



A Rockwell Automation Company

Sears Canada Inc. Parkway AS/RS Upgrade

The Client:

Sears Canada Inc. is one of Canada's leading retail department store chains. It operates a number of warehouses in Regina, Saskatchewan. The Parkway high bay facility is a 90,500 sq. ft. warehouse with 26,200 high bay storage locations. The high bay is serviced by a Clark automated storage and retrieval system

(AS/RS) which was installed in the 1970s. With the consolidation of their warehousing in a number of key locations it was necessary to upgrade the controls of the Parkway facility to increase throughput, and improve reliability.

The Requirement:

The original control system installed when the Sears facility was built in the 1970's had to be updated to a modern PLC-based control system in two phases. The first phase of the upgrade needed to replace most of the control hardware on the system and the sensing hardware on the stacker. This required minimal disruption to the normal operation of the warehouse which had to remain operational throughout the upgrade. The second phase of the upgrade had to replace the inventory control system from a DEC VAX-based system to new software developed by Sears. This phase would fully implement various enhancements to the operation of the warehouse.

The system physically consists of the main conveyor, four transfer cars and four storage/retrieval machines (stackers). The stackers operate in one of 12 aisles, storing and retrieving pallets as requested by the Inventory Control System. The transfer cars carry the stackers to other aisles when necessary, and accept pallets from the main conveyor system and position them such that the stackers can pick them up.

The Design Solution:

The new PLC-based system consists of one Allen-Bradley PLC 5/60, 8 Allen-Bradley SLC 5/03s, a Wonderware Man Machine Interface (MMI), and a Sears-developed Inventory Control System (ICS). The system has the ability to store and retrieve four different pallet sizes (4'x4'x4', 4'x4'x6', 4'x8'x4', and 4'x8'x6'). Merchandise is placed onto plywood pallets and inducted into the system as dictated by the inventory control system. From this point on human intervention is no longer required to move or track the pallet and its merchandise. When products that are stored in the system are requested by the ICS, the appropriate pallet is automatically withdrawn from storage and brought by the conveyor system to an area where human operators take the merchandise for shipment.

The main conveyor is controlled by an Allen-Bradley 5/60 PLC which also acts as the central communications 'hub' through which all communications regarding pallet movement flows. The 5/60 PLC communicates via DH+ with the Sears supplied ICS computer for instructions regarding each pallet in the system. It also has a DH+ link to the MMI and four serial infrared communications links to the four transfer car machines via DH+ to KE modules. Pallet movement is tracked on the main conveyor and appropriate action is taken by the PLC to prevent collisions between pallets as well as to ensure that the correct pallets arrive at their correct destinations within the system.

The MMI allows operators to observe the movement of pallets in the system, and to control all machines remotely. The status of all instruments and machines in the system is monitored and alarmed in the MMI to aid in maintenance of the system.

The transfer cars act as a home base for the stackers and bridges

the gap between the main conveyor system and the stackers. Since there are 12 aisles of storage locations and only four stackers, the ability to change from one aisle to another is provided by the transfer cars. The transfer car is controlled by an Allen-Bradley SLC 5/03 communicating with the PLC 5/60 through an infrared modem over a serial link using the built in serial port on the SLC 5/03 and to the stacker using another infrared link using a KE module. In addition to communicating with the stacker and PLC 5/60, the SLC 5/03 also tracks pallets on the conveyors and controls the conveyor motors to position the pallets where the stacker can pick them up or put them down.

