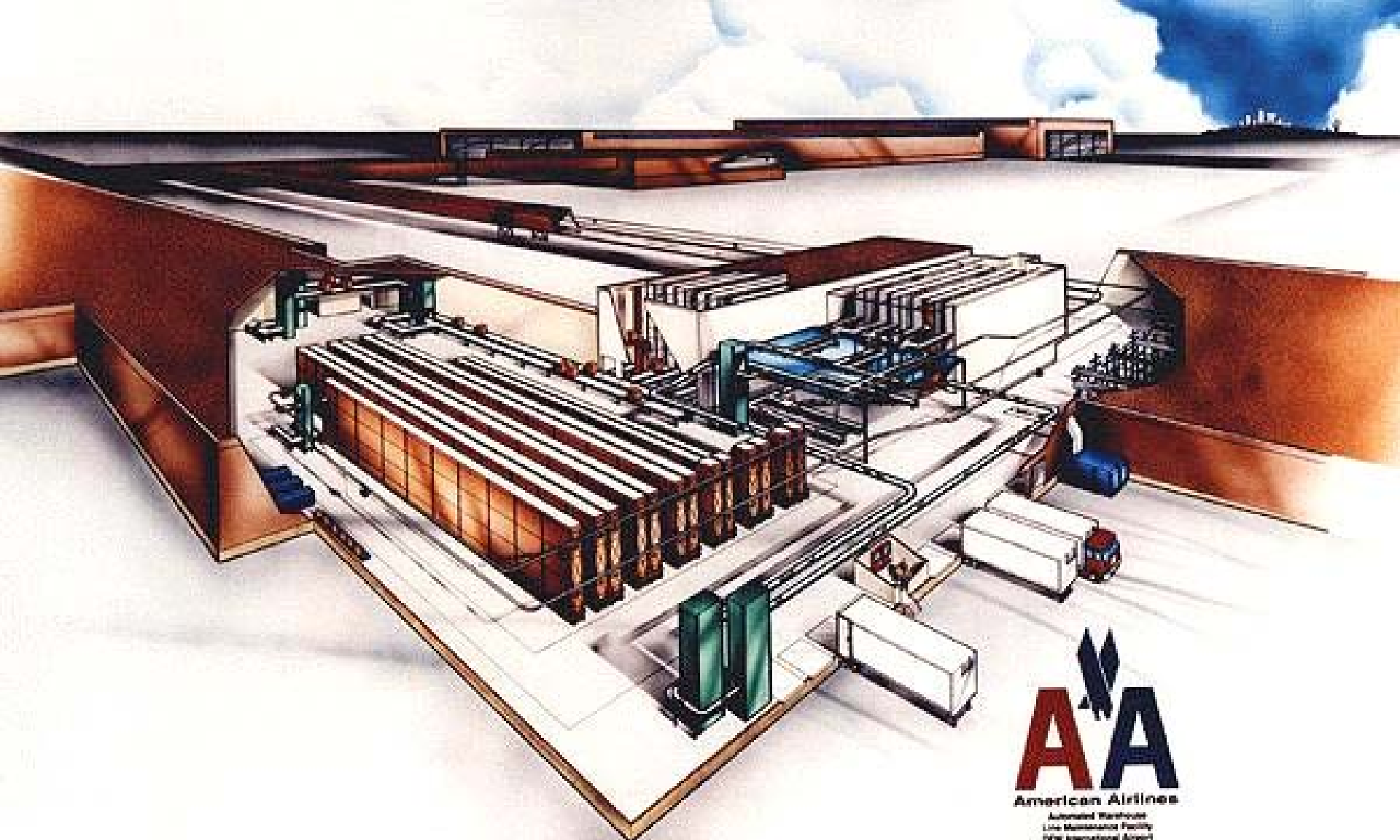
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# Abstract

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- ▶ **For reasons of wear, obsolescence, safety and/or change of mission, more companies are modernizing existing assets with great success at little cost. This American Airlines case study explains the process, planning, technology and results of a comprehensive upgrade to their system.**



