

WM2010, 5 Packaging and Transportation – Non-Specified Abstracts  
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## **Incorporating Radio Frequency Identification (RFID) Technology at Bechtel Jacobs to Optimize On-Site Waste Shipping Processes**

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### **ABSTRACT**

The Bechtel Jacobs Company (BJC) has implemented a fully integrated electronic waste shipping system to facilitate a paperless on-site shipping process. This process meets the equivalent level of safety requirements of DOE Order 460.1B using Passive RFID technology to reduce or eliminate the paperwork associated with on-site waste shipments destined to the Environmental Management Waste Management Facility (EMWMF).

The Radio Frequency Identification Transport System (RFITS) uses a combination of Motorola 9090G RFID handheld units to write shipping data to passive RFID tags mounted on trucks and ruggedized NEMA-4 compliant towers which automatically identify vehicles at designated checkpoints along a pre-defined route. These devices give BJC visibility into real-time material tracking in locations where an infrastructure may not exist. Encrypted tag data is captured by the RFID towers and transferred to a centralized RFID middleware system. The RFID middleware system applies filtering, formatting and logic so the data can be processed by the Waste Transportation Management System.

RFITS provides enhanced transportation logistics through advanced notification and estimated times of arrival for shipments entering EMWMF.

The system was installed and implemented in February 2009 by the K-25 Decontamination & Decommissioning (D&D) Project. The system has eliminated errors associated with manual data entry, and improved cycle time by 25 minutes per truck shipment. In addition, cost savings have been achieved through improving performance of vehicle searches at truck inspection stations when exiting security controlled areas, and centralizing logistics for all shipments to the EMWMF. The technology is scalable to assist new projects at the East Tennessee Technology Park (ETTP) and American Recovery and Reinvestment Act initiatives.

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Environmental benefits include the elimination of 25 minutes of idling time per shipping cycle resulting in the avoidance of over 39,000 liters (10,000 gallons) of diesel use, 1,814 kilograms (4,000 lbs) of NO<sub>x</sub> emissions, and 103,622 kilograms (228,448 lbs) of CO<sub>2</sub> emissions over the life of the project time. Additional benefits of paperless shipping include the use avoidance of 250,000 sheets of paper which has saved 30 trees (12 meters [40 ft] high and 15 to 20 centimeters [6 to 8 inches] diameter), 33,122 liters (8,750 gallons) of water, 1.845e+10 Joules (5,125 kilowatt-hours) of electricity, and 34 kilograms (75 lbs) of air pollution. These environmental and cost savings reflect only one of five BJC projects which are currently using RFITS.

In the five month period since implementation of RFITS, the K-25 D&D project has completed over 6,000 shipments destined to the EMWMF. Currently the system is being expanded to support American Recovery and Reinvestment Act D&D projects at Oak Ridge National Laboratory and Y-12 National Security Complex.

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## **IMPROVEMENT OBJECTIVE**

The primary objective of this initiative was to develop and implement a paperless shipping process using Radio Frequency Identification (RFID) technology. With more than 50,000 shipments of waste planned for delivery to the Environmental Management Waste Management Facility (EMWMF) from the East Tennessee Technology Park (ETTP) during 2009 – 2011, significant benefits and improvements to the project schedule could be realized by reducing the time spent manually completing paperwork for each shipment. Previously, Bechtel Jacobs Company LLC (BJC) completed a Six Sigma Process Improvement Project (PIP) to improve the process for transportation and disposal of contaminated waste from facilities at the ETTP destined to the EMWMF. Both the PIP team and an independent review conducted by the U. S. Department of Energy (DOE) identified completing paperwork for each shipment prior to its departure as a primary input to the overall cycle time for the process. Time spent completing paperwork not only resulted in a significant amount of *waste of waiting time* for each shipment, but it also required additional resources for separate activities associated with the manual entry of data and the handling and filing of paperwork for each shipment (*waste of over-processing*).

## **DESCRIPTION AND BACKGROUND INFORMATION**

The DOE Oak Ridge Reservation (ORR) is located on 37,000 acres in East Tennessee. The Reservation, established in the early 1940s by the Manhattan district of the U. S. Army Corps of Engineers, played a major role in the production of enriched uranium for the Manhattan Project. The current locations include the ETTP site, managed by BJC; the Y-12 National Security Complex (Y-12), managed by B&W and Bechtel; and the Oak Ridge National Laboratory (ORNL), managed by the University of Tennessee and Battelle.

ETTP was originally built as a uranium enrichment facility for defense programs. The majority of the building sites have been inactive since uranium enrichment production ceased in 1985. ORNL originally supported defense production operations and civilian energy research efforts, and now conducts applied and basic research in energy technologies and the physical and life sciences. The Y-12 Complex originally was a uranium processing facility, and now the site is responsible for dismantling nuclear weapons components and serves as one of the nation's storehouses for special nuclear materials.

Cleanup activities within the ORR address environmental legacies from the nuclear weapons production and nuclear energy research. These activities include environmental remediation, decontamination and decommissioning of radioactively contaminated facilities, and disposition of the radioactive waste. Waste disposition (processing,

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treatment, and disposal) is part of regulatory cleanup agreements. It is of interest to stakeholders and requires the oversight of regulators. BJC is responsible for various environmental management activities for the DOE Oak Ridge Office. Their scope includes environmental remediation, decontamination and decommissioning, waste management, and infrastructure management. BJC is currently the largest transporter of waste within the DOE Complex.