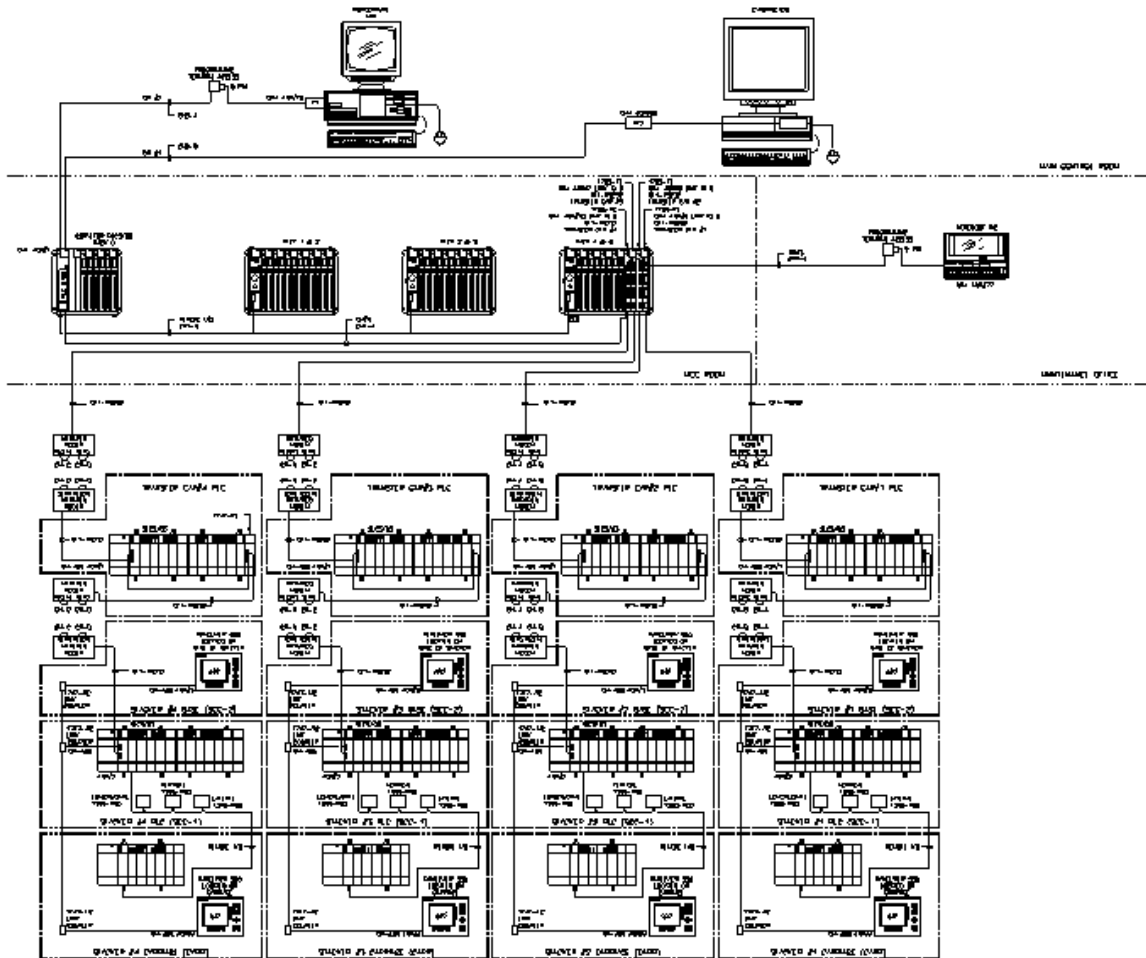
The stackers receive commands over the infrared link to take the pallets from the transfer car and place them in the appropriate storage location in the high bay area. The stackers have two axes of movement (up/down, out/back) within each aisle, and can store and retrieve pallets from either side of the aisle with two sets of shuttles (forks). The movement is from DC motors controlled by three Allen-Bradley 1395 DC drives. There are two Allen-Bradley PanelView 550s communicating via DH485 with the SLC 5/03. The two PanelViews allow local operation of the stacker and also provide diagnostic and other information to the operators. All alarms on the stacker and transfer car are annunciated on the PanelView's as well as the MMI.

The ICS decides where each pallet shall be placed, and also issues commands for pallet withdrawals. The first phase of the project changed all of the control hardware except for the ICS system which was running on a PDP-11 simulator card inside a MicroVax computer. The second phase of the project is primarily concerned with upgrading the ICS system to an IBM 486 machine communicating with the PLC 5/60 over DH+ using an IBM Artic card.



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System Specifications:

- 1 Main conveyor PLC 5/60 with 368 DI, 240 DO, 8 AI
- 4 Transfer Car SLC 5/03s each with 64 DI, 32 DO
- 4 Stacker SLC 5/03s each with 112 DI, 48 DO, 4 AI, 4 RTD, 2 encoder position inputs.
- 12 DC drives on RIO (3 per stacker)
- 8 Infrared Modem sets
- 1 Wonderware MMI
- 10 graphics pages
- 4530 database points

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