**AA**  
American Airlines  
Automated Warehouse  
Line Maintenance Facility  
DFA International Airport  
by  
**HK SYSTEMS**

# Agenda

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- ▶ **American Airlines DFW Parts Operations**
- ▶ **System Issues**
- ▶ **Project Description**
- ▶ **Project Implementation**
- ▶ **Results**
- ▶ **Key Takeaways**
- ▶ **Questions**

# DFW Parts Operations

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- ▶ **System Installed in 1991 by HK Systems**
- ▶ **Ultra critical system which stores and distributes parts supporting 4 airplane maintenance hangars**
  - ◆ Preventative and routine maintenance
  - ◆ Major overhauls
  - ◆ AOG emergency service
- ▶ **Controls integrated with American Airlines' Flight Operations Systems ERP.**

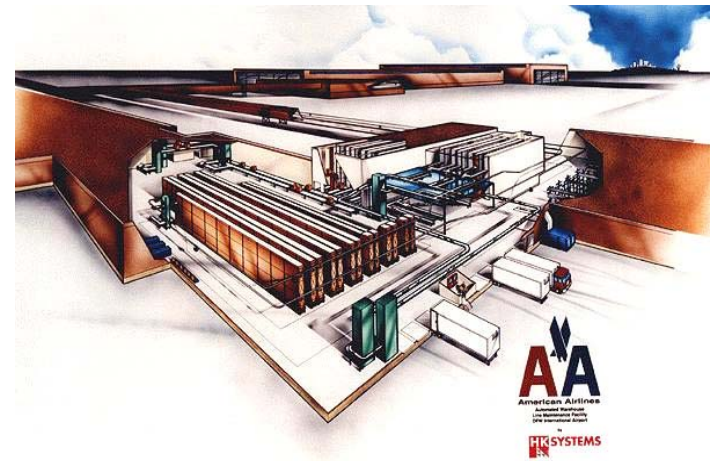
# DFW Parts Operations

## ▶ Receiving Conveyor System

- ◆ 520 feet of tote conveyor
- ◆ 3 tote elevators
- ◆ 200 feet of trash conveyor

## ▶ Mini-Load ASRS

- ◆ 3 HEI Mini-Load SRMs
  - Aisle Transfer Capability
- ◆ 5,852 rack locations w/300 lb. capacity
- ◆ Loop tray conveyor



# DFW Parts Operations

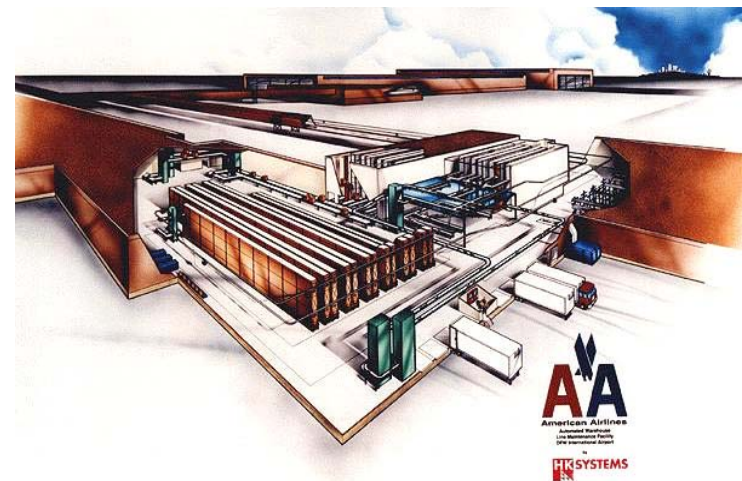
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## ▶ Unit Load ASRS

- ◆ 3 Unit Load SRMs
- ◆ 1,560 storage locations w/1,200 lb. capacity
- ◆ 480 feet of pallet conveyor
- ◆ 4 pallet lifts