The EMWMF operated by BJC for DOE, is a Comprehensive Environmental Response ,



Figure 1 EMWMF CERCLA Disposal Cell in Oak Ridge

Compensation and Liability Act (CERCLA) approved waste disposal cell designed to receive low level radioactive waste, hazardous waste as defined under the Resource Conservation and Recovery Act, waste as defined under the Toxic Substances Control Act of 1976 and mixed waste consisting of combinations of these waste types.

Waste disposed in the EMWMF is primarily from contaminated areas on the DOE ORR. BJC must transport the radioactive and hazardous waste to EMWMF in a safe and secure manner to ensure the safety of the public, the workers, and the environment.

Over 15,000 drivers use the state highway in front of the ETTP on any given day. In order to provide a safe environment for transportation of the planned shipments from ETTP to the EMWMF, BJC designed and built an on-site haul road for waste transports. With the dedicated road, BJC developed a Transportation Safety Document for DOE approval in accordance DOE Order 460.1B. This order allows BJC to provide a level of equivalency to Department of Transportation (TSD) regulations for hazardous material shipments. The TSD provides BJC the documentation necessary to allow use of RFID technology for tracking and transporting hazardous materials.

### **RADIO FREQUENCY IDENTIFICATION TRANSPORT SYSTEM (RFITS)**

BJC has developed and implemented a fully integrated electronic waste shipping system to facilitate a paperless on-site shipping process. This process meets the equivalent level of safety requirements of DOE Order 460.1B using Passive RFID technology to reduce or eliminate the paperwork associated with on-site waste shipments destined for the EMWMF.

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The BJC RFITS uses a combination of Motorola 9090G RFID handheld units to write shipping data to passive RFID tags mounted on trucks and ruggedized NEMA-4 compliant towers which automatically identify vehicles at designated checkpoints along a pre-defined route, thus giving BJC visibility into real-time material tracking in locations where an infrastructure may not exist. Encrypted tag data is captured by the RFID towers and transferred to a centralized GlobeRanger RFID middleware system. The RFID middleware system applies filtering, formatting and logic so the data can be processed by the Waste Transportation Management System (WTMS). RFITS provides enhanced transportation logistics through advanced shipping notices and estimated times of arrival for shipments entering EMWMF.



Figure 2 Passive RFID tag mounted on Truck

The Passive RFID tags are located on the side of the trucks within view of the driver of the vehicle to ensure a constant visual is maintained by the driver and the transportation specialist writing the shipping data to the tag.

The Transportation Specialist creates the shipping document in the field from pre-defined Waste Lots which are authorized for disposal at the EMWMF. The pick list driven choices makes creating a shipping document easy as well as ensures consistency in data quality and formatting. Once the Transportation Specialist creates a shipment, they confirm mandatory checks regarding the shipment, then ‘write’ the shipment to the passive RFID tag on the truck. Once the shipment is ‘written’ to the passive RFID tag, a summary screen shows specific information which would alert the Transportation Specialist to any incorrect information.

Upon a final visual confirmation, the truck then leaves the project bound for EMWMF for disposal. As the truck follows a predefined route via an onsite Haul Road, it is tracked electronically by Transportation Operations, Physical Security and EMWMF personnel. The truck passes multiple electronic check points along the route and its location as well as the estimated time of arrival at the EMWMF is updated. This information is critical to the management of logistics in and out of the cell.



Figure 3 Shipment departing K-25 Controlled Area for the Haul Road



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This information provides EMWWMF personnel with the ability to know in advance when a material type or vehicle type is inbound to the facility so they can prepare for any shipment that may require special handling.

The original system was designed, installed and implemented during the period of July of 2008 through February 2009. Testing was conducted in February 2009 and the system was put into operation on March 2, 2009. The initial intent for use of the system was the K-25 project. However the process proved to be so beneficial that it has now been deployed for all projects within BJC. The system has eliminated errors associated with manual data entry, and improved cycle time by 25 minutes per truck shipment. In addition, cost savings have been achieved by improving performance of vehicle searches at truck inspection stations exiting security controlled areas, and centralizing logistics for all shipments to the EMWWMF.



Figure 4 RFITS Sensor Tower at K-25 Controlled Area Access

The technology is scalable to assist new projects and American Reinvestment and Recovery Act initiatives at the ETTP, ORNL, Y-12 National Security Complex and other DOE installations.

Environmental benefits include the elimination of 25 minutes of idling time per shipping cycle resulting in the avoidance of over 39,000 liters (10,000 gallons) of diesel use, 1,814 kilograms (4,000 lbs) of NO<sub>x</sub> emissions and 103,622 kilograms (228,448 lbs) of CO<sub>2</sub> emissions. Additional benefits of paperless shipping include the use avoidance of 250,000 sheets of paper, natural resources preserved and pollution prevention resulting from the paper use avoidance includes 30 trees (12 meters [40 ft] high and 15 to 20 centimeters [6 to 8 inches] in diameter, 33,122 liters (8,750 gallons) of water, 1.845e+10 Joules (5,125 kilowatt-hours) of electricity, and 34 kilograms (75 lbs) of air pollution. These environmental and cost savings reflect only one of five projects at BJC currently using the RFITS.

Since March of 2009 through November of 2009, the RFITS system has supported more than 16,000 shipments.

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## REFERENCES

- DOE Order 460.1B, *Packaging and Transportation Safety*.
- BJC/OR-2142/R2, *Transportation Safety Document for On-Site Transport on the East Tennessee Technology Park Environmental Management Waste Management Facility Haul Road within the Oak Ridge Reservation, Oak Ridge, Tennessee*.