



## A DOE SUCCESS: Automated Storage of Surplus Nuclear Weapon Components at Pantex

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**The Project:** In the early 1990's, the United States began a program of rapid nuclear weapon dismantlement. Historically, nuclear weapons would be dismantled at Pantex Plant and then the plutonium pits would be shipped to Rocky Flats for reprocessing. When Rocky Flats stopped accepting stockpile returns, DOE decided to store all returned pits at Pantex Plant until ultimate disposition could be determined. The expected number of stockpile returns would significantly exceed their current storage capacity. In 1992, Pantex Plant asked Sandia National Laboratories to investigate cost-effective solutions to the storage capacity shortfall.

After an in-depth system study of the Pantex Plant's needs, Sandia proposed a solution that became known as Stage Right. The Stage Right concept involves storing the pit containers in stacking pallets on either side of a clear aisle. The Stage Right concept increased the capacity over the existing storage configuration by 84 percent in the Modified Richmond Magazines and completely solved the capacity shortfall.

Once the storage concept was approved, Pantex and Sandia teamed to develop the necessary technology and equipment to make Stage Right a reality. An essential item was the development of an Automated Guided Vehicle (AGV) to store and retrieve pallets in the storage magazines, since denser storage greatly raises radiation levels in the magazines. The commercially available AGV can lift and accurately place pallets that weigh more than 1,000 pounds inside the magazine. In addition, the AGV completely removes personnel from the hazardous radiation

levels found inside the magazines. To assure safe operations, the AGV incorporates a triple redundant safety system to assure invaluable national assets are not damaged, provided by the addition of sensors and control systems.

The Stage Right AGV system became operational in 1997. The operator, located inside the mobile base station, controls the system through a graphical point-and-click computer interface to dispatch the AGV on a variety of missions. Once the operator selects a mission, the system verifies that the mission parameters are appropriate and commands the vehicle (shown entering a storage magazine) to execute the mission. The vehicle will then execute the mission completely automatically. During mission execution, the vehicle continually monitors the environment and its own health to assure mission safety. In addition, the operator can monitor the mission progress by watching the computer status display and live video broadcast from cameras mounted on-board the vehicle. Should a problem arise, the operator can remotely recover from a variety of error conditions by approving pre-programmed error recovery primitives. By carrying a pallet with sensors on board, the vehicle can perform monitoring and accounting activities in situ.

**The Impact:** The Stage Right system avoided the need for construction of additional hardened storage magazines or structures to achieve the storage capacity required to accommodate the nuclear weapon dismantlement program. The immediate result was that Stage Right achieved a cost avoidance of more than \$100,000,000. Currently, a follow-on project called Strategic Reserve Stage Right (SR<sup>2</sup>) is in development. Not only will the SR<sup>2</sup> system provide increased

storage density over the existing Stage Right system, it will also integrate in real time material and information flow. The SR<sup>2</sup> system is targeted for use in the Pantex Special Nuclear Materials (SNM) Component Staging Facility, again allowing an existing facility to be modified for use.

**Further Advances through a RIM Initiative:**

For applications where personnel exposure to hazards must be minimized, Stage Right is a proven technology. The RIM Initiative will extend the technology to encompass other SNM and hazardous material handling applications making it a baseline technology ready for use across the DOE complex. Use in more complex, existing facilities will require mobility and autonomous guidance beyond that found in commercial AGV products. Better perception and reasoning must be incorporated to increase the productivity and safety of future systems.

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