## ▶ Automated Overhead Monorail System

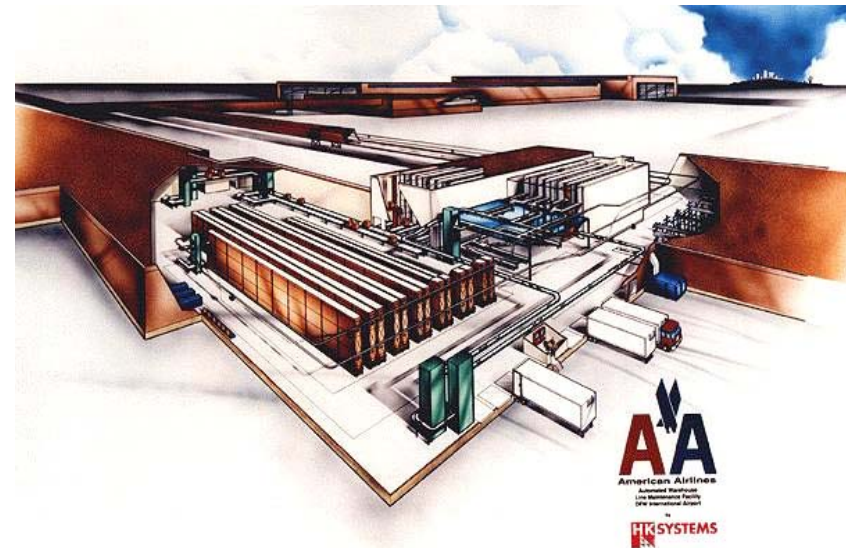
- ◆ 4,000 feet of track
- ◆ 18 Trolleys
- ◆ 3 lift/lowerators



# DFW Parts Operations

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- ▶ **Conventional Rack Storage**
  - ◆ **4 Man-ride Vehicles**
    - **RF Communications (LXE Terminals)**
- ▶ **Hanger Parts Storage**
  - ◆ **6 Vertical Carousels**
- ▶ **Warehouse Cell Director**
  - ◆ **2 Hanger Cell Directors**



# Systems Issues

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## ▶ Unit Load SRMs

### ◆ Obsolescence

- PLC 5/15 processor and 1771 I/O
- Indramat RAC Controllers (Horizontal & Vertical)
- Compumotor KHX Drive (Shuttle)
- Trimble TCS 4000 and ICS 5000 Infrared Positioning

### ◆ Maintenance Issues

- Non-standard Indramat Motors
- Poor diagnostics, no remote monitoring
- Slide Wire Communications

# Systems Issues

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## ▶ **Mini-Load SRMs**

### ◆ **Obsolescence**

- **PLC 5/15 processor and 1771 I/O**
- **Indramat KDV, KDS, TDM & CLM Modules (Horizontal, Vertical & Extractor)**
- **Trimble TCS 4000 and ICS 5000 Infrared Positioning**

### ◆ **Maintenance Issues**

- **Non-standard Indramat Motors**
- **Poor diagnostics, no remote monitoring**
- **Slide Wire Communications**

# Systems Issues

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- ▶ **Automated Electrified Monorail**
  - ◆ **Maintenance Issues**
    - **Worn Travel Rail**
    - **Intermittent Power Rail**
  - ◆ **Obsolescence/Support Issues**
    - **On-Board Carrier Controls (Modicon)**
    - **System Controls (Modicon)**
- ▶ **Conveyor Systems**
  - ◆ **Obsolescence/Support Issues**
    - **System Controls (Modicon)**

# Systems Issues

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## ▶ **Conventional Storage**

### ◆ **Obsolescence**

- **LXE Terminals**

## ▶ **Warehouse Cell Director**

### ◆ **Support Issues**

- **Legacy VAX based controls**

- **Antique computer hardware**
- **Ancient VMS operating system and software that no one remembers**

# System Upgrades

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## ▶ Phase I

- ◆ **Unit Load SRM Controls Upgrade**
- ◆ **Mini-Load SRM Replacement**
- ◆ **Automated Electrified Monorail**
- ◆ **LXE Terminals Upgrade**

## ▶ Phase II

- ◆ **Warehouse Cell Director Replacement**
- ◆ **Conveyor/Monorail Control Systems Upgrade**

# Unit Load SRM Upgrades

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## ▶ Controller

- ◆ Allen-Bradley ControlLogix 1756-L61 PLC
- ◆ 1756 IENBT Ethernet Module
- ◆ I/O Chassis & 1756 I/O Modules
- ◆ Allen-Bradley Point I/O Modules



# Unit Load SRM Upgrades

## ► Communications

### ◆ MDS iNet 900 Modems

- One onboard, one at end of aisle (each aisle)
- Provides serial & ethernet communications



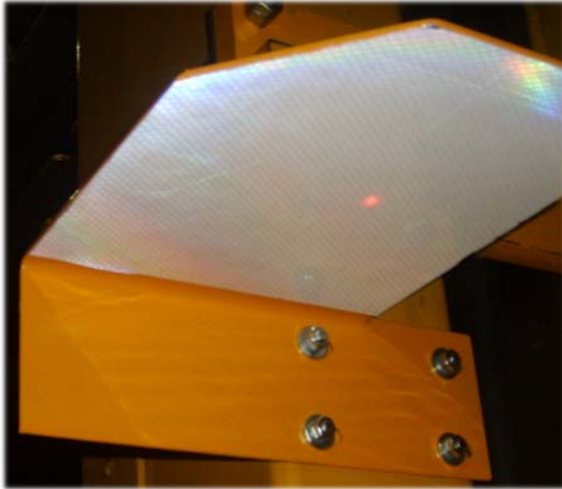
# Unit Load SRM Upgrades

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## ▶ Positioning

- ◆ **SICK DME 5000 Lasers for Horizontal and Vertical positioning**
  - Accuracy of +/- 0.04 inches
  - Instant positioning feedback on power up
  - Unaffected by wheel wear or rope stretch
  - Visible red light for alignment purposes
  - No internal moving parts
  - High reliability

# SICK DME 5000 Lasers



# Unit Load SRM Upgrades

## ▶ Drives & Motors

- ◆ **Allen-Bradley Power Flex Drives**
  - Horizontal and Vertical control
- ◆ **Compumotor Gemini AC Servo System**
  - Shuttle control
- ◆ **New AC Motors on all three axes**

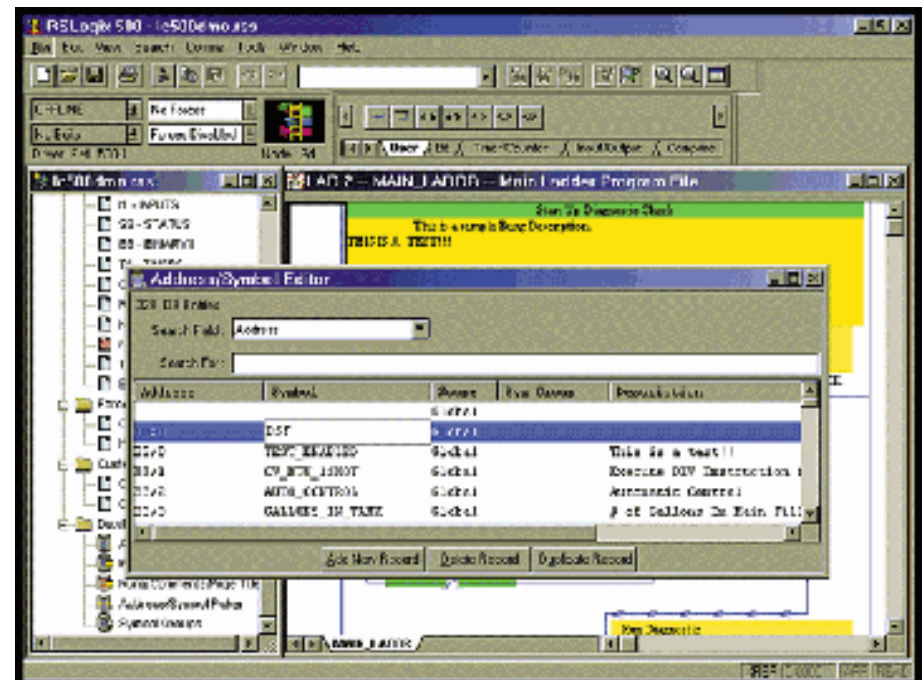


# Unit Load SRM Upgrades

## ► Maintenance

### ◆ Maintenance Laptop and Software

- Laptop PLC
- RSLogix5000 Software
- RS View Studio ME



# Unit Load SRM Upgrades

## ► Maintenance

### ◆ Maintenance HMI Displays

- PanelView 600 HMI
- On-board and End-of-aisle
- Alarm annunciation and history
- Diagnostic information
- Rack mapping
- SRM calibration and setup



# Unit Load SRM Upgrade Benefits

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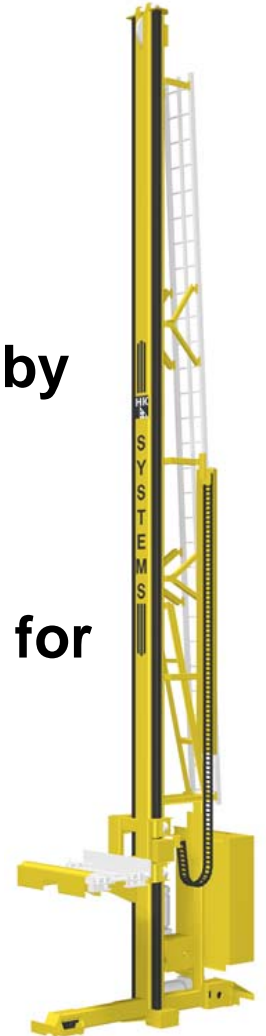
- ▶ **Eliminates Obsolescence concerns**
- ▶ **Improved positioning systems**
- ▶ **Enhanced communications (Ability to eliminate serial communications)**
- ▶ **Improved Maintenance Diagnostics**
- ▶ **Provided ability for remote Diagnostics**
- ▶ **Increased Reliability**

# Mini-Load SRM Replacement Benefits

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## ▶ **HK 750 Mini-Load SRM**

- ◆ **Performance Throughput**
  - Up to 70% increase over other technologies
- ◆ **Positioning Accuracy**
  - Unvarying accuracy in positioning functions by eliminating wasted times for creep speeds.
- ◆ **Operating Speeds**
  - A range of acceleration, deceleration, and operating speeds to assure smooth handling for all types of loads.
- ◆ **SRM Diagnostics**
  - Enhanced diagnostics provide continuous self-monitoring and comprehensive SRM-generated servicing instructions.

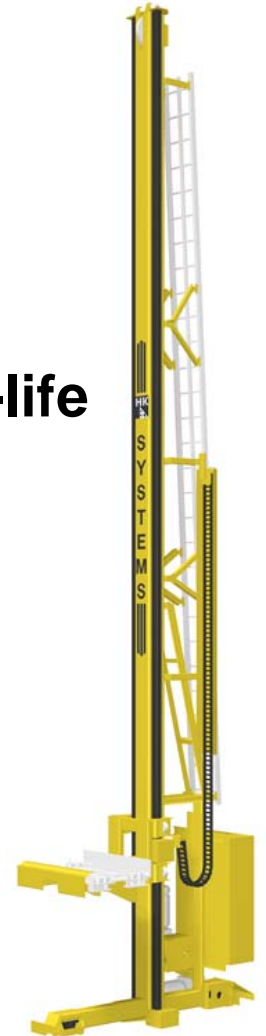


# Mini-Load SRM Replacement Benefits

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## ▶ HK 750 Mini-Load SRM

- ◆ **ISO 9001: 2000 certification**
  - Ensures built-in manufactured quality.
- ◆ **Preventative Maintenance**
  - Extensive use of synthetic oil and sealed-for-life bearings to reduce preventive maintenance.
- ◆ **Spare Parts**
  - A high degree of parts commonality and standardization with off-the-shelf availability reduce stocking requirements.
- ◆ **DFW's Transfer Car**
  - Eliminated since the Tulsa SRM reliability has been so high.



# Mini-Load SRM Removal



# Mini-Load SRM Installation



# Mini-Load SRM Installation



# Miscellaneous Upgrades

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- ▶ **Automated Electrified Monorail Upgrades**
  - ◆ Replaced worn rail sections
  - ◆ Replaced all power rail
  - ◆ Upgraded onboard controls
    - Replaced Modicon PLC w/Allen-Bradley Pico Controller
      - Dc and analog inputs
      - Up to 38 I/O points with I/O expansion module
      - EEPROM memory
      - Password security
      - Simple math
      - Real-time clock
      - Text display
      - PicoSoft programming software



[www.ab.com/programmablecontrol/plc/pico/controller.html](http://www.ab.com/programmablecontrol/plc/pico/controller.html)

# Miscellaneous Upgrades

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## ▶ Conventional RF Equipment

- Upgraded equipment to LXE Model VX6R
  - Voice enabled with ToughTalk™ technology.
  - Rugged vehicle mount computer with Windows® CE .NET OS - reduces application development & IT support costs.
  - Fully heated - ideal for freezer/cold weather applications.
  - Low profile with integrated keyboard improves driver's field of view.
- Upgraded to 802.11 a/b/g Communications



[www.lxe.com/pdf/VX6Datasheet.pdf](http://www.lxe.com/pdf/VX6Datasheet.pdf)

# Miscellaneous Upgrades Benefits

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- ▶ **Eliminated obsolescence problems**
- ▶ **Eliminated support issues**
- ▶ **Improved reliability**

# Phase II Upgrades

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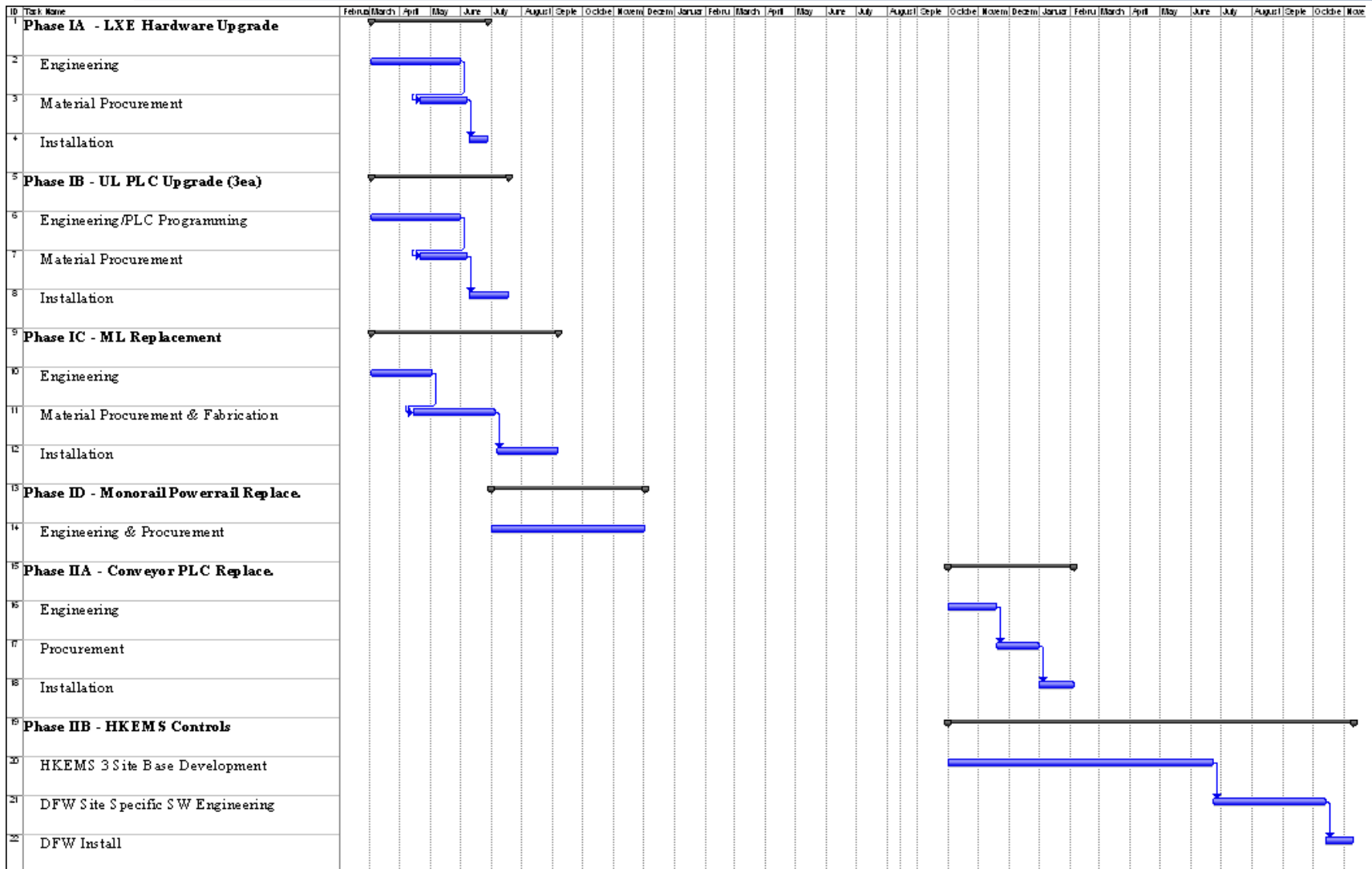
## ▶ **Equipment Management System**

- ◆ **Windows/Oracle based application**
- ◆ **Manages 3 Unit loads, 3 mini-loads, Monorail system 6 Carousels and 5 turret trucks.**
- ◆ **Common base line for three AA maintenance bases**
- ◆ **Virtual servers with remote virtual servers for backup**

## ▶ **Conveyor/Monorail Controls**

- ◆ **Modicon PLCs will be replaced with Allen-Bradley ControLogix PLCs**

# Phase I/II Integration Schedule



# Key Takeaways

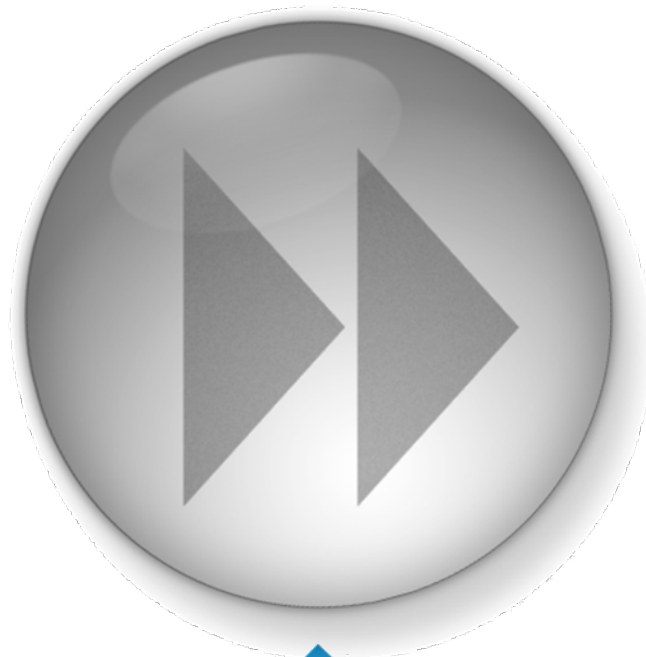
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- ▶ **You don't realize how important your AS/RS is to your operations until you think of life without it.**
- ▶ **Despite current economics, you can't afford to be behind when we all rebound.**
- ▶ **An old AS/RS can be made to function like brand new!**
- ▶ **A major system upgrade can be a precision, predictable, low risk procedure.**

# Key Takeaways

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- ▶ **Always have a lifecycle plan up-to-date and budgeted well before you need it.**
- ▶ **Involve Operations Staff in your Modernization Implementation Plan.**
- ▶ **Pick technologies with proven, long lifecycles.**
- ▶ **Justification comes in 3 colors**
  - ◆ **Disaster Avoidance**
  - ◆ **Pure financial ROI**
  - ◆ **Soft features that benefit the company**



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Questions?